Courses of Study

(Detailed Course Contents)

Under-graduate & Post-graduate Programmes

(2014-2015)

Shri Mata Vaishno Devi University

Kakryal, Katra 182320 Jammu & Kashmir

VISION

Establishment of a Scientific & Technical University of Excellence to nurture young and talented human resources for the service of Indian Society & world at large and preserving the integrity and sanctity of human values.

MISSION

The mission of the University is the pursuit of Education, Scholarship and Research at the highest International level of excellence.

OBJECTIVES

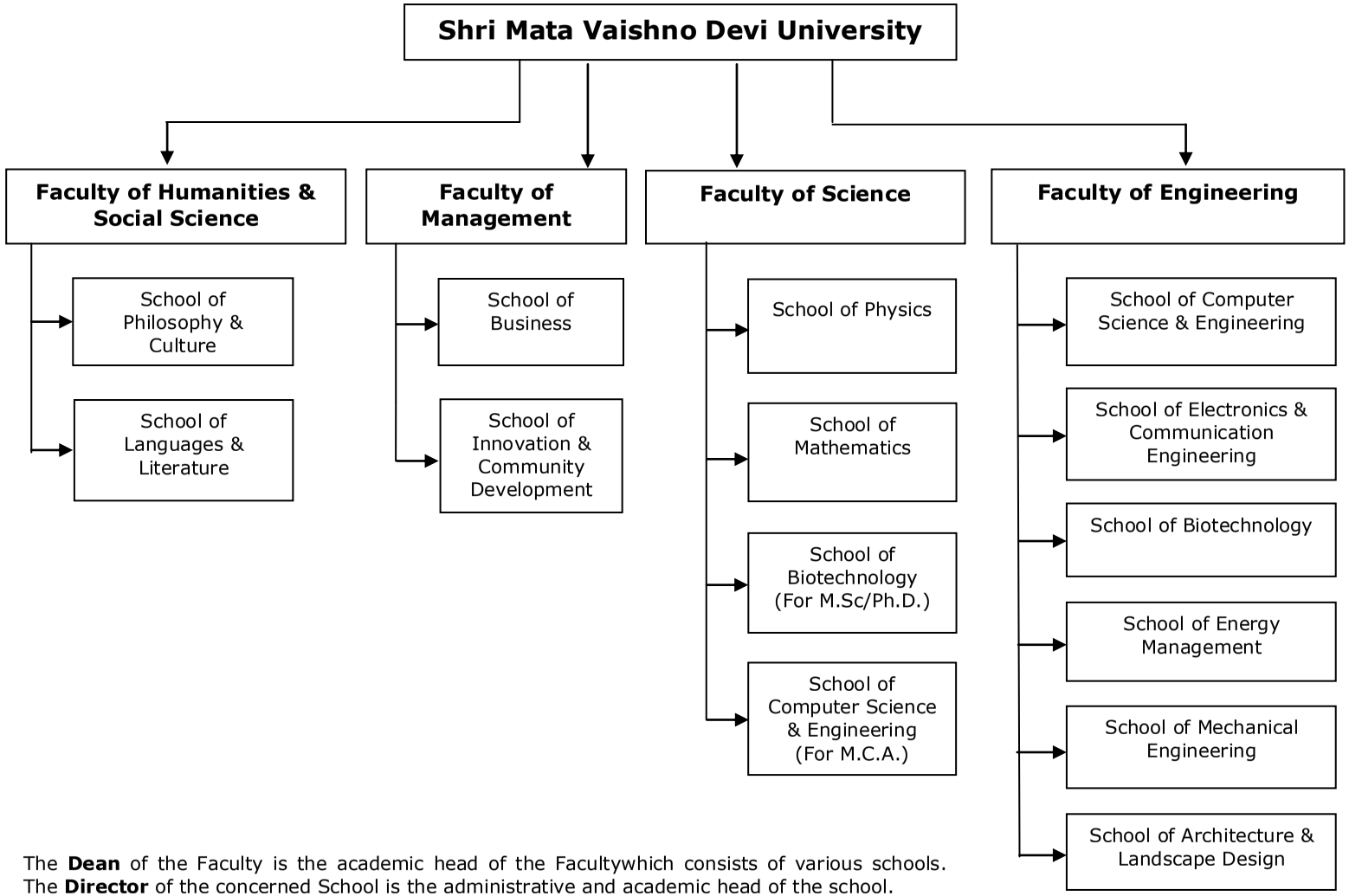
- Provide education and training of excellent quality, both at undergraduate and postgraduate level.
- Ensure that the University achieves and maintains an international standing in both teaching and research
- Promote study and research in new and emerging areas and encourage academic interaction of the faculty and the students at national and international levels.
- Encourage close collaboration with industry and facilitate the application of research for commercial use and for the benefit of society.

University Campus Address	Shri Mata Vaishno Devi University Sub Post Office, SMVD University, Kakryal, Katra 182 320 J&K, INDIA Phone:01991-285634, 285524 Fax: 01991-285694
Public Relations Officer Address	Public Relations Office, Shri Mata Vaishno Devi University 15-C, IInd Extension, Near JDA Market, Gandhi Nagar, Jammu-180004 J&K, INDIA Telefax: 0191-2470067

Website: www.smvdu.ac.in / www.smvdu.net.in

CONTENTS

Academic Structure of the University



The **Dean** of the Faculty is the academic head of the Facultywhich consists of various schools. The **Director** of the concerned School is the administrative and academic head of the school.

1.0 Introduction

Shri Mata Vaishno Devi University (SMVDU) has adopted the Indian Institutes of Technology (IIT) pattern of teaching and examination system in its endeavor to attain academic excellence. The University is offering graduate and postgraduate programs since 2004. The university also offers programs leading to award of PhD degree. The programs being offered from the academic session 2014-15 are mentioned below.

2.0 Programs of Study

The following programs of study are being offered by the university in the academic session 2014-15.

Undergraduate Programs

1. Bachelor of Technology in Computer Science & Engineering
2. Bachelor of Technology in Electronics & Communication Engineering
3. Bachelor of Technology in Mechanical Engineering
4. Bachelor of Technology in Biotechnology
5. Bachelor of Architecture

Post-graduate Programs

1. Master of Business Administration
2. Master of Technology (Manufacturing & Automation)
3. Master of Technology (Computer Science & Engineering)
4. Master of Technology (Electronics & Communication Engineering)
5. Master of Technology (Energy Management) (Part-Time Program)
6. Master of Arts (Philosophy)
7. Master of Arts (English)
8. Master of Sciences (Mathematics)
9. Master of Sciences (Physics)
10. Master of Sciences (Biotechnology)
11. Master of Computer Applications (M.C.A.)

Dual Degree Integrated Programs

1. 5 Year Integrated Master of Sciences(Economics)

PhD Programmes

3.0 Academic Session & Semester

The Academic Session is defined as period from July-June. e.g. Academic Session 2013-14 is from July 2013 till June 2014.

Each Academic Session consists of two regular Semesters identified as First Semester (Aug-Dec) & Second Semester (Jan-May). e.g. Academic Session 2013-14 **First Semester** (Aug-Dec 2013) & Academic Session 2013-14 **Second Semester** (Jan-May 2014). The semester grade sheets as well the transcript at completion of degree indicate the semester and sessions accordingly.

There **may also be a Summer Semester** of 8 weeks duration during the summer break period for offering various degree program or other courses as may be required, and/or feasible, in the interest of the students, including providing opportunity to students with backlog of courses to register in the Summer Semester and utilize the vacation period for clearing such courses and/or for some advance courses as permissible. The summer semester will be held during the summer break period i.e. June-July and will be considered as a part of the previous academic session. There may be an additional fee for registering for the courses in the Summer Semester.

3.1 Summer Semester

The **maximum number** of credits that a student can register for, in the Summer Semester, is limited to 12 credits. The syllabus of the courses registered for is not diluted in any manner and the requisite number of classes are conducted within the time-frame of the summer semester. The Minor & Major Exams are conducted during the course of the Summer Semester as per the Schedule.

In case there are a significant number of students having backlog in a particular course, **the school may consider offering such course in the Summer Semester** and students having obtained 'E' or 'F' grade in the previous semester(s) may register for the course. **Attendance requirement in these courses will be applicable as in the regular semester.**

In case of **passing out students,** deficient in total credit requirements up to 12 credits, they may be allowed to register in the Summer Semester upto 12 credits for the backlog courses or other eligible courses in lieu thereof. These courses may be offered on **Self-Study basis** also, if the number of registered students is small (upto five).

Any Student, in addition to backlog Courses, if any, is eligible to register for a **maximum of 02 new** (fresh) **courses** during summer semester (subject to upper limit of 12 Credits overall), so as to enable him/her to have more options for taking courses in the subsequent semesters. **Attendance requirement will be applicable for all courses except for those on self-study basis.**

3.2 Self Study Basis

Only a **passing out** student is eligible for registering for a course on Self-Study basis and is required to submit all the assignments and appear in the Minor & Major Exam and complete all other course related requirements as communicated by the course coordinator. A **passing out** student, in this context, is defined as one who is deficient by not more than 12 credits for completion of the degree.

4.0 Credit System

All programs of study are defined in terms of their credit requirements. Each course taken by a student as a part of the program of study helps to accumulate credits and once the minimum credit requirement of the program of study is completed, the degree can be awarded to the candidate, subject to fulfillment of all other relevant conditions. **There may be some Audit (Non-credit) Courses; however, securing the Pass Grade (NP) in these courses is required.**

4.1 Course Numbering Scheme

SC	**T**	**L**	**SA**	**Y**
School Code	Course-Type Code	Course Level	Sub-Area (up to-99)	Course No. (up to -9)

Example: MBA 1st Year Course titled "Introduction to Management" will be numbered as BUL6011 where BUL6011 indicates the following:

BU - School of Business,
L - Lecture-based Course
6 - Post-Graduate, 1st year Level Course
01 - General Management [Sub Area]
02: Human Resource
03: Marketing Management
1 - Course Number

Codes for Schools

Code	Name of School
CS	School of Computer Science & Engineering
ME	School of Mechanical Engineering
AL	School of Architecture & Landscape Design
BU	School of Business
PH	School of Physics
MT	School of Mathematics
EC	School of Electronics & Comm. Engineering
EM	School of Energy Management
BT	School of Biotechnology
LN	School of Languages & Literature
PC	School of Philosophy & Culture
XX	New Schools (new codes)

Codes for Course Type

L	Lecture Course	C	Colloquium
P	Practical (Lab.) Course	E	Elective
D	Project Based	U	Studio

T	Training	S	Self-Study
N	Non-credit Course	V	Special Topic Lecture

Codes for Level of Course

Code	Faculty Name
1	Under-graduate 1st Year Level Course
2	Under-graduate 2nd Year Level Course
3	Under-graduate 3rd Year Level Course
4	Under-graduate 4th Year Level Course
5	Under-graduate 5th Year Level Course
6	Post-graduate 1st Year Level Course
7	Post-graduate 2nd Year Level Course
8	Post-graduate 3rd Year Level Course
9	Pre-Ph.D. Level Course

4.2 Core Courses, Elective Courses & Open Elective Courses

Each School has a list of approved **Core Courses & Elective Courses** which are offered in different semesters as per Program requirements.

In addition to the core courses and elective courses, a studentis required to register for some courses of his/her interest as **Open Elective** courses, which could also be prescribed as core or elective courses for students of any other program.

4.3 Course Structure Description

The structure and credits associated with each course are defined by the (L-T-P) structure which indicates the number of lecture hours /week, number of tutorial hours/week and number of practical hours /week to be devoted for the course.
e.g. BUL 6011 (3-0-0). This means that this subject shall have 3 hours of lecture per week.

For calculating the number of credits associated with a subject, the following rules apply:

1. Each lecture/week contributes one credit. Therefore 3 lectures / week contribute 3 credits.
2. Each tutorial /week contributes one credit. Therefore 1 tutorial / week contributes 1 credit.
3. Every two hours of lab work contributes 1 credit. Therefore 2 hours of practical work/week contribute 1 credit.

e.g. BUL 6021 (3-1-0) means this course is worth 3+1=4 credits.
However, there can be some courses which can be Non-Credit Courses also. In such courses, the student is required to obtain a NP grade to pass the subject but will not earn any credit on passing the course. Passing the course however is mandatory. **The Credit/hour structure for certain courses may vary in the B.Architecture program and is as per the course structure provided in the Course of Study.**

4.4 Course Coordinator

Each course being taught has a faculty member who acts as the course coordinator for that course. The course coordinator has the complete responsibility for the conduct of that course including conduct of class-work, timely distribution of assignments, conduct of tutorials, conduct of minor and major tests, awarding of grades and attendance of students. Sometimes different parts of the course may be taught by more than one faculty member. In such a case the course coordinator has the responsibility of co-ordination amongst the concerned faculty members. The course coordinator also has the responsibility of ensuring that if a student is continuously absent from the class for more than a week at a stretch, then the Director of the school to which the student belongs is intimated in writing along with the Director of the School which is offering the course.

4.5 Program Structure

The Program structure contains the semester-wise list of Core & Elective Courses as well as the credit requirements for the Open Elective Courses to be registered and passed by the student of a program for becoming eligible for award of the degree after completing all other requirements.

The program course structure clearly enlists the Core Courses, Elective Courses and Open Elective Courses in the Program structure. School Elective courses may include courses from other Schools as specified & may be considered relevant to the program.

Under the **Open Elective Course** category, a student is eligible to register for any core or elective course offered by any School other than his/her own School or an additional elective course of own School. Under Open Elective Category:

- PG students are not eligible to opt for UG courses offered by their own School
- UG students, after having earned 100 credits, are eligible to register for the PG courses

Passing the core-courses of a program is mandatory while in case of an elective course a student can register for same or an alternate elective course being offered by the same School.

5.0 Entry Number of Students

Each UG & PG student is assigned a unique Entry Number (9 character long) at the time of joining a program of study and this remains the main mode of identification for the duration of the stay in the campus.

13	**X**	**XX[$] / YY[£]**	**002**
Year of Joining	Degree Code	Program / School Code	Student Distinctive Number

$ For all UG & PG students XX (Program Code) will be used in the Entry Number,
£ For doctoral students YY (School Code) will be used instead of XX (Program Code).

Codes for Degree (X)

Code	Name of School
B	Bachelor's Degree
M	Master's Degree
D	Doctoral Degree
I	Integrated Dual-Degree

Codes for Schools (YY)

Code	Name of School
CS	School of Computer Science & Engineering
ME	School of Mechanical Engineering
AL	School of Architecture & Landscape Design
BU	School of Business
PH	School of Physics
MT	School of Mathematics
EC	School of Electronics & Comm. Engineering
EM	School of Energy Management
BT	School of Biotechnology
LN	School of Languages & Literature
PC	School of Philosophy & Culture

Code of Program

Code	Program of Study
CS	B.Tech. (Computer Science & Engineering)
ME	B.Tech. (Mechanical Engineering)
IB	B. Tech. (Industrial Biotechnology)
EC	B.Tech. (Electronics & Comm. Engineering)
AR	B.Arch
MS	M.Tech. (Computer Science & Engineering)
MC	M.Tech. (Electronics & Comm. Engineering)
MA	M.Tech. (Manufacturing & Automation)
EM	M.Tech. (Energy Management)
MM	M.Sc. (Mathematics)
BT	M.Sc. (Biotechnology)
PY	M.Sc. (Physics)
MB	M.B.A.
MP	M.A.(Philosophy)
EN	M.A.(English)
DP	Ph.D.
ES	5 Year Integrated M.Sc. in Economics
CA	M.C.A.(Master of Computer Applications)

6.0 Evaluation System

The objective of the examination system at SMVDU is to expose students to continuous evaluation rather than focus only at term end exams. This system ensures that the students develop the ability to study regularly and do not need to put any extraordinary work towards the end of the semester. This system also puts the onus on students to perform consistently and not study in a sporadic manner. Also, the system encourages the use of assignments to inculcate the spirit of self-learning in the students besides developing ability to solve practical problems.

During the course of a semester, which is generally of 90 working days, a student is evaluated in the following manner:

1. Students are given a minimum of two assignments by the faculty member, which they are required submit on specified dates. These assignments carry marks which contribute to the total obtained for that subject. The dates for submission of assignments are defined in academic Calendar.
2. Students are required to sit for three tests, which are conducted after 30, 60 and 90 working days approximately. These are called Minor I, Minor-II and Major. Major test carries a weight age of 50% while Minor-I, Minor-II carry a weight age of 40% while the assignments, quiz, presentations etc carry a weight age of 10%.
3. Faculty members may assign weight age to quiz, presentations or any similar activity besides the two assignments. **However this should be notified by the Course Coordinator at the beginning of the Semester.**
4. The above mentioned structure may vary in the B.Arch program in specific courses which will be duly notified by the Director of the School at the beginning of the relevant Semester

At the end of the semester, the faculty member assigns a grade to each student depending upon the performance of the student in that course in minor tests, assignments, major test, quiz, presentations etc. Using the grades that are assigned to each student in each course, the CGPA and the SGPA are calculated.

6.1 Evaluation Indices

The performance of a student is evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point for all the completed semesters at any point in time. The SGPA is calculated on the basis of grades obtained in all courses, except audit courses and courses in which S/Z grade is awarded, registered for in the particular semester:

$$SGPA = \frac{\sum_{\text{Semester}} (\text{Earned credits} \times \text{Grade point}) \text{ for all course except audit , I, W \& S/Z grade courses}}{\sum_{\text{Semester}} (\text{Registered Course credits}) \text{ except audit \& S/Z grade courses}}$$

The CGPA is calculated on the basis of all pass grades, except audit courses and courses in which S/Z grade is awarded, obtained in all completed semesters.

$$CGPA = \frac{\sum_{\text{All Semester}} (\text{Earned Course credits} \times \text{Grade point}) \text{ for all course except audit, I, w, \& S/Z grade courses}}{\sum_{\text{All Semester}} (\text{Earned Course credits}) \text{ except audit \& S/Z grade courses}}$$

An example of these calculations is given below:

Semester –I

Course No	Course Credits	Grade Awarded	Earned Credits	Grade Points	Points Secured= 2 x 5
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
SMTL 101B	4	C(+)	4	6	24
SMTL 102B	4	C	4	5	20
EMEL 101B	3	A(+)	3	10	30
PCLL 101B	3	B(+)	3	8	24
ECSL 101B	3	F	0	0	0
ECSL 102B	4	B	4	7	28
SPMP 101B	1.5	B(+)	1.5	8	12
ECSP 101B	1.5	C(+)	1.5	6	9

Credits registered in the semester (total of column 2 excluding W grades courses) = **24**

Earned credits in the semester = (total of column 2- credits lost due to F/ W/I)) = 24-3=21

Points secured in this semester (total of column 6) = 147

$$\textbf{SGPA} = \frac{\text{Points secured in the semester}}{\text{Credits registered excluding S/Z, I grade courses}} = \frac{147}{24} = \textbf{6.125}$$

$$\textbf{CGPA} = \frac{\text{Cumulative points secured in all passed courses}}{\text{Cumulative earned credits, excluding audit, I, \& S/Z grade courses}} = \frac{147}{21} = \textbf{7.0}$$

As can be seen the denominator for CGPA is not same as for SGPA because the student got 'F' grade and thus did not earn the credit.

At end of Semester –II for same student

Course No	Course Credits	Grade Awarded	Earned Credits	Grade Points	Points Secured= 2 x 5
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
SMTL 103B	4	C(+)	4	6	24
SMTL 104B	4	C	4	5	20
ECSL 103B	3	A(+)	3	10	30
EECL 101B	4	B(+)	4	8	32
EECL 102B	3	F	0	0	0
ECSP 102B	2	B	2	7	14
SPMP 102B	1.5	B(+)	1.5	8	12
EMEP 102B	1.5	C(+)	1.5	6	9

Credits registered in the semester (total of column 2 excluding W grades courses) = 23

Earned credits in the semester =(total of column 2- credits lost due to F/ W/I) = 23- 3 = 20

Points secured in this semester (total of column 6) = 141

Cumulative points secured as of date (total of points secured in previous semesters and current semester) = 147 + 141= 288

$$\textbf{SGPA} = \frac{\text{Points secured in the semester}}{\text{Credits registered excluding S/Z, I grade courses}} = \frac{141}{23} = \textbf{6.13}$$

$$\textbf{CGPA} = \frac{\text{Cumulative points secured in all passed courses}}{\text{Cumulative earned credits, excluding audit, I \& S/Z grade courses}} = \frac{288}{21+20} = \textbf{7.02}$$

6.2 Grading system

At the end of the term after conduct of minor and major tests the course coordinator awards a grade to each students depending upon their performance. No marks are awarded. However, each grade is associated with the number of points it carries. The different grades are as follows:

Grade	Points	Description of Performance	Marks Assigned
A(+)	10	Outstanding	> 90
A	9	Excellent	> 80 to 90
B(+)	8	Very Good	>70 to 80
B	7	Good	>60 to 70
C(+)	6	Fair	>50 to 60
C	5	Poor	>40 to 50
D	4	Marginal	>35 to 40
E	3	Fail	>25 to 35
F	0	Fail	0-25
I	-	Incomplete	
NP	-	Audit Pass	
NF	-	Audit Fail	
W	-	Withdrawal	
X	-	Continued	
S	-	Satisfactory	
U	-	Unsatisfactory	

As the University is following Absolute Grading System, the CGPA to percentage equivalence is obtained by multiplying CGPA by ten (10.0)

Appearing in Major examination is a mandatory requirement for award of any pass grade in any course.

A(+) & A Grades
´A(+)´ grade stands for Outstanding achievement while A for Excellent performance.

B(+) & B Grades
´B(+)´ grade stands for Very Good performance while B for Good performance.

C(+) & C Grades
'C(+)' grade stands for Fair while C for Poor.

D Grade
The 'D' Grade stands for Marginal performance; i.e. it is the minimum passing grade in any course.

E & F Grades
The 'E' & 'F' grades indicate failing in a course. A student has to repeat all core courses in which she/he obtains E or F grade, until a passing grade is obtained. In case of elective courses in which E or F grade has been obtained, the student may take the same course or any other course from the same category.

In case of 'E' grade, a student is required to complete all requirements, except for attendance requirement, with respect to the course when registered again, as applicable to all other fresh students. However, in case of 'F' grade awardees, the attendance requirement will also apply.

Further 'E' or 'F' grade obtained in any course is recorded permanently on the Semester Grade Sheet as well as the Transcript. This grade is not counted in the calculation of the CGPA; however, this is counted in the calculation of the SGPA.

In case a core course ceases to exist in the process of revision of the curriculum, the nearest substitute course is to be done by a student having backlog in the old course.

In case there are significant number of students having backlog in a particular course, the School may offer such course in the Summer semester and students having obtained 'E' or 'F' grade may register for the course during the Summer Semester.

I Grade
An 'I' grade denotes incomplete requirements in any L (lecture), P (practical), V (Special Module) category course. It may be awarded to a student if he/she has not fulfilled all the requirements of the course due to absence on medical grounds or exceptional circumstances. In case of absence on medical grounds or other exceptional circumstances, before or during the major examination period, the student can apply for I-grade. 75% attendance in a course is necessary for being eligible for request of I- Grade in that course. An Application requesting 'I' grade should be made at the earliest but not later than the last day of major tests. The application should be made to the Director of the School of the student's program who will recommend the same to the Dean of the College/Faculty for grant of approval depending on the merit of the case. The Dean will further process the request through AR(A&E) for grant of approval from the competent authority. Once approved, the information will be passed on to the course coordinators also. The student should complete all course requirements within 10 days of the last date of Major Tests. The 'I' grade will then be converted to a regular grade.

NP or NF Grades
These grades are awarded in a course that the student opts to audit or in Non-Credit Courses. Audit facility is open to all students who have completed 100 credits for UG students. A student will be permitted to do any number of audit courses over and above the graduation requirements. However, for UG students at the most 8 credits can be counted towards the minimum requirement of 185 credits. Also for UG students, only Elective subjects can be chosen as Audit course. Audit applications are allowed during the first four weeks of a semester.

The audit pass (NP) Grade is awarded if the student's attendance is above 75% in the class and he/she has obtained at least 'D' grade unless course coordinator has specified a higher criterion at the beginning of the semester. If either of these requirements is not fulfilled, the audit fail (NF) grade is awarded. The grades obtained in an audit course are not considered in the calculation of SGPA or CGPA however they are counted towards the total number of credits earned subject to the upper limit of 8 credits for UG courses. For PG programs the credits are not counted towards degree completion credit requirements.

W Grade
A 'W' grade is awarded in a course where the student has opted to withdraw from the course. Withdrawal from a course is permitted until one week after the first Minor Tests.

X Grade
The 'X' grade is awarded for incomplete work in Independent Study, Mini Project, Minor Project, Major Project based on the application of the student. On completion of the work, X grade can be converted to a regular grade within the first week of the next semester. Otherwise, the student is awarded 'X' grade on a permanent basis and it appears in his/her grade card. Further, the student is required to register for the course in the next semester. The credits of the course are counted towards his total load for the semester. In case of Major Project part I, the student is not permitted to register for Major Project part II simultaneously as Major Project Part I is a pre-requisite for Major Project Part II. A student can be awarded 'X' grade only once in a course.

S & Z Grades
The 'S' grade denotes satisfactory performance in Ph.D. thesis work whereas 'U' denotes unsatisfactory performance in Ph.D. thesis work. 'S' grade will also be assigned for satisfactory completion of NSS.

6.3 Evaluation Methodology for Courses with Theory & Lab Component

For courses which consist of both theory & Lab component e.g. "ECSL 208B Introduction to Data Structures (2-0-2)" the evaluation methodology consists of evaluation of Theory component and Lab component separately out of 100 marks each initially. After this, the marks obtained in the two components are merged together (out of 100 marks) in the ratio of the credits of the theory and lab component.

7.0 Requirements for Continuation and conditions for Termination of Admission for all programs

At the completion of the first two semesters attended by a student (excluding Semester Withdrawal), the student is required to earn 60% of the total credits as per Course Structure, failing which his/her admission in the program will stand terminated and his/her name struck from the rolls of the program. However, if the same student has earned at least 80% of the Credits (as per Course Structure) in either of the first two semesters attended by him/her then his/her admission will not be terminated.

The students can register in the forthcoming semester for courses based on the Time-Table constraints and pre-requisite requirements. Attendance requirement will **be applicable as specified in Attendance rules**

8.0 Requirements for Award of Degree

It is mandatory for the student to complete successfully each of the criterion mentioned at **Point 1-6** above for award of degree. Failure to complete any one of the above requirements will make the student in-eligible for award of Degree and his/her admission will be terminated.

1. Earned Credits

The earned credit requirements for award of degree are equal to the credits of all courses as defined in the program structure. It is mandatory to pass all courses mentioned as a part of the course structure of that particular program including non-credit courses, if any, for award of degree.

In case of passing out students deficient in total credit requirements up to 12 credits, they may be allowed to register in the Summer Semester upto 12 credits for the backlog courses or other eligible courses in lieu of these courses. These courses could be registered and studied on Self-Study basis also. In case there are significant number of students having backlogs in a particular course, the School may decide to offer the course in the Summer Semester for which attending the classes will be a requirement. This will also apply to students who are not on the verge of passing out.

2. Maximum Period for Completion of Degree

The maximum period for completion of degree is as below:

Program	Max. Period for Completion of Degree *
B.Tech.	6 Years
B.Arch.	7 Years
Full Time Master's Degree Programs (M.Sc., M.A., M.B.A., M.Tech. etc.)	3 Years
Part Time Master's Degree Programs [e.g. M.Tech.(EM)]	4 Years

***** The period of Semester Withdrawal is not counted towards the maximum time limit for completion of degree.

3. Cumulative Grade Point Average (CGPA) Requirement

A student must obtain a **minimum Cumulative Grade Point Average (CGPA) of 5.0 at end of the Program for being eligible for award of any UG or PG degree.**

Students not meeting the above conditions after completion of required credits in the degree programme may be permitted to register for additional elective courses under any category to improve the CGPA within the maximum time limit for completion of that programme.

4. Practical Training

A student of the 4-year B.Tech. program and 5-year B. Arch. program must complete the prescribed number of days of practical training to the satisfaction of the concerned School. This training will be normally undertaken in the summer vacation following the 6th semester for B.Tech. and during 7th semester for B. Arch. program. Practical training duration is **a minimum of 8 weeks for B.Tech. & 100 working days for B.Arch.** Training should be carried out preferably in industry or R&D institutions in India or recognized architectural offices for B.Arch. course. Practical training may also be taken in any academic institution of national importance.

5. NSS

All undergraduate students are required to enroll for NSS in the first year. This requirement should be completed in one year. If, however, a student is not able to complete this requirement in the first year, he/she must complete it by the end of the 2nd year (4th semester). **An S or X grade is awarded to each student for NSS which requires 40 hours per semester of time devoted to NSS activities. Concerned students will have to register for NSS as a Non-credit Course. The grade obtained will be displayed on the grade sheet.**

6. Minimum Number of Academic Semesters

A student is required to register for at-least 8 semesters for B.Tech., 10 Semester for B.Arch., 4 Semesters for Full-Time PG Courses and 6 Semesters for Part-Time PG courses such as

M.Tech.(EM)-Part Time to be eligible for award of degree. Withdrawal Semester & Summer Semester do not count towards this.

9.0 Regulations & Procedures

9.1 Semester Registration& Pre-Registration

Registration in each semester is a mandatory requirement**, failing which the name of the students will be struck off the rolls of the university.** The Registration procedure ensures that the students name is on the roll list of each course that he/she wants to study in a semester. No credit is given if the student attends a course for which he/she has not registered. Registration for courses to be taken in a particular semester will be done according to a specified schedule as indicated in Academic Calendar. During registration each student is required to indicate clearly the courses he is registering for. **Registration after due date or in absentia will be allowed only in rare cases at the discretion of Dean of the Faculty, subject to the approval of the Vice Chancellor.** In case of illness or absence during registration, a student should intimate the same to his/her course advisor and the Dean. On-line Registration System is used to keep track of the courses chosen by each student besides providing information to the student regarding his/her backlog courses. Registration is done twice every Academic Session at the beginning of the semester in August/January.

Semester Registration will be mandatory for the Summer Semester for all PhD scholars and students of full-time M.Tech. program. Students from any other program wishing to stay back during the Summer Semester are also required to register for the Summer Semester.

Registration of the students from external institutions, who come to the university for Project/Summer Training, will be done in a different mode. The Registration for Summer Semester will be done in the last week of May.

In addition to the Semester Registration at the beginning of each semester (August/January), a **Pre-registration for the forthcoming semester is also required to be done by each student during the preceding semester in March/October.**

This is beneficial to the students since they are aware of the courses being offered by the Schools in the forthcoming semester.

This also facilitates the School administration to know in advance the courses for which the students wish to register in the forthcoming semester and the number of students registering for each course.

9.2 Advice on Courses

At the time of completing the registration form, each student must consult his /her student advisor to finalize the academic program keeping in view minimum/ maximum numbers of total and lecture credits, past performance, backlog of courses, SGPA/CGPA, prerequisite, workload and students interests.

9.3 Slot System For Time Table

A slot based centralized Time Table will be devised in every semester of every academic session. The objective is to enable the students to have the flexibility to opt for elective courses being offered by Schools other than their own and enable the Schools to design the Time-Table based on Pre-Registration information submitted by students.

9.4 Lower and Upper Limits for credits registered.

A student may be allowed to register for as many mandated and/or backlog courses as he/she can attend or register for as per the Time-Table constraints during each regular semester. However, each student will have to register for a minimum of 12 credits in a regular semester unless the number of credits required for the award of degree is less than 12 and/or it is due to constraints of Time Table or courses offering.

A student will not be allowed to register for more than 12 credits in the Summer Semester.

9.5 Addition, Deletion, Audit and Withdrawal from courses

a) **Add/Drop:** A student has the option to add a course(s) that he/she has not registered for, or drop a course(s) for which he/she has already registered for. This facility is restricted to the first week of the semester.

b) **Audit:** A student may apply for changing a credit course to an audit one within one week of the end of the first minor test. Audit facility is open to all students who have completed 100 credits for UG students. A student will be permitted to do any number of audit courses over and above the graduation requirements. However, for UG students at the most 8 credits can be counted towards the minimum requirement of 185 credits. Also for UG students, only Elective subjects can be chosen as Audit course. NP or NF grades are awarded in a Audit Course and these grades and credits are not counted towards calculation of SGPA/CGPA. However in case of UG, the credits of the audit course are counted towards the total credits earned while in PG courses the credits of the audit course are not counted as earned credits.

c) **Withdrawal:** A student who wants to withdraw from a course should apply **within one week of the end of first minor test.** A withdrawal grade (W) will be awarded in such cases. In case a student withdraws from a core course he is required to register for the same the next time it is offered. He will be required to meet the attendance requirement when he registers for the course the next time and should carefully consider the feasibility of the same before withdrawing. It is mandatory for a student to clear that course to be eligible for award of degree. In case a student withdraws from an elective course he has a choice to either register for the same course the next time it is offered or to register for some other elective course being offered this time or next time. However, the student is required to meet the attendance requirement when he registers for the same elective the next time or takes a new elective this time or the next time. He/She should be careful in considering the feasibility of meeting the attendance criterion before withdrawing.

9.6 Semester Withdrawal (Undergraduate & Postgraduate students)

If a student is absent for more than 20 teaching days in a semester **on medical grounds**, then he/she may apply for withdrawal from that semester, i.e. withdrawal from all courses registered in that semester. A student can also choose to withdraw from a semester for the following reasons:

1) Industrial internship
2) Disciplinary action
3) **Extra-ordinary situation which renders the student unable to continue studies in the immediate future on any genuine and justifiable ground, and if recommended by BUGS /BPGS & approved by the Vice-Chancellor.**

Application for semester withdrawal must be made as early as possible and latest before the start of the major tests. No applications for semester withdrawal will be considered after the major tests have commenced.

The application for withdrawal on Medical Grounds must be supported by a Medical Certificate issued by a duly registered Medical practitioner along with copies of relevant prescriptions, Medical Test reports etc. The opinion of the Medical Officer of the University will be obtained in this case.

The application for withdrawal will be considered for approval by the Vice-Chancellor if recommended by the Director of the School & Dean of the Faculty.

In case a student seeks Semester Withdrawal then this will result in withdrawal for a semester only and the student may be allowed to register in the subsequent semester. However the student may be allowed to register for only those courses in the subsequent semester, besides backlog courses, for which the pre-requisite condition is met. However, in either case, this period of withdrawal will not be counted towards the maximum time limit for completion of degree. The period of withdrawal can't be more than one year after which the student's admission will be cancelled.

9.7 Attendance Requirements

All the students are expected to attend every lecture, tutorial and practical class. However, to account for late registration, sickness or other contingencies, the minimum attendance requirement will be 75% of the classes actually held. For the purpose of attendance calculation, every scheduled practical class will count as one unit irrespective of the number of contact hours. Attendance record will be maintained by the concerned faculty for all lectures, tutorials and practicals held.

A **student with less than 75% attendance but more than 60% attendance** in any course during the semester shall be allowed to sit for the Major Exam, however he will be **awarded a grade one lower than the grade actually earned by him/her** based on the marks obtained.

A student with less than 60% attendance will not be allowed to appear in the Major Exam and will be awarded Fail grade ('E' or 'F' as per the total marks obtained). The student will be required to re-take the course i.e. register for the course and attend all classes. In case of audit / non-credit courses NP grade will be changed to NF if attendance is less than 60%.

9.8 Absence during the semester

a) A student must inform the Director of the School and Dean of the Facultyimmediately of any instance of continuous absence from classes.

b) A student who is absent due to illness or any other emergency, up to a maximum of 2 weeks, should approach the course coordinator for make-up quizzes, assignments and laboratory work that he may have missed.

c) A student who has been absent in the minor test due to illness should approach the course coordinator for re-conduct of Minor test which may be allowed by Dean under specific circumstances as detailed in **Rule 9.9 below.**

d) In case of absence on medical grounds or other special circumstances, before or during the major examination period, the student can apply for I-grade. 75% attendance in a course is necessary for being eligible for request of I- Grade in that course. An Application requesting I- grade should be made at the earliest but not later than the last day of major tests. The application should be made to the Director of the School of the student's program who will recommend the same to the Dean of the Facultyfor grant of approval depending on the merit of the case. The Dean will further process the request through AR(Academics) for grant of approval from the competent authority. Once approved, the information will be passed on to the course coordinators also. The student should complete all course requirements within 10 days of the last date of Major tests. The I- grade will then be converted to a proper grade (A to F, NP, NF).

e) In case the period of absence on medical grounds is more than 20 working days during the semester, a student may apply for withdrawal from the semester, i.e. withdrawal from all courses registered that semester as mentioned at **Rule 9.6 above.**

f) If a student is continuously absent from the institute for more than four weeks without notifying the Director of the school, his/her name will be removed from university's rolls.

9.9 Re-conduct of Minor Exam if missed

In case a student fails to appear in any Minor Exam due to exceptional circumstances then re-conduct of the missed Minor Exam may be allowed by the Dean of the College/Faculty **on the recommendation of the Course Coordinator and the Director of the School offering the course.** However, the application **for re-conduct of Minor Exam must be received within 07 working days after the end of Minor Exams.**

The Minor Exam should usually be re-conducted before the next Minor or Major Exam whichever is earlier.

10.0 Un-Fair Means Cases

10.1 Unfair Means & Misconduct by Students during Exams

The following actions performed by any student during the course of his/ her examination shall be termed as unfair means/misconduct by the candidate:-

1. Copying from or referring to any material other than the question paper or answer book of the candidate himself during the course of examination. The material could be a piece of paper/cloth, calculator, mobile phones, benches in the examination hall/ labs or different parts of the human body such as hands, arms, feet etc.
2. Bringing to the examination hall any material with the intention to use it in attempting the questions or performing some experiments in the labs during the course of examination.
3. Taking help from the peer examinees in the form of verbal conversation or seeing /showing the answer book of/ to other examinees with or without their consent.
4. Taking/ providing help in performing the experiments in the lab or fields during the course of exam.
5. Refusal to obey the orders of the Faculty Invigilator.
6. Misbehaving or creating disturbance of any kind in and around the examination hall or organizing a walk out or instigating other to walk out.
7. Impersonating or misrepresenting any other candidate in connection with the examination.
8. Smuggling in an answer book or continuation sheet or taking out or arranging to send out the question paper or an answer book or a continuation sheet or replacing the answer book, its inner sheets, or continuation sheets during or after the examination with or without the connivance of the staff on duty in connection with the examination.
9. Forcing his entry into examination hall for the purpose of taking the examination even after being told that he/she is not eligible to sit in the examination.
10. Possessing a lethal weapon or fire arm or coming in drunken condition to the examination hall.
11. Engaging in any other act or omission which creates the tendency to disrupt the orderly conduct of the examination.

10.2 Preventive Measures (Do's & Don'ts)

The following is a list of Do's & Don'ts for Students sitting for an exam:

1. The students must not possess any material with them other than the ones permitted which could be of any help in the course of examination.
2. The students should search their pockets and seats (on & around) and if any such material is present, the same should be placed outside the exam hall/ room.
3. The students are not allowed to bring mobile phones in the examination hall
4. The students should be asked to sit as per the seating plan prepared by the invigilator.
5. The students are not allowed to converse/talk to their peers during the course of examination. In case of any difficulty/ requirement, the student may raise his/ her hand to indicate his intention to converse with the faculty in charge on invigilation duty.
6. The students must not try to refer to the answer book/ question paper of their peer examinees.
7. The students are not allowed to leave the exam hall during the first 90 minutes of their examination for the purpose of attending to the toilets or otherwise.
8. Although the use of calculators becomes essential to answer the questions for many engineering and science subjects. However there are still many subjects where the use of calculator is not required. The paper setter should clearly mention on the question paper whether the calculator is required to be used in the exam hall or not. Accordingly an announcement whether the calculator is allowed or not should be made by the invigilator.
9. The students should place their I-cards on their tables(it is mandatory for the students to carry their I-cards during any exam)

10. The students may be allowed to enter the examination hall/ room not more than 10 minutes before the start of examination.
11. The students may not be allowed to appear for the examination after 30 minutes of the start of the examination.
12. In case a student is found conversing/ talking to his/her peers during the course of examination for the first time, the faculty member may ask for his/ her seat to be changed but if he/she continues to do it, a UMC case may be recorded against the student.
13. In case a student behaves in a hostile manner or creates a ruckus and disturbs other students or there is a mass protest by the students inside the exam hall, the faculty member will report the matter immediately to the Director of the concerned schools and the Dean of the college.
14. The students may not be allowed to leave the exam hall before half of the time allowed for exam is over.

10.3 Procedure to Deal a Case pertaining to the Use of Unfair Means/Misconduct during the examination

If a student is caught using unfair means during the course of his/ her examination by the invigilator or any other member of faculty on examination duty, the following sequence of steps must be taken:

1. The answer book and the material used for unfair means will be confiscated by the invigilator and a statement to the effect may be got recorded from the student who possessed the material and was taking help from the same. In case the student refuses to record such a statement, then the invigilator may record that the student had refused to record such a statement.
2. The invigilator will give a new answer booklet to the student if the student intends to continue his/her exam. Otherwise the student may be allowed to leave the exam hall after half of the time allowed for exam is over.
3. At the end of the examination, the invigilator will submit the case in the prescribed form along with both the answer books and the confiscated material to the Director of the school to which the subject belongs, after recording his own statement regarding the use of unfair means by the student. However, if the material used for Unfair Means is like the desk or some part (s) of the human body or is some oral conversation between peer examinees and can't be attached with the answer book of the student then the invigilator may call the Director of the School to which the student belongs so as to make him witness the case.
4. The use of unfair means case shall be discussed by the UMC Committee where by the student shall be given a chance to defend his/ her case before the committee. The case shall be presented by the concerned invigilator, before the UMC committee. The UMC committee constituted shall consist of the following :
    i. Dean of the Facultyto which the student belongs
    ii. Director of the school to which the student belongs
    iii. Director of the school to which the Subject Coordinator belongs
    iv. Subject coordinator
    v. Concerned Invigilator as Presenter
    vi. AR/ A & E as Secretary
5. The notice relating to the date & time of hearing of the case shall be sent to the candidate through the Director of the school to which the candidate belongs. If the service of the notice is not affected due to the fault of the candidate, the committee shall proceed ex-parte. In case delay is caused in the service of the notice for no fault on the part of the candidate, a new date of hearing shall be fixed by the committee.

6. The UMC committee shall submit its recommendations for consideration and approval by the Vice Chancellor at the earliest.

7. The UMC Committee may observe the following guidelines for the purpose of awarding punishment to the student. Secretarial assistance for this purpose may be provided by the A&E Section.

If the candidate was found having in his/her possession or accessible to him/her papers, books or notes which do not relate to the subject of examination and which could not possibly be of any assistance to him , no action may be taken against the candidate, otherwise,

i. In case of first such offence by the student, the student be awarded zero marks only in the concerned examination such as minor 1 or minor 2 or major and a warning letter be issued to the student, warning him to desist from such activities and in case of repetition of such

as an offence, a more stringent action including expulsion from university may be taken against him/ her. A copy of the Warning Letter be sent to the parents of the student

ii. In the case of second such offence, the student be failed in the subject in which the student was caught using unfair means irrespective of the fact whether he is caught during Minor or Major exam of the subject. A warning letter be issued to the student and a copy be sent to his/her parents.

iii. In the case of 3rd subsequent offense, the student be failed in all the subjects registered by the student during that semester. A warning letter with copy to his/her parents may also be issued.

iv. In case a student still indulges in such an offence after case iii above, strict action as deemed fit including expulsion from university may be taken against the student.

v. For unfair means/ misconduct of the nature specified by A(5) to A(11) above , the committee shall have the right to recommend to the Competent Authority, a disqualification for the candidate from passing or from appearing in University examinations for a period of up-to 3 years depending upon the gravity of the case. The period of disqualification shall commence from the session in which the candidate is found to have committed the misconduct.

10.4 Remedial Measures

The remedial measures include the punishments and counseling given to the students who are caught using unfair means so that they don't repeat the offence during the course of their studies. The following steps are recommended to be taken:-

1. The punishment as recommended by the UMC Committee and approved by the Vice-Chancellor as per Para (C) above may be given to the student.
2. The student should be counseled by his faculty-mentor so as to persuade the student not to indulge in such malpractices in future.
3. The faculty-mentor may recommend that the faculty member teaching the subject may give some extra time to the student so that the student is enabled to understand and pass the subject.

10.5 Appeal against Punishment awarded by UMC

A candidate aggrieved by the punishment awarded to him/her may prefer an appeal to the Vice Chancellor within forty five days from the date of the order. Provided further that the Vice-Chancellor may entertain an appeal after the expiry of the said period if he is satisfied that the appellant has sufficient justification for not preferring the appeal in time

Note:

All Rules & Regulations, Program Course structure & Detailed Syllabus as given in the "Courses of Study (UG&PG) 2013-14" booklet may be revised by the university for the purpose of streamlining and improving quality of academic system in the university. Any revisions made will be notified by the university separately and shall be applicable as and when notified.

Certain set of rules, regulations and procedures apply specifically to the **B.Arch program** and have been notified vide **Notification No. SMVDU/A&E/11/2008 dated 23rd Feb 2012.** Students admitted to the B.Arch program are advised to contact the Director of School of Architecture & Landscape Design to get more information on this and for any new amendments subsequently.

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Computer Science & Engineering

Objectives

The School of Computer Science & Engineering has been set up to impart training of the highest standards to the students, in the field of computers, thus preparing them to meet the exacting demands of the highly competitive global industrial market.

The school currently offers a 4 year (8 semesters) B.Tech programme in Computer Science & Engineering, a M.Tech Programme in Computer Science & Engineering and a Masters Degree in Computer Applications.

The purpose of B. Tech programme is:

- To have a perception and a value system appropriate to the pursuit of high science and high engineering science to meet the critically evaluated needs of the society in terms if products and processes using indigenous resources
- To develop in each student mastery of fundamentals , versatility of mind , motivation for learning, intellectual discipline and self-reliance which provide the best foundation for continuing professional achievement;
- To provide a liberal; as well as a professional education so that each student acquires a respect for moral values, a sense of their duties as a citizen , a feeling for taste and style , and a better human understanding. All these are required for leadership;
- To send forth men and women of the highest professional competence with a breath of learning and a character to deal constructively with issues, and problems anticipated in the next decade relevant to the Programmes of development of our country.

Training Methodology

The emphasis of the program is on practical, hands-on learning. Significant part of the curriculum is dedicated to ensuring that the students get to work with latest equipment and explore the implementation of the knowledge learnt through the class-work. The students are also required to undergo summer training in an industrial environment to learn industrial standards of project management, teamwork, quality considerations and documentation.

Infrastructure

State-of-the-art laboratories, containing the computers with latest configuration networked together to ensure that the students get complete facilities to thoroughly understand and explore the concepts of computers as learnt in the class-room. All the labs including Basic Computing Lab, Linux Lab, DBMS Lab, Programming Lab, Projects Lab and the Internet Lab and the Server are equipped with latest state-of-the-art softwares and hardware and are interconnected through 20 MBPS dedicated connection.

Course Structure of
B. Tech (Computer Science & Engineering) programme

Semester I **First Year**

Course Code	Course Title	L-T-P	Credit
PHL 1011	Fundamentals of Physics	3-0-0	3
MTL 1012	Calculus and Linear Algebra	3-0-0	3
MEL 1039	Engineering Graphics with CAD	1-0-2	2
CSL 1011	Computer Fundamentals & Information Technology	3-0-0	3
ECL 1020	Basic Electrical Engineering	3-0-0	3
LNL 1141	Communication Skills	3-0-0	3
CSP 1011	Basic Computer Lab	0-0-2	1
ECP 1020	Basic Electrical Engineering Lab	0-0-2	1
PHP 1011	Physics Lab	0-0-2	1
	NSS		0
	Total Credits	16-0-8	20

Semester II **First Year**

Course Code	Course Title	L-T-P	Credit
BUL 1061	Engineering Economics & Management	3-0-0	3
MTL 1022	Differential Equations & Vector Calculus	3-0-0	3
CSL 1020	Programming with 'C'	3-1-0	4
ECL 1010	Basic Electronics	4-0-0	4
MTL 2024	Discrete Structures	3-1-0	4
ECP 1010	Basic Electronics Lab	0-0-2	1
CSP 1021	Programming Lab	0-0-2	1
MEP 1115	Workshop Practice	0-0-2	1
LNP 1142	Language Lab-I	0-0-2	1
	Total Credits	16-2-8	22

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credit
CSL 2061	Computer Organization & Architecture	3-1-0	4
ECL 2150	Principles of communication Engineering	3-0-0	3
ECL 2072	Digital Electronics Fundamentals	3-0-0	3
PCL 2042	Introduction to Logic	3-0-0	3
	Open Elective-I	3-0-0	3
CSL 2031	Data Structures	3-0-0	3
CSP 2031	Data Structure Lab	0-0-2	1
ECP 2070	Digital Electronics Lab	0-0-2	1
ECP 2150	Principles of Communication Engg. Lab	0-0-2	1
	Total Credits	18-1-6	22

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credit
PCL 2047	Advanced Logic	3-0-0	3
CSL 2041	Theory of Computation	3-1-0	4
CSL 2051	Operating System	3-0-0	3
MTL 2025	Engineering Computational Methods	3-0-0	3
	Open Elective-II	3-0-0	3
CSL 2022	Object Oriented Programming	3-1-0	4
MTP 2025	Engineering Computational Methods Lab	0-0-2	1
CSP 2022	OOPS LAB	0-0-2	1
CSP 2051	Operating System Lab	0-0-2	1
	Environmental Studies	2-0-0	NC
	Total Credits	18-2-6	23

Semester V **Third Year**

Course Code	Course Title	L-T-P	Credit
ECL 3061	Microprocessors & Interfacing	3-0-0	3
CSL 3032	Design & Analysis of Algorithm	3-0-0	3
CSL 3052	System Programming	3-0-0	3
	Open Elective-III	3-0-0	3
CSL 3023	Java Programming	3-1-0	4
CSL 3071	Computer Network & Communications	3-1-0	4
CSP 3023	Java Programming Lab	0-0-2	1
CSP 3032	DAA Lab	0-0-2	1
CSP 3061	Microprocessor Lab	0-0-2	1
CSP 3071	Networking Lab	0-0-2	1
	Total Credits	18-2-8	24

Semester VI **Third Year**

Course Code	Course Title	L-T-P	Credit
CSE XXXX	School Elective-I	3-0-0	3
CSE XXXX	School Elective-II	3-0-0	3
CSL3101	Artificial Intelligence	3-0-0	3
CSL3091	Software Engineering	3-0-0	3
CSL3034	Visual Programming	3-1-0	4
CSL3081	Database Management System	3-1-0	4
CSP3091	Software Engineering Lab	0-0-2	1
CSP3034	Visual Programming Lab	0-0-2	1
CSP3081	Database Management System Lab	0-0-2	1
	Total Credits	18-2-6	23

Note: *Practical Training* to be performed in the summer vacation following the sixth semester

Semester VII **Fourth Year**

Course Code	Course Title	L-T-P	Credit
CSC 4001	Colloquium		3
MTL 4021	Applied Graph Theory	3-0-0	3
CSL 4121	Computer Network Security	3-0-0	3
CSL 4111	Computer Graphics	3-0-0	3
CSL 4053	Compiler Design	3-1-0	4
CSE XXXX	School Elective-III	3-0-0	3
CSP 4111	Computer Graphics Lab	0-0-2	1
	Open Elective-IV(HM)	3-0-0	3
CSD 4002	Mini Project		3
	Total Credits	18-4-8	26

Semester VIII **Fourth Year**

Course Code	Course Title	L-T-P	Credit
CSD 4083	Major Project		10
	Total Credits		10

Total Credits: 170

List of Electives

School Elective-I			
Course Code	**Course Title**	**L-T-P**	**Credits**
CSE 3082	Data mining & warehousing	3-0-0	3
CSE 3072	Storage Networks	3-0-0	3
CSE 3122	Cyber Security	3-0-0	3
CSE 3112	Image processing and pattern recognition	3-0-0	3

School Elective-II			
Course Code	**Course Title**	**L-T-P**	**Credits**
CSE 4152	Cloud Computing	3-0-0	3
CSE 4151	Parallel & Distributed Computing	3-0-0	3
CSE 4102	Neural Networks & Fuzzy Set	3-0-0	3
CSE 4062	Advanced Computer Architecture	3-0-0	3
CSE4154	Soft Computing	3-0-0	3

School Elective-III			
Course Code	**Course Title**	**L-T-P**	**Credits**
CSE 4141	Mobile & Pervasive Computing	3-0-0	3
CSE 4087	Advanced Database with SQL	3-0-0	3
CSE 4012	Information Coding & Theory	3-0-0	3
CSE 4054	Computer Embedded Systems	3-0-0	3
CSE 4044	Robotics & Vision Control	3-0-0	3
CSE 4016	Ecommerce& Cyber Laws	3-0-0	3

Computer Fundamentals & Information Technology

CSL 1011 **3 – 0 – 0 = 3**

Introduction to Computers: Introduction, characteristic of computers, evolution of computers, generations, classification, applications of computers, number systems, conversions, Boolean algebra and logic gates, organization and architecture of modern computer systems and their structure and function, Instruction fetch and execute cycle, memory hierarchy, primary memory -RAM, ROM, secondary memory, input and output devices

Information Concepts and Processing: Definition of information, need for information, value of information, categories and level of information in business organization, data concepts and data processing, data representation, entropy.

Programming Language: Computer language, generation of languages, introduction to 4 GLS, software development methodology, life cycles, software coding, testing, maintenance, industry standards, introduction to ISO, SEI-CMM standards of IT industry.

Data Communication and Networks: Issues in data communication, need for data transmission over distance, types of data transmission, media for data transmission, networking of computers, introduction of LAN and WAN, network topologies, basic concepts in computer networks, client server architecture, introduction to advanced communication techniques like ISDN, ATM, token based protocols CSMA/CD

Internet Technology and Applications: Internet structure and components, TCP/IP communication protocol, gateways, routers, internet service providers, www, gopher, ftp, SMTP, PPP, e-commerce, data warehousing, HTML, elementary concepts in object oriented programming, EDI, electronic payments, digital signatures, network security and firewall.

Recommended Books:

- Digital Computer Fundamentals, Bartee, Thomas TMH
- Introduction to Digital Computer Design, Raja Raman, PHI
- Introduction to Computers, Norton Peter, TMH
- Inside IBM PC, Norton Peter, PHI
- Introduction to Computer Science, Mata Toledo, TMH
- Introduction to Computer Science, ITL ESL, Pearson Education

Programming in C

CSL 1020 **4 – 0 – 0 = 4**

Fundamentals: Introduction to C, data types, constants, variables, declarations, expression statements, arithmetic operations, unary operations, relational and logical, conditional, library functions, single character input and output, entering and writing data.

Control Statements and Functions: Statement and blocks, if else, looping, while and for, do while, switch, block and continue statements, go to and labels, nested control structures, comma operator. Functions returning non-integer, external variable, scope rules, header files, static variables, register variables, block structures, initialization, recursion, C pre processor, storage classes.

Arrays and Pointers: Definition, processing an array, passing arrays to function, multidimensional array, arrays and strings, command line arguments, pointers, pointers to function, pointers and one dimensional arrays, dynamic memory allocation, array of pointers, passing functions to other functions.

Structures and Unions: Structure basics, structures and functions, array of structures, pointers to structures, self referential structures, table lookup, typedef, unions, files, creating a data file, enumerators, bit wise operation.

File structures: Definitions, concept of record, file operations: Storing, creating, retrieving, updating Sequential, relative, indexed and random access mode, Files with binary mode(Low level), performance of Sequential Files, Direct mapping techniques: Absolute, relative and indexed sequential files (ISAM) concept of index, levels of index, overflow of handling.

File Handling: File operation: creation, copy, delete, update, text file, binary file.

Recommended Books:
- Lets C, Y. Kanitkar, BPB
- Programming with C, Gottafried, Schaum Series
- C The Complete Reference, Scholdt, TMH
- Programming with C, S. Kaicher, Macmillan
- Programming in ANSI C, Balagurusamy, TMH
- C For Yourself, Asian Inst. of Tech AIT
- Structured Programming Approach Using C, B. Forouzen, Thomas Learning

Introduction to Programming using 'C'

CSL 1021 **3 – 0 – 0 = 3**

Fundamentals: Introduction to C, data types, constants, variables, declarations, expression statements, arithmetic operations, unary operations, relational and logical, conditional, library functions, single character input and output, entering and writing data.

Control Statements and Functions: Statement and blocks, if else, looping, while and for, do while, switch, block and continue statements, go to and labels, nested control structures, comma operator. Functions returning non-integer, external variable, scope rules, header files, static variables, register variables, block structures, initialization, recursion, C pre processor, storage classes.

Arrays and Pointers: Definition, processing an array, passing arrays to function, multidimensional array, arrays and strings, command line arguments, pointers, pointers to function, pointers and one dimensional arrays, dynamic memory allocation, array of pointers, passing functions to other functions.

Structures and Unions: Structure basics, structures and functions, array of structures, pointers to structures, self referential structures, table lookup, typedef, unions, files, creating a data file, enumerators, bit wise operation.

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- Programming with C, S. Kaicher, Macmillan
- Programming in ANSI C, Balagurusamy, TMH
- C For Yourself, Asian Inst. of Tech AIT
- Structured Programming Approach Using C, B. Forouzen, Thomas Learning

Basic Computer Lab

CSP 1011 **0 – 0 – 2 = 1**

Note: A student is required undergo training in the following areas:
- Introduction to Windows & MS-office software
- Introduction to the components of a PC.
- Assembling of a PC.
- Basic trouble shooting of a PC.
- Software Installation (both system and application software's).

Programming Lab

CSP 1021 **0 – 0 – 2 = 1**

Note: A student is required to perform a minimum of five experiments
1. Basic program in Sequential Statement in C
2. Program on Selection Control structure (quadratic equation, max. of 3 no.'s)
3. Program of multiway control structure (Switch Case)
4. Program of different types of loops nested loops.
5. Program on function (Parameter passing - call by value)
6. Recursion (Tower of honor, Fibonacci Series) Program.
7. Program on string manipulation (string length, string copy, string concat) with or without string function.
8. Program on 1-D/2-D Arrays (Sorting techniques, matrix manipulations)
9. Program on pointers
10. Program on structure
11. Program on unions
12. Program on file handling.

Computer Organization & Architecture

CSL 2061 **3 – 1 – 0 = 4**

Introduction: Overview of Digital Fundamentals

Register Transfer and Microoperation: Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations.

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing & Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupts, Design of Basic Computer, Design of Accumulator Logic.

Microprogrammed Control Unit: Control Memory, Address Sequencing.

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes.

Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating Point Arithmetic Operation, Decimal Arithmetic Unit, Decimal Arithmetic Operations.

Input–Output Organization: Peripheral devices, Input – Output interface, Asynchronous Data Transfer, Modes of Data Transfer, Priority Interrupt, Direct Memory Access, Input – Output Processor.
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.
Multiple Process Organization: Flynn's classification of parallel processing systems, pipelining concepts.

Recommended Books:
- Computer System and Architecture, Mano, M , PHI
- Computer Organization & Design, Pal Chaudhuri, P., PHI
- Digital Computer Electronics: An Introduction to Microcomputers, Malvino
- Digital Principles and Applications, 4/e ,Malvino , M G Hill
- Computer Architecture and Organization, Hayes. J.P , M G Hill
- Computer Organization & Architecture, Stallings, W , PHI

Data Structures

CSL 2031 **3 – 0 – 0 = 3**

Introduction to programming methodologies and design of algorithms.
Structured programming concepts
Study and implementation of basic data structures like:
- Arrays, multidimensional arrays and their organization, introduction to sparse arrays
- Linked list (singly, doubly and circular)
- Stacks
- Queues

Evaluation of arithmetic expressions using stacks and binary trees.
Searching: Sequential and binary searching.
Sorting: Insertion, selection, shell, merge and quick sort
Introduction to file structures: Sequential, Indexed, Indexed sequential
B-trees, B+ trees, AVL trees.
Hashing techniques
Introduction to graphs and graph traversal methods.

Recommended Books:
- Data structures , Lipshutiz, Shaum series
- Data structures & program design, R Kurse, PHI
- Data structures: A pseudo code approach with C, R F Gilbarg, Thomson

Data Structure Lab

CSP 2031 **0 –0 – 2 = 1**

List of Experiments
1. Strings and files in C
2. Implementation of stack and its operations
3. Implementation of Q and its operations
4. Implementation of circular Q and its operations
5. Array and dynamic implementation of linked list and its operations
6. Binary tree, implementation, creation, insertions and deletion of nodes in an existing tree

Theory of Computation

CSL 2041 **3 – 1 – 0 = 4**

Turning Machine(TM) - Model, Computable Languages and Functions, TM construction technique, Modification of TM, Church's Hypothesis; Undecidability – The Problem, Properties of Recursive & Recursively Enumerable Languages, Universal TM, Rice's Theorem, Post's Correspondence Problem; Intractable Problems, Polynomial Time and Space, The class P and the other problems, Boolean Satisfiability, The class NP , Polynomial-time Reduction, Introduction to Cook's Theorem, Some NP-Complete problems.

Recommended Books:
- Elements of The Theory of Computation Lewis & Papadimitriou Pearson
- Theory of Computer Science (Automata, Languages and Computation) Misra & Chandrasekaran, PHI
- Introduction to Languages and the Theory of Computationq, John C. Martin, TMH.
- Introduction to Automata Theory, Languages and Computation, Hopcroft & Ullman, Narosa Publication

Operating System

CSL 2051 **3 – 0 – 0 = 3**

Introduction to OS: Processor management, memory management, file system management, system calls.
Memory management: Single user contiguous: protection; fixed partition multiprogramming; protection, fragmentation, relocation; variable partition multiprogramming: compaction, storage placement strategies; multiprogramming with storage swapping; paging: segmentation; paging and segmentation together; virtual memory: page replacement and strategies, locality, working sets, page fault frequency, demand paging, optimization technique.
Processor management: Scheduling levels, quantities to be optimized , preEMEPtive/non preEMEPtive, interrupting clock, FIFO , shortest job first, shortest remaining job first, round robin, priority, multilevel queues, multilevel feedback queues.

File systems: directory organization, functions, data hierarchy, blocking and buffering, file organization, free space management, allocation techniques: contiguous, non contiguous; sector oriented linked; block: block chaining , index block chaining, block oriented file mapping;
Device management: types: block, character; PIO, DMA, I/O channels, virtual devices.
Dead locks: Resource concepts, necessary conditions, resource allocation graph, deadlock prevention: three strategies of Havender, deadlock avoidance: Bankers algorithm, deadlock detection: reduction of resource allocation graph, deadlock recovery.

Concurrent processes: Mutual exclusion and Bernstein's conditions, Fork/Join construct, PARBEGIN/PAREND construct; semaphores: use of semaphores to complement PARBEGIN/PAREND; critical section problem ; 2 process critical section problem and solution, both H/W and S/W; monitors; message passing ; case studies: dining philosophers problem, reader writer problem and disk head scheduler problem.
Disk scheduling: operations of disks, quantities to be optimized, seek optimization : FCFS, SSTF, SCAN, C-SCAN, M-STEP SCAN, Eschenbach; rotation optimization, system consideration, disk caching and other optimizations.

Recommended Books:
Operating system concepts : Silberschatz, Addison Wesley Longman
Modern Operating Systems : Tanenbaum, PH(I)
Operating systems : H.M.Deitel, Addison Wesley Longman
Operating systems : Madnick and Donovan, McGraw-Hill I.E.

Object Oriented Programming

CSL 2022 **3 – 1 – 0 = 4**

Principles of Object Oriented Programming
The Traditional Approach, Shortcoming of procedure oriented languages, Basic concepts of Object Oriented Programming, Benefits of OOP, Object Oriented Languages
Overview of Programming Basics
Input/Output using cin/cout, processor directives, basic and user defined data types, operators, loops, decision making, control statements, functions, pointers to functions
Classes
Definition, Class objects, Class member functions, Static Class Members, Class Scope, Nested Classes, Local Classes, Composite class, Constructor, Destructor, Friends, *this* Pointer
Operator Overloading
Overloading unary and binary operators, Special operators : Operator [ ], ( ), →, ++ and --, << and >>
Inheritance and Polymorphism
Class hierarchy : Definition, Identifying the members of the hierarchy, Base class member access, Base and derived class construction, Member wise initialization and assignment, virtual functions, multiple inheritance, class scope under inheritance, virtual classes.
Templates
Class Templates, Function Templates
Exception Handling
Throwing, The try…..catch block, Exception specifications

Recommended Books:
Object Oriented Programming with C++ ANSI/ISO Standards, R. Subburaj

Operating System Lab

CSP 2051 **0 – 0 – 2 = 1**

Students will be required to do at least 10 experiments based on the following topics:-
Two on memory management,
Two on virtual memory,
Two on CPU scheduling,
Two case studies of existing OS,
Two on file systems.

Object Oriented Programming Lab

CSP 2022 **0 – 0 –2 = 1**

1. Simple C++ Program.
2. Programs on Function overloading.
3. Programs on Operator overloading.
4. Programs on Inheritance.
5. Virtual functions and Dynamic binding.
6. Templates.
7. File Handling.
8. Exception handling.

Design and Analysis of Algorithms

CSL 3032 **3 – 0 – 0 = 3**

Introduction: Definition of algorithm, algorithm specification, performance analysis: Time and space analysis, Asymptotic, recurrence relations.

Design of Efficient algorithms: Graphs, trees, recursion, divide and conquer, balancing, dynamic programming.

Sorting: Merge sort, Heaps and maintaining the heap properties, building a heap, Heap sort, Quicksort: algorithm, performance and anlaysis, Sorting without comparison: Radix sort, counting sort, bucket sort.
Some data structures: Hash tables, hash functions, Open addressing, Binary search trees-insertion and deletion, Balanced trees: AVL trees, m-way trees, B Trees, 2-3 Trees, Binomial heaps: Binomial trees and operations on binomial heaps.
Advanced design and analysis Techniques: Dynamic programming: Definition, Matrix-chain multiplication, Optimal binary search trees, Longest common subsequence, 0-1 knapsack problem.
Greedy algorithms: Definition, Fractional knapsack problem, Huffman coding, Task-scheduling problem.
Divide and conquer algorithm: Definition, Strassen's matrix multiplication, finding minimum and maximum from an array.
Backtracking: Definition, n-queens problem, sum of subset problem.
Graph algorithm: Elementary graph algorithms, Breadth-first and Depth-first search, Minimum spanning trees: Prim's and Krushkal's algorithm, Single source shortest path problem, Bellman-Ford algorithm, Floyd-Warshall algorithm, Johnson's algorithm.Integer and Polynomial arithmetic:Polynomial addition and multiplication.

Recommended Books:
- Introduction to Algorithm, TH Corman, Charles E, PHI
- The design and anal. Of Comp. Algorithms Aho, Hopcroft, Ullman Addition Wesley
- Computer Algorithms, Galgotia., Horowitz, Sahni and Rajsekaran
- Data Structure, Tata McGraw Hill , Lipschuitz
- Fundamentals of Data Structures, Galgotia , Horoqwitz, Sahni .

Introduction to Data Structures with C

CSL 2035 **2 – 0 – 2 = 3**

Introduction to programming methodologies and design of algorithms.
Structured programming concepts
Study and implementation of basic data structures like:
Arrays, multidimensional arrays and their organization, introduction to sparse arrays
Linked list (singly, doubly and circular)
Stacks
Queues
Searching: Sequential and binary searching.
Sorting: Insertion, selection, shell, merge and quick sort
Introduction to trees and graphs and traversal methods.
Introduction to Files

List of Experiments
1. Implementation of Strings (with and without using functions)
2. Implementation of stack and its operations
3. Implementation of Q and its operations
4. Array and dynamic implementation of linked list and its operations
5. Implementation of searching and sorting techneques

Recommended Books:
- Data structures , Lipshutiz, Shaum series
- Data structures & program design, R Kurse, PHI
- Data structures: A pseudo code approach with C, R F Gilbarg, Thomson

System Programming

CSL 3052 **3 – 0 – 0 = 3**

Unit-1: Introduction
Introduction to Unix operating system, Kernel, Shell, Files and directories, System calls, Editors.
Unit-II
Portability with C, Processes, Background processes, Process Synchronization, sharing of data, User id, groupid, pipes, fifos, message queues, semaphores, shared variables, introduction to Socket programming.
Unit-III Files and System Calls
Root File system, Boot Block, super Block, Inode Table, data Block, File Permissions, data Security and Suid Bit, Links, F_Test, Locking, Deadlocking, signals, SIGHUP, SIGCHLD, SIGALM, KILL, mknod(), Nice(), memcpy(), getpass(), nice(), clock(), ioctl()
Unit-IV System tools and Debuggers
System Development tools: lint, make, SCCS; Language Development tools: yacc, LEX, M4; Text Formatting Tools: nroff, troff, tbl, eqn, pic Debubugger tools Dbx, Adb, strip, Ctrace.

Recommended Books:
C Odyssey, Ravi sethi, BPB Publication
Unix Concept and app., Sumit Abha Das, TMH
Design of UNIX OS, Maurice J bach, PHI

Java Programming

CSL 3023 **3 – 1 –0 = 4**

Principles of Object Oriented Programming with Introduction to JAVA

The Traditional approach, drawback of procedure oriented languages, the three basic constructs of OOPS including abstraction and encapsulation, inheritance and polymorphism, comparison of various object oriented languages, Need of java, The creation of java, Basic differences of java and c++, byte code, difference between JDK, JRE, JVM, java applets and applications, java buzzword, three basic constructs of oops applicable to java.

Data types, variables, and Arrays

Classification of various data types used in java(including Integer, float, characters, Boolean), closer look at the literals used in java, defining and initialization of variables, type conversion and casting, automatic type promotions in expressions, arrays(one dimensional and multidimensional).

Operators and control statement

Arithmetic operators, bitwise operators, relational operators, Boolean logical operators, assignment operator,? operator, operator precedence, java's selection statement(if, switch statement), iteration statement(while, do-while, for, nested loops) Jump statement (break, continue).

Classes and Methods

Class fundamentals, declaring objects, assigning object to reference variables, constructors (default and parameterized), this keyword, garbage collection, finalize keyword, method introduction and returning a value from a method, overloading method, overloading constructor, object as parameter, returning objects, recursion, understanding static keyword, final keyword, introduction to inner and nested classes, exploring String class, using command line argument.

Inheritance and package introduction and Exception Handling

Inheritance basic, use of super, method overriding, abstract class, Object class, defining a package, access protection, importing a package, introduction to interface, defining a interface, applying a interface, variables in interface, extension of interface, fundamentals of Exception handling, types of exception, use of try and catch, nested try block, throw, throws, finally keywords, java's built in exception, creating your own exception.

Multithreaded Programming and I/O

The java thread model, thread priorities, synchronization, crating a thread, creating multiple thread, using is Alive() and join(),Synchronization in multiple thread, I/O basics, streams(byte and character), reading and writing console input and output, Reading and writing files.

Applet, Event Handling, and AWT

Applet fundamentals, applet architecture, Applet skeleton, passing parameter to applet, Delegation event model, Exploring all Event Classes, Event Listener interface, Adapter class, Anonymous inner class, Window fundamentals, working with frame window, working with graphics, working with color, fonts, layout managers, using of buttons, checkbox, choice lists, lists, scroll bar, text fields, text area, menu bars and menus, and handling the corresponding events generated by above components.

Recommended Books:

1. The complete Reference Java2(Fifth Edition),Herbert Schildt: TMH
2. Java how to program(Sixth Edition), Deitel and Deitel : PHI Publication
3. Programming with Java, E.Balagurasamy :TMH publication

Java Programming Lab

CSP 3023 **0 – 0 –2 = 1**

1. Simple Java Program.
2. Programs on Function overloading.
3. Programs on Operator overloading.
4. Programs on Inheritance.
5. Virtual functions and Dynamic binding.
6. Templates.
7. File Handling.
8. Exception handling.

Computer Networking & Communication

CSL 3071 **3 – 1 – 0 = 4**

Introduction: Uses of Computer Networks, Network Architecture, Reference Model (ISO-OSI, TCP/IP-Overview, IP Address Classes, Subneting), Domain Name Registration & Registrars

The Physical Layer: Theoretical basis for data communication, transmission media-Magnetic Media, Twisted Pair, Baseband Coaxial Cable, Broadband Coaxial Cable, Fibre Cable, Structured Cabling, Cable Mounting, Cable Testing, Wireless transmission, the telephone system, narrowband ISDN, broadband ISDN and ATM.

The Data Link Layer: Data link layer design issues, error detection and correction, data link protocols, sliding window protocols, Examples of Data Link Protocols.

The Medium Access Sublayer: The channel allocation problem, multiple access protocols, IEEE standard 802 for LANS and MANS, high-speed LANs, satellite networks, Network devices-repeaters, hubs, switches and bridges.

The Network Layer: Network layer design issues, routing algorithms, congestion control algorithm, internetworking, the network layer in the internet, the network layer in ATM networks.

The Transport Layer: A simple transport protocol, internet transport protocols, UDP, introduction to TCP, service model, TCP connection establishment, transmission policy, congestion control, timer management, wireless TCP and UDP, transactional TCP.

The Application Layer: HTTP, electronic mail, SNMP, SMTP, DNS.

Recommended Books:

- Computer Networks, 3 rd Ed, Tananbaum A.S, PHI
- Computer Networks-Protocols, Standards and Interfaces, Black U. PHI
- Computer Communication Networks, Stallings W. , PHI
- Data communication and networking, B. F. Ferouzan, TMH

Design & Analysis of Algorithms Lab

CSP 3032 **0 – 0 – 2 = 1**

The lab implements most of the algorithms of this subject in C language.

Network Lab

CSP 310B **0-0-2=1**

The School is planning to purchase a software Netsim which provides practical aspects of the Thereotical concepts in Networking. The Software will provide Real time hands on exposure to the Students of BTech on Various protocols of Networking.

Artificial Intelligence

CSL 3101 **3-0-0 = 3**

The course aims to provide an understanding of the diverse branches of AI through a discussion of its theoretical foundations. At the end of the course the students shall have in-depth understanding of different knowledge representation formalisms and various techniques used for "reasoning" and "theorem proving".

1) Introduction: AI History and applications. Overview of AI application areas: game playing, automated reasoning and theorem proving, expert systems, natural language understanding, planning and robotics, machine learning and Alan Turing Test.

2) The Propositional and Predicate Logic: Symbol and sentences, the semantics of the Propositional Calculus & Predicate Calculus. Inference Rules and Theorem Proving. Axioms, Literals, Horn clause & Clausal forms.

3) Reasoning: Inductive, Deductive, Abductive and Default reasoning. More examples on Resolution proof.

4) Problem Solving as Search: **Structures and strategies for state space search. Algorithms for Heuristic search, Heuristic evaluation functions.**

5) Knowledge Representation: knowledge representation Techniques; conceptual graphs; structured representations; frames, scripts; issues in knowledge representation: hierarchies, inheritance, exceptions.

6) Knowledge Elicitation and Knowledge Acquisition: An overview of the induction methods, types and tools. Stages in Knowledge acquisition with examples. Analyzing, coding, documenting and diagramming. Scope of knowledge.

7) **Expert Systems:** Overview of expert system technology; rule-based expert systems; Construction of ES. Components of an ES, The explanation facility, Rule-based formation and forward and backward chaining techniques for problem solving.

8) Natural Language Processing: Introduction. Vocabulary and issues, How NLP programs work, Natural Language application, NL Interfaces.

Recommended Books:

1. Artificial Intelligence - A New Synthesis by Nils J. Nilsson, Morgan Kaufmann Publishers.
2. Artificial Intelligence: Strategies and techniques for complex problems solving by George Luger, Addison-Wesley, 2003.

3. Artificial Intelligence - A Modern Approach by Stuart Russell & Peter Norvig, Prentice Hall.

Software Engineering

CSL 3091 **3 – 0 – 0 = 3**

UNIT 1: Introduction: The role of Software, Software Characteristics, Industrial strength software, Classification of software products, Legacy Software, Software Engineering Challenges, Software Development Life Cycle.

UNIT 2: Software Process: Software Development Process Models**:** Waterfall, Prototyping, Iterative, Spiral. Comparison of Models, Project Management Process, Inspection Process, Software Configuration management Process, Requirements Change management Process, Agile Process.

UNIT 3: Feasibility Study, Requirements Engineering & Analysis Modeling: Feasibility study: Technical, Economic & Behavioral; Data Gathering: Sources of Data, Observation, Interviewing, Questioneers, On-site Observation, Software Process & Characteristics, Software Requirements, Problem Analysis**:** Data Flow Modeling, Object Oriented Modeling, Prototyping, Cost Benefit Analysis, SRS, Developing Use Cases. Validation & Metrics

UNIT 4: Planning Software Projects: Effort Estimation**:** Constructive Cost Model (COCOMO), Project Scheduling, SCM planning, Quality Planning, Risk Management, Project Monitoring Planning

UNIT 5: Design Engineering: Design Concepts & Principles, Cohesion, Coupling, Design Methodology, Introduction to Unified Modeling Language (UML), Verification, Metrics

UNIT 6: Coding & Testing: Programming principles, Coding Conventions, Coding process, Refactoring, Verification, Coding Metrics, Test Cases, Test Plan, White box & Black box testing, Unit Testing, Integration Testing, Validation Testing**:** Alpha & Beta Testing, System Testing, Debugging, Testing Metrics

UNIT 7: Reliability, Quality & Maintenance: Software Reliability & Metrics, ISO 9000 Standard, Capability Maturity Model, CASE Tools, User Training, Software Maintenance

Recommended Books:

- Software Engineering: A practitioner's Approach, Pressman,6th Ed., McGraw Hill

- System Analysis & Design, Elias M Awad
- Fundamentals of Software Engineering. , Ghezzi, C ,PHI
- Managing the Software Process ,W S Humphrey Addison–Wesley
- Ed. Encyclopedia of Software Engineering., Vols 1&2 , J J Marciniak, John Wiley
- Software Engineering, 5th Edition, Sommerville Ian Addison Wesley.
- Software Engineering., Manmdrioli, Dino
- Software Engineering:A programming Approach,3rd Edition, Bell, Douglas
- An integrated Approach to Software Engineering. ,Jalote, P ,Narosa Pub House

Visual Programming

CSL 3034 **3 – 1 – 0 = 4**

UNIT 1 Object Oriented Design with Visual Basic.Net: Structured Vs. Object Oriented Approach, Modern Programming Approach, Introduction of Object Oriented Languages and Explanation Concepts Such as Data Abstraction, Inheritance, Exception Handling, Concurrency Mechanism, etc with context to Visual Basic.Net

UNIT 2 : Developing VB.Net Window Applications using Visual Studio .NET: Introduction to Software Engineering, Development of VB.Net Window Application Project using Visual Studio .NET, Adding window controls, Access data by using the built-in data access tools in Visual Studio .NET, and the integration of VB.Net with them., use of Microsoft ADO.NET to access data in a Window application., Configuration and deployment of an VB.Net application

UNIT 3 Developing ASP.NET Web Applications using Microsoft Visual Studio .NET: Create an ASP.NET Web Application Project by using Visual Studio .NET. Adding server controls and web page functionality to an ASP.NET page, using the debugging features of Visual Studio.NET, Use of validation controls to validate user input, Access data by using the built-in data access tools in Visual Studio .NET, Overview of .NET technologies and how ASP.NET integrates with them., use of Microsoft ADO.NET to access data in a Web application., Configuration and deployment of an ASP.NET application..

Recommended Books:

- Microsoft Visual Basic .NET Step by Step (Microsoft) by Michael Halvorson, Pearson
- Microsoft Visual Basic .NET The Complete Reference by TMH
- Microsoft Visual Basic .NET Programmer Cookbook by Matthew MacDonald, TMH
- Beginning VB.NET Databases by Thearon Willis, TMH
- ASP.Net with Web Design The Complete Reference" by Powell from TMH
- ASP.Net by Duthie from TMH

Database Management System

CSL 3081 **3 – 1 – 0 = 4**

Introductory Database Concepts: Introduction to data processing, overview of files and file systems, drawbacks of files systems, concept of a database, data abstraction and data independence, data models, database language, database users and administrators, transaction management, database system structure.
Entity Relationship Model: Basic concepts, constraints, design issues, entity relationship diagram, week entity sets, extended ER features, design of ER database schema, reduction of ER schema to tables.
Relational Model: Concept of a relation, primary and secondary keys, foreign keys, structure of relational databases, the relational algebra and extended relational algebra operations, formulation of queries, modification of the database, views.
SQL: Background, basic structure, set operations, aggregate functions, null values, nested queries, views, complex queries, database modification, DDL, embedded SQL, stored procedures and functions, dynamic SQL, other SQL features.
Integrity & Security: Domain constraints, referential integrity, assertions, triggers, triggers and assertions in SQL, security in authorization in SQL.
Relational Database Design: First normal form, pitfalls in relational database design, functional dependencies, decomposition, desirable properties of decomposition, boyce codd normal form, third and fourth normal forms, other normal forms.
Transactions: Transaction concept, transaction state, implementation of atomicity and durability, concurrent executions, serializability, recoverability, implementation of isolation, transaction definition in SQL.
Concurrency Control: Lock based protocols, timestamp based protocols, validation based protocols, multiple granularity, multiversion schemes, deadlock handling, inset and delete operations.
Recovery Systems: Failure classification, storage structure, recovery and atomicity, log based recovery, shadow paging, recovery with concurrent transitions, buffer management.
Recommended Books:
Principles of Database System, Ullman , Galgotia.
Database System Concepts,Silberschatz, Korth & Sudarshan, McGraw Hill.
Database Management Systems , Raghu Ramakrishnan, McGraw Hill.
Fundamentals of Database Systems , Elmasri &Navathe Addison Wesley

Software Engineering Lab

CSP 3091 **0 – 0 – 2 = 1**

- Hands on experience to the Industry Standard tools for Software engineering e.g. Rational Suite Enterprise.
- Students are required to do a project following the Industry Oriented methodologies taught in Software Engineering course

Visual Programming Lab

CSP 3034 **0 – 0 – 2 = 1**

Design problems using Microsoft Visual Basic.Net & ASP.Net

Database Management System Lab

CSP 3081 **0 – 0 – 3 = 1.5**

At least ten practical assignments in SQL which will include basic SQL, advanced SQL. Programs will also include use of embedded SQL store procedures, triggers and assertions. A small application to be designed and implemented for OODBMS.

Data Communication & Computer Networks

CSL 3076 **3 – 0 – 0 = 3**

Analog and digital conversion, Digital to Analog conversion, Digital data transmission, DTE – DCE Interface, EIA-449, EIA-530, X.21, Modems, Cable Modems.

FDM, WDM, TDM, Multiplexing application – telephone systems, DSL, Par Circuit switching Packet Switching & Message switching virtual circuits.

Uses of Computer Networks, Network Hardware, Network Software.
Seven-layer OSI architecture of ISO, concepts of layer protocols and layer interfaces, TCP/IP reference model, comparison of OSI &TCP/IP reference models.

Physical Layer: Transmission media , telephone system (structure, trunks , multiplexing and switching), wireless transmission

Data Link Layer: Design Issues, Error detection and correction , elementary data link protocols , sliding window protocols

Medium Access Sub layer: The channel allocation , IEEE standards 802 for LAN & MAN.

Network Layer: Design issues, routing algorithms, Congestion control Algorithms, IP protocol, IP addresses, Sub nets.

Transport Layer: Transport Services, Elements of Transport protocols, TCP service Model , protocol, Header.

Application Layer: Network security , DNS . E-mail , world wide web, multimedia.

Recommended Books

- Data Communications and Networking" – Behrouz A Ferouzan – 2nd Edition, TATA McGraw Hill.
- Data and Computer Communication" – William Stallings – 7th Edition, Pearson Education.
- Computer Networks by Andrew S. Tanenbaum, Prentice Hall of India
- Data Communication and Distributed Networks– Ulylers D Black – 3rd Edition PHI.
- Data Communication by Miller

Colloquium

CSC 4001 **0 – 3 – 0 = 3**

Contents: The students will deliver talks on their experience during the 50 working days of practical training and topics of current interest in the computer science and engineering field. These would include technology, research as well as standards issues.

Compiler Design

ECSL 4053 **3 – 1 – 0 = 4**

Introduction: Issues related to programming Language Design, Issues relatd to Finite-State Machines, Phases of Compiler Design, Lexical Analysis, Error Detection and Recovery.
Basic Parsing Techniques: Parsers, Shift-Reduced Parsers, Operator-Precedence Parsing, Predictive Parsers.
Top-Down Parsing, Bottom-up Parsing: LL(1) Grammars, Recursive Descent Parsers, LR Grammars – Concepts and Terminology, LR(O) Parsers, SLR(1) Parsers, Canonical LR(1) Parsers, LALR(1) Parsers, using ambiguous grammar. Attributed Translation Grammar, L-Attributed Translation Grammar.
Syntax-Directed Translation (SDT): SDT Schemes, Implementation of SDTs, Intermediate Code, Parse Trees and Syntax Trees. Three Address Code, Quadruples and Triples. Translation schemes for DECSLarations, Assignment statements, Boolean Expressions, Flow of control statements, Array references in Arithmetic Expressions, Procedure Calls, Case Statements, and |Structures.
Semantic Analysis & Type Checking: Introduction, Implicit-Stacking in Recursive Descent Compilation, Semantic Stacks in Bottom-up Compilation, Action-Symbols in Top-Down Compilation, Type Expressions, Overloaded Functions, Polymorphic Functions.
Symbol Table Handling Techniques: When to construct and Interact with the symbol Table, Symbol-Table Contents, Operations on symbol Table. Symbol Table organizations for Block – Structured Languages.
Run-Time Storage Organization and Management: Static Storage Allocation, Dynamic Storage Allocation, Heap Storage Allocation, Garbage Collection and Compaction.
Code Optimization: Principal sources of Optimization, Loop Optimization, Loop-Invariant Computation, Induction variable elimination, Other Loop Optimizations, The DAG representation of Basic Blocks. Global Data – Flow Analysis.

Code Generation: Object programs, Problems Code Generation, A simple Code Generator. Register Allocation and Optimization, Code Generation from DAG, PEECPhole optimization.

Recommended Books:
- Principles of Compiler Design; A. V. Aho & J. D. Ullman Narosa
- The Theory and Practice of Compiler Writing, J Tremblay and Paul G. S.

Computer Graphics

CSL 4111 **3 – 0 – 0 = 3**

Graphics pipeline; Graphics hardware: Display devices, input devices; Raster Graphics; line and circle drawing algorithms; Windowing and 2D/3D clipping. Cohen and Sutherland line clipping, Cyrus Beck clipping method; 2D and 3D Geometrical Transformations: scaling, translation, rotation, reflection; Viewing Transformations: parallel and perspective projection; Curves and Surfaces: cubic splines, Bezier curves, B-splines, Parametric surfaces. Surface of revolution Sweep surfaces, Fractal curves and surfaces; Hiddenline/surface removal methods; illuminations model; shading: Gouraud, Phong; Introduction to Ray-tracing; Animation; Programming practices with standard graphics libraries like openGL

Recommended Books:
- Procedural elements of computer graphics, D F Rogers, TMHl
- Mathematical Elements for Computer Graphics Rogers, Adams, TMHl
- Introduction to Computer Graphics, Foley, Dam, Phillips, Feiner, Addison Wesley
- Computer Graphics: C Version, D Hearn and M P Baker, Prentice Hall

CSL 4121 **Computer Network Security** **3 – 0 – 0 = 3**

1. **Introduction:**
Attacks, Services and Mechanisms, Security Attacks, SecurityServices, Integrity check, digital Signature, authentication, hasalgorithms.
2. **Secret Key Cryptography:**
Block Encryption, DES rounds, S-BoxesIDEA: Overview, comparison with DES, Key expansion, IDEArounds, Uses of Secret key Cryptography; ECB, CBC, OFB,CFB, Multiple encryptions DES.
3. **Hash Functions and Message Digests:**
Length of hash, uses, algorithms (MD2, MD4, MD5, SHS) MD2:Algorithm (Padding, checksum, passes.) MD4 and 5: algorithm(padding, stages, digest computation.) SHS: Overview, padding,stages.
4. **Public key Cryptography:**
Algorithms, examples, Modular arithmetic (addition,multiplication, inverse, and exponentiation) RSA: generatingkeys, encryption and decryption. Other Algorithms: PKCS,Diffie-Hellman, El-Gamal signatures, DSS, Zero-knowledgesignatures.
5. **Authentication:**
Password Based, Address Based, Cryptographic Authentication. Passwords in distributed systems, on-line vs offline guessing, storing. Cryptographic Authentication: passwords as keys, protocols, KDC's Certification Revocation, Interdomain, groups, delegation. Authentication of People: Verification techniques, passwords, length of passwords, password distribution, smart cards, biometrics.
6. **Security Policies and Security Handshake Pitfalls:**
What is security policy, high and low level policy, user issues? Protocol problems, assumptions, Shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonce and sequence numbers, session keys, one-and two-way public key based authentication.
7. **Example System:**
Kerberos: purpose, authentication, serer and ticket granting server, keys and tickets, use of AS and TGS, replicated servers. Kerberos V4: names, inter-realm authentication, Key version numbers. Kerberos V5: names, realms, delegation, forwarding andproxies, ticket lifetimes, revoking tickets, multiple Realms.
8. **Network Security:**
Electronic mail security, IP security, Network management security.
9. Security for electronic commerce: SSL, SET
10.**System Security:**
Intruders and Viruses, Firewalls, Intrusion Detection

Recommended Books:
1. Kaufman, c., Perlman, R., and Speciner, M., Network Security,Private Communication in a public world, 2nd ed., Prentice Hal PTR., 2002.
2. Stallings, W.,.Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003.
3. Stallings, W. Network security Essentials: Applications and standards, Prentice Hall, 2000.
4. Cryptography and Network Security; McGraw Hill; Behrouz A Forouzan.
5. Information Security Intelligence Cryptographic Principles and App. Calabrese Thomson.
6. Securing A Wireless Network Chris Hurley SPD

Computer Graphics Lab

CSP4111 **0-0-2 = 1**

Implementation of the Line, Circle and Ellipse generation algorithms, Solid Area Scan Conversion algorithms, Clipping algorithms, Rendering, @-D and 3-D transformations, SPMLines and Bezier Curves.
C/C++/PHIGS/OPENGL may be used for the implementation.

Mini Project

ECSD 4002 **0- 0-6 = 3**

Contents: Design/implementation work under the guidance of a faculty member. Prior to registration a detailed plan of work should be submitted by the student to the Director of the School for approval by faculty board.

Major Project

ECSD 402B **0-0-24 = 12**

Contents: During the course of this project the students are expected to work towards the goals and milestones set in their problem definition. At the end there would; be a demonstration of the project and also the possible future work on the same problem. A dissertation outlining the entire problem, including a survey of literature and the various results obtained along with their solutions is expected to be produced.

Data Mining & Warehousing

CSE 3082 **3 – 0 – 0 = 3**

Module - I

Data Mining : Introduction, Relational Databases, Data Warehouses, Transactional databases, Advanced database Systems and Application, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining.

Module - II

Data Warehouse : Introduction, A Multidimensional data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, From Data warehousing to Data Mining.

Module - III

Data Processing : Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept Hierarchy Generation.

Data Mining Primitives, Languages and System Architecture : Data Mining Primities, DMQL, Architectures of Data Mining Systems.

Module – IV

Concept Description : Data Generalization & Summarization – Based Characterization, Analytical Characterization, Mining class Comparisons, Mining Descriptive Statistical Measures in Large Databases.

Module - V

Mining Association Rules in Large Databases : Association Rule Mining, Single – Dimensional Boolean Association Rules, Multilevel Association Rules from Transaction Databases, Multi Dimensional Association Rules from Relational Databases, From Association Mining to Correlation Analysis, Constraint – Based Association Mining.

Module - VI

Classification and Prediction : Classification & Prediction, Issues Regarding Classification & Prediction, Classification by decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification based on concepts & Association Rule, Other Classification, Prediction, Classification Accuracy.

Module - VII

Cluster Analysis : Types of Data in Cluster Analysis, Partitioning methods, Hierarchical methods, Density – Based Methods, Grid – Based Methods, Model – Based Clustering Methods, Outlier Analysis.

Mining Complex Types of Data.

Text Books :

1. Jiawei Han & Micheline Kamber - Data Mining Concepts & Techniques
   Publisher Harcout India. Private Linited.

Recommended Books :

1. G.K. Gupta – Introduction to Data Mining with case Studies, PHI, New Delhi – 2006.
2. A. Berson & S.J. Smith – Data Warehousing Data Mining, COLAP, TMH, New Delhi – 2004
3. H.M. Dunham & S. Sridhar – Data Mining, Pearson Education, New Delhi, 2006.

Storage Networks

CSE 3072 **3-0-0=3**

Section 1 Introduction to Storage Technology

Data proliferation and the varying value of data with time & usage, Sources of data and states of data creation, Data center requirements and evolution to accommodate storage needs, Overview of basic storage management skills and activities, The five pillars of technology, Overview of storage infrastructure components, Evolution of storage, Information Lifecycle Management concept, Data categorization within an enterprise, Storage and Regulations

Section 2 Storage Systems Architecture

Intelligent disk subsystems overview, Contrast of integrated vs. modular arrays, Component architecture of intelligent disk subsystems, Disk physical structure- components, properties, performance, and specifications, Logical partitioning of disks, RAID & parity algorithms, hot sparing, Physical vs. logical disk organization, protection, and back end management, Array caching properties and algorithms, Front end connectivity and queuing properties, Front end to host storage provisioning, mapping, and operation, Interaction of file systems with storage, Storage system connectivity protocols

Section 3 Introduction to Networked Storage

JBOD, DAS, SAN, NAS, & CAS evolution, Direct Attached Storage (DAS) environments: elements, connectivity, & management

Storage Area Networks (SAN): elements & connectivity, Fibre Channel principales, standards, & network management principles, SAN management principles
Network Attached Storage (NAS): elements, connectivity options, connectivity protocols (NFS, CIFS, ftp), & management principles, IP SAN elements, standards (iSCSI, FCIP, iFCP), connectivity principles, security, and management principles,
Content Addressable Storage (CAS): elements, connectivity options, standards, and management principles, Hybrid Storage solutions overview including technologies like virtualization & appliances.

Section 4 Introduction to Information Availability

Business Continuity and Disaster Recovery Basics, Local business continuity techniques, Remote business continuity techniques, Disaster Recovery principles & techniques

Section 5 Managing & Monitoring

Management philosophies (holistic vs. system & component), Industry management standards (SNMP, SMI-S, CIM), Standard framework applications, Key management metrics (thresholds, availability, capacity, security, performance), Metric analysis methodologies & trend analysis, Reactive and pro-active management best practices, Provisioning & configuration change planning, Problem reporting, prioritization, and handling techniques, Management tools overview

Unit: 6 Security & Virtualization

Storage Security (Importance of Information security, elements and attributes of security), Developing a storage security model (Restricting Access Path, Vulnerability Management, Understanding Vulnerabilities), Securing Data Storage (Storage Security domains, Risk assessment Methodology, Security elements, threats against applications, Controlling user access to data, threats again backup , recovery and archive) Virtualization (Define virtualization, types of virtualization), Storage Virtualization (Storage functionality, Virtual storage, Comparison of virtualization architectures, challenges of storage virtualization), Block level virtualization, File level virtualization.

Recommended Books"

Information Storage and Management: Storing, Managing, and Protecting Digital Information, Published by Wiley Publishing ISBN: 9780470294215

Cyber Security

CSE 3122 **3-0-0 = 3**

Introduction

Terminologies : cyberspace, cybercrime, cyber security, Cyber squatting, cyberpunk, cyber warfare, cyber terorrism, Cyber security needs, Cyber criminals : Introduction, Cybercriminals Groups, Classification of cyber crimes, Cybercrime categories, Cybercrime : The legal perspective

Cyber offenses

Hackers, crackers, phreakers : Introduction, Planning cybercrime, Social engineering Cyberstalking, Cybercafe and cybercrime, Attack vector, Botnets

Cybercrime techniques

Proxy servers and Anonymizers, phishing, Password cracking, Keyloggers and spywares, Virus and worms, Trojan horse and backdoors, Steganography, Dos and DDos attacks,SQL injection, Buffer overflow

Phishing and Identity theft

Phishing : Introduction, Phishing methods : Dragnet, Rod-and-reel , Lobsterpot, Gillnet, Techniques of phishing, Phishing Toolkits and Spy Phishing, Phishing countermeasures, Personally Identifiable Information (PII),Types of Identity theft, Techniques of Identity theft, Identity Theft Countermeasures

Legal Perspective of Cyber security & Forensics fundamentals

Need for cyber laws: The Indian context, Indian IT Act 2000,Changes made in IT Act 2000, Digital signatures and the Indian IT Act, Cybercrime and punishment, Cyberforensics : introduction, types, Needs of cyber forensics, Cyberforensics and digital evidence

Cyber Security: Organization Implications

Search Breach: PI Collecting by Organization, Insiders threats in Organization,Privacy Dimension,Key-challenges in Organization,Cost of cyber crimes and IPR issues,Organizational guidelines for Internet usage, safe computing guidelines and computer usage policy,Forensics best practices for organization

References Books:

1. Marjie T. Britz Computer Forensics and Cyber Crime: An Introduction, Pearson
2. AlfaredBasta and Wolf Holten, Computer Security Concepts, Issues and Implementation, CENGAGE learning
3. Raghu Santanam, M. Sethumadhavan, MohitVirendraCyber Security, Cyber Crime and Cyber Forensics, IGI Global
4. George M. Mohay,Alison AndersonComputer and intrusion forensics, Artech House

Image Processing & Pattern Recognition

CSE 3112 **3-0-0=3**

Introduction to Pattern Detection, Pattern Recognition, Pattern Classification techniques including Bays classifiers and Sequential methods, Pattern Recognition Application, Preprocessing for Character Recognition.

Syntactic Pattern Recognition, Pattern Grammar, High Dimension Pattern Grammars, Binarisation, Smoothing, Edge Detection, Thinning.

Origin of Digital Image Processing, Digital Image Processing Problems and Applications, Image Representation and Modeling, Image enhancement, Image Restoration, Image Analysis, Image data Compression.

Recommended Books:

1. You-Han Pao Adaptive Pattern Recognition and Neural Network, Addison Wesley Publishing Co
2. Fu, K.S Pattern Recognition
3. Anil K. Jain Fundamental of Digital Image Processing

Parallel & Distributed Computing

CSE 4151 **3 – 0 – 0 = 3**

Classification of parallel computing structures, instruction level parallelism - static and dynamic pipelining, improving branch performance, superscalar and VLIW processors; High performance memory system; Shared memory multiprocessors and cache coherence; Multiprocessor interconnection networks; Performance modelling; issues in programming multiprocessors; Data parallel architectures. Models of distributed computing; Basic issues; Causality, Exclusion, Fairness, independence, Consistency; Specification of DIstributted Systems; Transition systems, Petri nets, process algebra properties; Safety, Liverness, Stability.

Recommended Books:

- Advanced Computer Architecture, Kai Hwang

Neural Networks and Fuzzy Logic

ECSE 4102 **3-0-0 = 3**

The course aims to provide knowledge about Neural Networks their structures, Design and applications. It shall present different types of machine learning techniques The course shall also provide an in-depth understanding of "reasoning" and "theorem proving" under Fuzzy environments and with uncertain and incomplete information.

1) Introduction: Biological neural system, Artificial Intelligent Systems, Modeling human performance.
2) Reasoning with uncertain and incomplete information: The statistical approach to uncertainty, Bayesian reasoning, Dempster-Shafer theory of evidence, Certainty Factor, non-monotonic systems.
3) Fuzzy Logic: Introduction, Min-Max Theorem, Resolution Rule under Fuzzy environment. Refutation method for theorem proving, Reasoning with Fuzzy sets.
4) Genetic Algorithms: Introduction. Operators: reproduction, crossover & mutation. Fitness function. Simple program demonstration. G. A. software packages.
5) Neural Networks: Foundations for connectionist networks. Activation functions, McCulloch-Pitts Neurons, Perceptron learning, Backpropagation learning, Competitive learning, Hebbian learning. Supervised and Unsupervised learning. Reinforcement learning, Neural Networks: promises and problems. Neural Networks applications.

Recommended Books:
1. Neural Networks : A Comprehensive Foundation by Simon Haykin, Prentice Hall
2. Artificial Intelligence - A New Synthesis by Nils J. Nilsson, Morgan Kaufmann Publishers.

Advanced Computer Architecture

CSE 4062 **3-0-0 = 3**

Unit-I:Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors. Conventional and EPIC architecture. Evolution of parallel processors, future trends and there architecture. Overview of Parallel Processing and Pipelining Processing Necessity of high performance, Constraints of conventional architecture, Parallelism in uni-processor system, Evolution of parallel processors, future trends, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture, Case study of Intel Itanium Processor. Principles of scalable performance: Performance Metrics and Measures, Speedup Performance Laws. Programming aspects for Intel Itanium Processor

Unit-II: Principles and implementation of Pipelining, Classification of pipelining processors, Pipeline Architecture, Study and comparison of processors with and without pipelining. General pipelining reservation table, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register Stack Engine, Software pipelining, VLIW (Very Long Instruction Word) processor, Case study: Super scalar Architecture- Pentium, Ultra SPARC. Super scalar architecture of Pentium, Ultra SPARC, Advances in pipeline architectures. Implementation issues of a program on any pipelined processor their analysis.
Unit-III: Study and comparison of Vector and array processors, Vector and Array Processor, Basic vector architecture, Issues in Vector Processing, Vector performance modeling, vectorizers and optimizers, Case study: Cray Arch. SIMD Computer Organization Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network. Parallel Algorithms For Array Processors: Matrix Multiplication. Sorting, SIMD computer organization. Implementation issues of Matrix multiplication and sorting on array processor and their analysis.
Unit-IV: Microprocessor Architectures, study and comparison of Loosely and Tightly coupled multiprocessors.Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP), Cow's and NOW's Cluster and Network of Work Stations), Chip Multiprocessing (CMP), Case Study of IBM Power4 Processor Inter Processor Communication and Synchronization, Implementation issues of a program on multiprocessor system.

Unit-V: Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions. Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming. Implementation issues of a multithreaded program.
Unit-VI: Parallel software issues, study of parallel programming concepts.
a)Parallel algorithms for multiprocessors, classification of parallel algorithms, performance of parallel algorithms
b) Operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI), Threads (in shared memory system)
c) Parallel Programming Languages : Fortran 90, Occam, C-Linda, CCC etc.
d) Issues towards cluster computing. Introduction to Neuro Computing and Grid Computing:

Text Books
1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hill international Edition
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill

Recommended Books:
1. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.
2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.
3. Kai Hwang, Scalable Parallel Computing.
4. Harrold Stone, High performance computer Architecture.
5. Richard Y. Kain, Advanced Computer Architecture
6. http://www.intel.com/products/processor (for Intel Itanium Processor)

Cloud Computing

CSE 4152 **3-0-0=3**

Unit I :Cloud Computing Fundamental: Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

Unit II :Cloud Applications: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

Unit III :Cloud Services Management: Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics : Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

Unit IV :Application Development: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Recommended Books:

1. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach [ISBN: 0071626948]
3. Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]

Mobile communications

CSE 4141 **3-0-0=3**

UNIT I:WIRELESS COMMUNICATION FUNDAMENTALS
Introduction – Wireless transmission – Frequencies for radio transmission – Signals –Antennas – Signal propagation – Multiplexing – Modulations – Spread spectrum –MAC – SDMA – FDMA – TDMA – CDMA –Cellular wireless networks.
UNIT II :TELECOMMUNICATION NETWORKS
Telecommunication systems – GSM – GPRS – DECT – UMTS – IMT–2000 –Satellite networks **–** Basics – Parameters and configurations – Capacity allocation –FAMA and DAMA – Broadcast systems – DAB – DVB.
UNIT III: WIRELESS LAN
Wireless LAN – IEEE 802.11 – Architecture – Services – MAC – Physical layer –IEEE 802.11a – 802.11b standards – HIPERLAN – Blue tooth.
UNIT IV: MOBILE NETWORK LAYER
Mobile IP – Dynamic host configuration protocol – Routing – DSDV – DSR–Alternative metrics.
UNIT V: TRANSPORT AND APPLICATION LAYERS

Traditional TCP – Classical TCP improvements – WAP – WAP 2.0**.**

Recommended Books:
1) Mobile communications by raj kamal
2) Mobile & pervasive computing by sandeep gupta & frank adelstein

Advanced Database with SQL

CSE 4087 **3-0-0=3**

Unit 1: The Relational Model of Data and RDBMS Implementation Techniques Theoretical concepts, Relational model conformity and Integrity, Advanced SQL programming, Query optimization, Concurrency control and Transaction management, Database performance tuning, Distributed relational systems and Data Replication, Security considerations

Unit 2: The Extended Entity Relationship Model and Object Model:
The ER model revisited, Motivation for complex data types, User defined abstract data types and structured types, Subclasses, Super classes, Inheritance, Specialization and Generalization, Constraints and characteristics of specialization and Generalization, Relationship types of degree higher than two.

Unit 3: Emerging Database Management System Technologies
Object Oriented database concepts; Object Relational database concepts; Active database concepts; Temporal database concepts; Spatial database concepts and architecture; Deductive databases and Query processing; Mobile Databases; Geographic Information Systems.

Unit 4: New database applications and environments
Data Warehousing and Data Mining, Multimedia; Mobility; Multidatabases; Native XML databases (NXD), Internet

Unit 5: Database Related Standards
SQL standards, SQL 1999, SQL:2003, Object Data Management Group (ODMG) version 3.0 standard, Standards for interoperability and integration e.g. Web Services, SOAP, XML related specifications, e.g. XQuery, XPath.

Recommended Books:

1. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill
3. Korth, Silberchatz, Sudarshan , Database System Concepts, McGraw-Hill.
4. Peter Rob and Coronel, Database Systems, Design, Implementation and Management, Thomson Learning.
5. C. J. Date & Longman, Introduction to Database Systems, Pearson Education

Information Coding practices

CSE 4012 **3-0-0=3**

INFORMATION THEORY
Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.

ERROR CONTROL CODING: BLOCK CODES Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC

ERROR CONTROL CODING: CONVOLUTIONAL CODES Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

SOURCE CODING: TEXT, AUDIO AND SPEECH Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

SOURCE CODING: IMAGE AND VIDEO Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

Text Books:

1.R Bose, "Information Theory, Coding and Cryptography", TMH 2007
2.Fred Halsall, "Multidedia Communications: Applications, Networks, Protocols and Standards", Perason Education Asia, 2002

Recommended Books:

.K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007
Amitabha Bhattacharya, "Digital Communication", TMH 2006

Computer Embedded Systems

CSE 4054 **3-0-0=3**

Product specification : Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Selection Processes – Microprocessor Vs Micro Controller – Performance tools Bench marking – RTOS Micro Controller – Performance tools – Bench marking – RTOS availability – Tool chain availability – Other issues in selection processes.

2. PARTITIONING DECISION : Hardware / Software duality – coding Hardware – ASIC revolution – Managing the Risk –Co-verification – execution environment – memory organization – System startup –Hardware manipulation – memory mapped access – speed and code density.

3. INTERRUPT SERVICE ROUTINES
Watch dog timers – Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyser – Caches – Computer optimisation –Statistical profiling

4. IN CIRCUIT EMULATORS
Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.

5. TESTING
Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.

Recommended Books:
1. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
2. Sriram Iyer, "Embedded Real time System Programming"
3. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.

Robotics & Vision Control

CSE 4044 **3-0-0=3**

Computer vision. Introduction. The human eye and the camera. Vision as an information processing task. Homogeneous transformations. A geometrical framework for vision. 2D and 3D images interpretation. Industrial applications.
Digital Image. Basics of image processing. Image acquisition. Segmentation, Binary and grey morphology operations. Thresholding. Filtering. Edge and corner detection. Features detection. Contours.Tracking edges and corners. Object detection and tracking. Image data compression, Real time Image processing.
Lighting in Machine Vision. Introduction. Light used in machine vision. Basic rules and laws of light distribution. Filters. Light sources. Light techniques. Choice of illumination.
Camera and Optical System. Camera technology. Analog and digital camera. Camera model. CCD and CMOS Technology. Sensor size. Intrinsic and extrinsic camera parameters. Camera calibration.Systems of lenses The thin lens. Beam converging and beam diverging lenses. General imaging equation. Aberrations. Practical aspects.
Fundamental of Robot. Robotics. Introduction. Robot. Definition. Robot anatomy. Robot parts and their functions. Classification of robot and robotic systems. Laws of robotic. Co-ordinate systems. Drives and control systems, Power transmission systems. Planning for navigation. Different applications.
Robot actuator effectors. Types of end effectors. Types of grippers. Interface. Sensors. Touch and Tactile sensors.
Kinematics of Robot. Introduction. Definition. Open and closed kinematic mechanisms. Matrix representation. Homogeneous transformation, forward and inverse kinematics. Direct vs inverse kinematic task. Programming. Basics of Trajectory planning.
Industrial applications. Quality control. Mapping and robot guidance. Motion estimation. Passive navigation and structure from motion .Autonomous systems.

Recommended Books:
Computer Vision: Algorithms and Applications, Richard Szeliski, Ed. Springer, ISBN-10: 1848829345, ISBN-13: 978-1848829343, Publishing, 2010.
Handbook of Robotics, Bruno Siciliano, Ed. Springer-Verlag Berlin and Heidelberg GmbH & Co. K, ISBN-10: 354023957X, ISBN-13: 978-3540239574,Publishing, 2008.

E-Commerce & Cyber Laws

CSE 4016 **3-0-0=3**

Unit-1- Introduction to E-commerce
Define E-commerce, Brief history of E-commerce, Forces fuelling E-commerce, E-com Vs E-Business, Challenges to traditional methods, E-Business communities, Model for E business, Information superhighway, Types of E-commerce, E business trident.

Unit-2 Transaction Security
Data, value of data, Protection of data, Firewall, Network security, Security policies, Emerging firewall management issues, Types of online transactions, Requirement for online transactions, Encryption, security, Secret key encryption.

Unit-3 Electronic Payment system.
Overview of E- payment system, Digital cash, Properties, Electronic cheques and benefits, online credit card system, types of credit card payments, secure electronic transactions, Debit cards, E-benefit transfer.

Unit-4 E business Issues and Internet Marketing
Organizational issues, Implementation issues, Marketing issues, Internet Marketing, Different stages of internet marketing, Critical success factor of internet marketing, E commerce strategies for development, E-commerce & sales.
Unit -5 Cyber laws
Definition, Need for cyber laws, Jurisprudence of Indian cyber law, Cyber crimes and criminal justice IT ACT2000 objectives, E-governance, digital signature, Sections related to ,Electronic records, Attribution, acknowledgement and dispatch of Electronic Records, security of E-records and digital signature, Controller functions, Certificates, subscriber duties, Penalties and Adjudications, Cyber regulation Appellate tribunal, Offences, Contracts in the InfoTech world, Power of arrest without warrant a critique, IT Act Modifications. Cyber consumer protection.

Recommended Books:
1. Cyber Law Simplified , Vivek Sood, TMH
2. E Commerce, Bharat Bhasker TMH
3. E- Commerce, Ravi kalakote, Pearson ed.
4. E commerce , Lauden, PHI

Summary, Objective & Highlights of the M.Tech(Computer Science & Engineering) Program

Computer Science is playing a vital role in the development of society and it is difficult to find an area where the Computers do not have applications. There is always a requirement for the qualified Computer professionals to provide quality service to the society. With significant increase in the number of Engineering Institutions in the recent past; the availability of qualified faculty has gone down drastically. In order to bridge the gap, there was a need to start an M.Tech program in Computer Science & Engineering (CSE) in the state of J&K.

With these motives in mind, it is considered to be the right time and geographical place to offer a 2-year full time M.Tech in Computer Science and Engineering, at SMVDU.

The thrust areas for M.Tech in CSE shall be the Soft Computing and Intelligent Systems. Communication System Networks, Adhoc Networks, Modelling and Simulation, Multimedia and Virtual Reality and Optimization techniques and the Coding Theory.

Course Structure of M.Tech(Computer Science & Engineering)

SEMESTER I

Course Code	Course Title	L-T-P	Credits
CSL 6025	Advanced Programming	3-0-2	4
CSL 6103	Artificial Intelligence & fuzzy Logic	3-1-0	4
CSL 6142	Modeling & Simulation	3-1-0	4
CSL 6073	Network management	3-1-0	4
CSL 6046	Discrete Mathematical Structure	3-1-0	4
	Total Credits	15-4-2	20

SEMESTER II

Course Code	Course Title	L-T-P	Credits
CSL 6062	Advanced Computer Architecture	3-1-0	4
CSL 6104	Neural Networks & Probabilistic Reasoning	3-1-0	4
CSL 6083	Advanced DBMS	3-0-2	4
CSL 6084	Data Mining & Data Warehousing	3-1-0	4
CSE XXXX	School Elective-I	3-1-0	4
	Total Credits	15-4-2	20

SEMESTER III

Course Code	Course Title	L-T-P	Credits
CSL 7133	Research Methodology	3-0-0	3
CSL 6042	Optimization Techniques	3-0-0	3
CSL 7015	Information & Coding Theory	3-0-0	3
CSE XXXX	School Elective-II	3-0-0	4
CSD 7004	Dissertation(preliminary)	0-0-8	4
	Open Elective-I	4-0-0	3
	Total Credits	12-4-8	20

***LTP for Elective " Image Processing & Pattern Recognition" is 3-0-2=4 Credits**

SEMESTER IV

Course Code	Course Title	L-T-P	Credits
CSD 7005	Dissertation		20
	Total Credits		20

Total Credits = **80 Credits**

List of Electives

School Elective-I			
Course Code	**Course Title**	**L-T-P**	**Credits**
CSE 6123	Cryptography & Network Security	3-0-0	3
CSE 6131	Real Time System	3-0-0	3
CSE 6132	Knowledge Processing System	3-0-0	3
CSE 6113	Image Processing	3-0-0	3
School Elective-II			
CSE 7141	Mobile & Pervasive Computing	3-0-0	3
CSE 7045	Robotics	3-0-0	3
CSE 7057	Embedded Systems	3-0-0	3
CSE 7114	Multimedia & Virtual Reality	3-0-0	3

Advanced Programming

CSL 6025 **3-0-2=4**

The course aims to provide an understanding of the diverse areas of Java framework through a discussion of its theoretical as well as practical foundations at the end of the course the students shall have in-depth practical understanding of different areas and topics.

UNIT 1

Introduction to Java Programming: Basic constructs of OOPS, Data types, Operators & Control Statements, Classes and Methods, Inheritance and Packages, Exception handling: Fundamental of Exception, Types of Exceptions, creating of Exceptions, Multithreaded programming and I/O.

UNIT 2

AWT and Event handling: Fundamental of AWT working with Frames Fonts Layout Managers, Buttons, Menus, Event Classes, Interfaces. JDBC: Introduction to SQL, ODBC, JDBC API Application Architecture steps for creating DSN, Interfaces.

UNIT 3

Swing and Java: Introduction to JFC, Features, Handling Components with Swing, listener Interfaces. Introduction of beans creation of own bean, Enterprise Java beans (EJB) other bean development tools. Remote Method Invocation: Introduction Comparison of Distributed and Non-distributed Java programs, RMI Packages, RMI Enhancements.

UNIT 4

Networking: Connecting to a Server, Implementing Servers, Sending E-Mail making URL Connections, Advance Socket programming: Socket Timeouts, Interruptible Sockets, half/Close Internet Addresses. Security: Class Loaders, Security Manager and Permissions, User Authentication Digital Signatures, Code Signing JAR file Signing, Encryption, Internationalization: Locales Number formats, Message Formatting, Text files and Character Sets, Resources Bundles Classes, Native Methods.

Recommended Books:

1. Java-2 Volume II by Cay S.Horstmann, Cornell, Pearson Education
2. The Complete Reference Java 2 (5th Ed.), Herbert Schildt: TMH
3. Java how to Program (6th Ed.) Deitel and Deitel: PHI Publication

Artificial Intelligence and Fuzzy Logic

CSL 6103 **3-1-0=4**

The course aims to provide an understanding of the diverse branches of AI through a discussion of its theoretical foundations. At the end of the course the students shall have in-depth understanding of different knowledge representation formalisms and various techniques used for "reasoning" and "theorem proving".

1) Introduction: AI History and applications. Overview of AI application areas: game playing, automated reasoning and theorem proving, expert systems, natural language understanding, planning and robotics, machine learning and Alan Turing Test.
2) The Propositional and Predicate Logic: Symbol and sentences, the semantics of the Propositional Calculus & Predicate Calculus. Inference Rules and Theorem Proving. Axioms, Literals, Horn clause & Clausal forms.
3) Reasoning: Inductive, Deductive, Abductive and Default reasoning. More examples on Resolution proof.
4) **Problem Solving as Search**: Structures and strategies for state space search. Algorithms for Heuristic search, Heuristic evaluation functions, Heuristic search and expert systems, using Heuristics in games, Time & Complexity issues etc**.**
5) Knowledge Representation: knowledge representation Techniques; a survey of network representation; conceptual graphs; structured representations; frames, scripts; issues in knowledge representation: hierarchies, inheritance, exceptions; efficiencies.
6) Knowledge Elicitation and Knowledge Acquisition: An overview of the induction methods, types and tools. Stages in Knowledge acquisition with examples. Analyzing, coding, documenting and diagramming. Scope of knowledge.
7) **Expert Systems**: Overview of expert system technology; rule-based expert systems; Construction of ES. Components of an ES. The explanation facility. Rule-based formation and forward and backward chaining techniques for problem solving.
8) Reasoning with uncertain and incomplete information: The statistical approach to uncertainty, Bayesian reasoning, the Dempster-Shafer theory of evidence, Certainty Factor, Reasoning with Fuzzy sets.

Recommended Books:

1. *Artificial Intelligence: Strategies and techniques for complex problems solving* by George Luger, Addison-Wesley, 2003.
2. *Artificial Intelligence - A Modern Approach* by Stuart Russell & Peter Norvig, Prentice Hall.
3. *Artificial Intelligence - A New Synthesis* by Nils J. Nilsson, Morgan Kaufmann Publishers.

Modeling And Simulation

CSL6142 **3-1-0=4**

UNIT 1

Concepts of systems, Models, and Simulation, Distributed Lag Model, Cobweb Models, The process of a simulation-Study, Exponential Growth Models, Exponential Decay Models, Type of simulation, Discrete-Event

Simulation: Time-Advance Mechanisms, Components and Organization of a Discrete-Event Simulation Model. Monte Carlo Method. Simulation of Single-Server Queuing System, Simulation of an Inventory System.

UNIT 2
Continuous Simulation: Pure-pursuit Problem. Random Number Generators: Linear Congruential Generators, Other kinds of Generators, Testing Random-Number Generators. Generating Random Variates: General Approaches, Continuous and Discrete distributions.

UNIT 3
Introduction to GPSS, General Description, GPSS block-diagram, Simulation of a Manufacturing Shop, SNA, Function, Simulation of a Supermarket, GPSS Model of a Simple Telephone system.

UNIT 4
Output Data Analysis for a Single System: Transient and Steady-State Behavior of a Stochastic Process, Type of Simulations with regard to output Analysis and Statistical Analysis for Testing Simulation, Verification and Validation of Simulation. An introduction of different types of simulation languages.

Recommended Books:

1. G.Gorden, "System Simulation", Pearson Education
2. Law and Kelton, "Simulation Modeling and Analysis", McGraw Hill
3. N.Deo,"System Simulation with Digital Computer", Prentice Hall of India
4. Fred Maryanski, "Digital Computer Simulation", CBSPD

Discrete Mathematical Structures

CSL 6046 **3-1-0=4**

Basic counting principle: Pigeonhole principle, inclusion - exclusion principle, recurrence relations, generating functions. Construction of finite fields, codes grammars and language, elements of logic.

Undirected and direct graphs, modelling with graphs, trials and cycles, connectivity and trees.

Graph algorithms: BFS, DFS, shortest path, optimal spanning trees, matching, job assignment problem, optimal transportation through flows in networks.

Introduction to Operations research. Linear Programming: Principles of simplex Method. Simplex method in tabular from. Duality and Dual simplex Method. Degeneracy and cycling.

Recommended Books:

1. K. H. Rosen, Discrete Mathematics and its applications, McGraw-Hill, 2007.
2. Kolman, Busby and Ross, "Discrete Mathematical Structures", Pearson Education.

Network Management

CSL 6073 **3-1-0=4**

Data Communications and Network Management Overview: Review of Computer Network Technology, Basic Foundations: Standards, Models, and Language Networking Components, Overview of Network Management, Network Management Strategies, Configuration of client, Server and Infrastructure Components

SNMPv1, SNMPv2, SNMPv3 Network Management: Organization, Information Models, Communication and Functional Models, Secure SNMPv3, RMON, RMON2

Network Management Tools and Systems : Network Management Applications, Broadband Network Management, ATM Network, Telecommunications Management Network, Web-Based Management , Network Management Initiatives.

Recommended Books:

Network Management: Principles and Practice, 1/e, Mani Subramaniam, Pearson Educations

Advanced Computer Architecture

CSL 6062 **3-1-0=4**

Unit-I: Parallel computer models
The state of computing, System Attributes to Performance: Clock Rate and Cycles per Instruction, Performance Factors, System Attributes, MIPS Rate, Performance factors versus System attributes, Throughput Rate, Programming Environment, Implicit & Explicit Parallelism, MIPS Ratings and Performance Measurement, Classification of parallel computers, Multiprocessors and Multi-Computers: Shared- Memory Multiprocessors: UMA Model, Symmetric & Asymmetric Multi Processors Distributed Memory Multi-Computers, NUMA and COMA models for Multiprocessors, Computer Generations. Multi vector and SIMD computers

Unit-II: Program and network properties
Conditions of parallelism, Data and resource Dependences, Control Dependence, Resource Dependence, Bernstein's Conditions for Parallel Processing, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms

Unit-III: System Interconnect Architectures
Network properties and routing, Node Degree and Network Diameter, Bisection Width, Data Routing Functions, Permutations, Perfect Shuffle and Exchange, Hypercube Routing Functions, Broadcast and Multicast, Network Performance

Unit-IV: Static and Dynamic Interconnection Networks
Static interconnection Networks: Linear Array, Ring and Chordal Ring, Barrel Shifter, Tree and Star, Fat Tree, Mesh and Torus, Systolic Array, Hypercubes, Cube-Connected Cycles, k-array n-cube networks, Network Throughput, Comparison of characteristic of various static interconnection networks, Dynamic interconnection Networks: Digital Buses, Switch Modules, Multistage Networks, Omega Network, Baseline Network, Crossbar Network, Comparison of characteristic of various dynamic interconnection networks.
Unit-V: Advanced processors
Advanced processor technology, Design Space of Processors, Instruction pipelines, Processors and Coprocessors, Instruction-set Architectures, Complex Instruction Sets, Reduced Instruction Sets, Architectural Distinctions, CISC Scalar Processors, Representative CISC Scalar Processors, RISC Scalar Processors, Representative RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors

Recommended Books:
1. Kai Hwang, "Advanced computer architecture"; TMH. 2000
2. Hwan and Briggs, "Computer Architecture and Parallel Processing"; MGH. 1999
3. D. A. Patterson and J. L. Hennessey, "Computer organization and design", Morgan Kaufmann, 2nd
4. M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design"; Narosa Publishing
5. Stalling W, "Computer Organisation & Architecture", PHI. 2000

Neural Networks and Probabilistic Reasoning

CSL 6104 **3-1-0=4**

The course aims to provide knowledge about Neural Networks their structures, Design and applications. It shall present different types of machine learning techniques. The course shall also provide an in-depth understanding of "reasoning" and "theorem proving: with uncertain and incomplete information.

1. Reasoning with uncertain information: Review of Probability theory, conditional Probabilities, Probabilistic Inference, Conditional Independence, Bays Networks, Bayesian Reasoning, Dempstor-Shafer theory of evidence, Probablistic Inference in Polytrees, Evidence above and evidence below, non-monotonic systems, Certainty Factor.

2. Genetic Algorithms: Introduction: Operatiors: reproduction, crossover & mutation. Fitness function, Simple program demonstration. G.A. software packages.

3. Neural Networks: Biological neural system, Artificial Intelligent Systems, Modeling human performance. Foundation for connectionist networks. Activation functions, McCulloch-Pitts Neurons, Perceptron Learning, The Window-Hoff Procedure, Generalised Delta Procedure, Error-correction Procedure. Backpropagation learning, Competitive learning, Hebbian learning. Supervised and Unsupervised learning, Kohonon Self-Organising Maps, Reinforcement learning, Neural Networks: promises and problems. Neural Networks application.

Recommended Books:
1. Neural Networks : A Comprehensive Foundation by Simon Haykin, Prentice Hall of India
2. Artificial Intelligence – A New Synthesis by Nils J.Nilsson, Morgon Kaufmann Publishers.

Advanced DBMS

CSL 6083 **3-0-2=4**

Overview of relational model, database design, ER models, functional dependency, normalization, transaction concurrency control and recovery systems

Storage and File structures: RAID, tertiary storage, storage access, file organization, Data dictionary storage

Query Processing: Overview, query cost, selection operation, sorting, join operation,
Other operations, evaluation of expressions

Query Optimization: Overview, Transformation of relational expression, estimating statistics of expression results, choice of evaluation plans, materialized views

Database system architectures: Centralized and client-server architectures, parallel systems, distributed systems

Parallel databases: Introduction, I/O parallelism, interquery parallelism, intraquery parallelism, intraoperational parallelism, interoperational parallelism, design of parallel systems

Distributed databases: homogeneous and heterogeneous databases, distributed data storage, distributed transactions, commit protocols, concurrency control in distributed databases, distributed query processing, heterogeneous distributed databases, directory systems

Advance transaction processing: Transaction processing monitors, Real time transaction systems, Long duration transactions

Recommended Books:
- Silber Schatz. Korth, "Database System Concepts", Tata Mc Graw Hill.
- ShamKanth B. Navathe, "Fundamental of DataBase System", Pearson Education.
- C. J. Date, "An introduction to database systems", Addison Wesley publishing company

Data Mining And Data Warehousing

CSL6084 **3-1-0=4**

UNIT 1

Overview of decision support systems: organizational need for strategic information, Failures of past decision-support systems, operational versus decision-support systems, data warehousing-the only viable solution, data warehouse defined. Data warehouse – The building Blocks: Defining Features, data warehouse and data marts, overview of the components, metadata in the data warehouse. Defining the business requirements: Dimensional analysis, information packages - a new concept, requirements gathering methods, requirements definition: scope and content.

UNIT 2

Principles of dimensional modeling: Objectives, From Requirements to data design, the STAR schema, STAR Scheme keys, Advantages of the STAR Schema. Dimensional Modeling: Updates to the Dimension tables, miscellaneous dimensions, the snowflake scheme, aggregate fact tables, families of STARS.

UNIT 3

OLAP in the Data Warehouse: Demand for online analytical processing, need for multidimensional analysis, fast assess and powerful calculations, limitations of other analysis methods, OLAP is the answer, OLAP definitions and rules, OLAP characteristics, major features and functions, general features, dimensional analysis, what are hypercubes? Drill-down and roll-up, slice-and-dice or rotation, OLAP models, overview of variations, the MOLAP model, the ROLAP model, ROLAP versus MOLAP, OLAP implementation considerations.

UNIT 4

Data Mining Basics: What is Data Mining, Data Mining Defined, The knowledge discovery process, OLAP versus data mining, data mining and the data warehouse, Major Data Mining Techniques, Cluster detection, decision trees, memory-based reasoning, link analysis, neural networks, genetic algorithms, moving into data mining, Data Mining Applications, Benefits of data mining, applications in retail industry, applications in telecommunication industry, applications in banking and finance.

Recommended Books:

1. Paul Raj Poonia, "Fundamentals of Data Warehousing", John Wiley & sons.
2. Sam Anahomy, "Data Warehousing in the real world: A practical guide for building decision support systems", John Wiley
3. Alex berson, Stephen J. Smith, "Data Warehousing, Data Mining & OLAp", Tata McGraw Hill
4. W.H.Inmon, "Building the operational data store", John Wiley
5. Lamber and Han, "Data Mining Concepts and Techniques", Hartcourt India P.Ltd.

Research Methodology

CSL 7133 **3-0-0=3**

UNIT I

Research methodology: An Introduction Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved inDefining a Problem.

UNIT II

Research Design Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling.

UNIT III

Measurement and Scaling Techniques Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale,Scale Construction Techniques.

UNIT IV

Methods of Data Collection and Analysis Collection of Primary and Secondary Data, Selection of appropriate method Data Processing Operations, Elements of Analysis, Statistics in Research,Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation.

UNIT V

Techniques of Hypotheses, Parametric or Standard Tests Basic concepts, Tests for Hypotheses I and II, Important parameters limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, As a non-parametric Test, Conversion of Chi to Phi, Cautioninusing Chi-square test.

UNIT VI 6

Analysis of Variance and Co-variance ANOVA, One way ANOVA, Two Way ANOVA,ANOCOVA Assumptions in ANOCOVA, Multivariate Analysis Technique Classification ofMultivariate Analysis, factor Analysis, R-type Q Type factor Analysis, Path Analysis

RECOMMENDED BOOKS:

1. "Research Methodology", C.R. Kothari, Wiley Eastern.
2. "Formulation of Hypothesis", Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.
3. "Research in Education", John W Best and V. Kahn, PHI Publication.
4. "Research Methodology- A step by step guide for beginners", Ranjit Kumar, Pearson Education
5. "Management Research Methodology-Integration of principles, methods and Techniques", K.N. Krishna swami and others, Pearson Education

Optimization Techniques

CSL 7015 **3-0-0=3**

Convex sets and functions, constrained optimization methods: Introduction, Kuhn-Tucker conditions, convex optimization, Lagrange multipliers, Non-linear programming: One-dimensional minimization method, seach method, unconstrained and constrained optimization theory and practices. Reliability: Basic concepts, conditional failure rate function, Failure time distributions, Certain life models, Reliability of a system in terms of the reliability of it's components, series system, Parallel system. Dynamic Programming: Multistage decision problems, computation procedure and case studies. Fundamentals of queuing system, Poisson process, the birth and death process, special queuing methods.

Books Suggested:

1. S.S Rao.. Optimization: Theory and Practices, New Age Int. (P) Ltd. Publishers, New Delhi.
2. Chong, E.K.P.and Zak, S. H.. An Introduction to Optimization, John Wiley & Sons, N.Y.
3. Peressimi A.L., Sullivan F.E., Vhl, J.J..Mathematics of Non-linear Programming, Springer – Verlag

Information and Coding Theory

CSL 7042 **3-0-0=3**

Mathematical Background and Introduction

Introduction to algebraic structures, Field extensions, Quadratic Residues, Krawtchouk Polynomials, Combinatorial Theory, Probability Theory, Shannon's Theorem, Coding Gain, Problems.

Linear and Good Codes

Block Codes, Linear codes, Hamming codes, Majority Logic decoding, Weight enumerators, The Lee Metric, Hadamard codes and generalizations, Binary Golay code, The Ternary Golay code, Constructing codes from other codes, Reed-Muller codes, Kerdock codes

Bounds on Codes and Cyclic Codes

Gilbert bound, Asymptotic Plotkin bound, Griesmer bound, The Linear Programming bound, Cyclic codes, Zeros of a Cyclic codes, The Idmpotent of a cyclic codes, Other representations of a Cyclic codes.

Recommended Books :

1. Introduction to Coding Theory, J. H. Van Lint

Cryptography and Network Security

CSE 6123 **3-0-0=3**

UNIT 1

Introduction to cryptography and network security, Networks OSI Model of networking layers, Importance of Security in networks enemies vulnerability share of different information types on internetwork, attacks, security services pervasive security mechanism.

UNIT 2

Foundation of Modern Cryptography, private key cryptography, DES, TDEA, Block Ciphers, Linear cryptanalysis, differential cryptanalysis, AES public key Cryptography, DH algorithm, Algorithms for discrete algorithms birth day paradox, pollard's p algorithm for discrete algorithm, EI Gomel public key, RSA, Elliptic curve cryptography, stream chippers

UNIT 3

Hashing Authentication & Signature Schemes

Hashing schemes SHA- Family, MAC, Digital Signature RSA EI Gamel, DSS DSA Authentication Protocols, applications Kereberos X.509 Directory Services, E-mail security, Email architecture SSL PGP, MIME, S/MIME

Internet Protocol Security (IPSec) IPSec architecture, IPSec verses other layers security, Mobile IPsec VPN Web security, SSl, TLS, SET etc

UNIT 4

System Security Intruders, Types of Attacks, Protecting against Intruders, Honeypots, Scanning and analysis tools, Viruses and Worms, Types of Viruses, Protection, Firewall architecture implementing firewalls, XML firewalls, Trusted systems, Trusted system security implementation, wireless security.

Recommended Books:

1. Cryptography and Network Security: Behrouz A. Forauzan 2/e
2. Cryptography and Network Security: William Stallings 4/e
3. Cryptography and Network Security: Atul Kahate 2/e

Real Time Systems

CSE 6131 **3 – 0 – 0=3**

Unit -I

Real time definition, Applications, Basic model, Safety, types, Timing Constraints events, Classification of timing constraints, examples, modeling.

Unit-II

Real Time Task Scheduling: Concepts, types, Task scheduling algorithms, Clock Driven, Table Driven, Cyclic Schedulers, Generalized task scheduler, Comparison, hybrid schedulers, Event Driven Scheduling, earliest deadline first scheduling, Implementation, Shortcomings of EDF, Rate Monotonous algorithm, Issues with RMA, DMA algorithm, context switching overhead, Handling critical tasks, aperiodic and sporadic tasks, Coping with limited Priority Levels, Dealing with task jitter.

Unit-III
Resource sharing and Dependencies: Resource sharing among real-time tasks, Priority inversion, Priority inheritance protocol, Highest Locker Protocol, Priority Ceiling Protocol, Different Types, Important features of PCP, issues with RSP.

UNIT-IV
Scheduling and commercial RTOS: multiprocessor task allocation, Dynamic allocation of tasks, fault tolerant scheduling, Clocks in distributed Real time system.Synchronization, Time services, Features of RTOS, Unix, windows, as real time OS, POSIX PSOS,VRTX, Vx Works, QNX RT Linux, Windows CE.

UNIT- V

Real Time communication: Networks, types, QOS Traffic Categorization, LAN, Soft real time communication in LAN,Hard communication, GPBS,CBP, IEEE802.4, RETHER, SRTE,routing algorithms, Resource reservation, Qos Models, Real time databases.

Recommended Books:
1) Real Time Systems Rajib Mall Pearson Education
2) REAL Time System Jaen W.S. Liu Wileys

Knowledge Processing Systems

CSE 6132 **3-0-0=3**

Intelligent Decision Support System: DSS development methodology and tools; Need for expertise in Decision Models and Expert Systems; Expert System Fundamentals; Knowledge management.

Knowledge Based System: Concepts of Artificial Intelligence; Basic Concepts of Expert System; Applications, Structure and working of Expert System; benefits, and problem areas best suited to Expert System.

Knowledge Engineering: Types of Knowledge, Knowledge acquisition, verifications, validation, Knowledge Representatives and Interfacing, Reasoning in rule based system, inference with uncertainty, Expert system development, explanation, Meta knowledge,

Advanced Intelligent System: Machine Learning Techniques, learning in Artificial Neural Networks, Genetic Algorithms, development of Integrated Advanced Systems, Intelligent System over the Internet

Image Processing

CSE 6113 **3 – 0 – 0=3**

UNIT-1 Basics
Image, Steps in DIP, components, Image Acquisition, Sampling, Quantization, Pixel Relationships, Adjacency, Connectivity regions & Boundaries, Distance Measures. Image Coding, Run length, Compression, Huffman.

UNIT-II Transformations
Image Transformation, Geometrical Transformation, digital image Resampling, Filtering, Linear, Rank Order, Morphological Filtering, Background separation, Gray Level Thresholding, Boundary Detection and Representation, Smearing, Run Length Smearing Thinning and Structural representation

UNIT-III Segmentation and Classification
Segmentation, Connected Component Labeling, X-Y Tree Decomposition, Hough's Transform, Feature Extraction, Geometrical Extraction, Moments, Relational Descriptions, Gradient, Matching, Template, Zernike Moments, Unitary Image Transform, Projection Histograms Zoning, Minimum Distance Classifiers, Bayes Classifier, NN Classifier.

UNIT-IV Restoration
A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function

UNIT V Color images and compression
Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation
Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards LZ, Arithmetic compression

Recommended Books:
1) Image Processing by Gonzalez and woods

2) Image Processing Analysis and Machine Vision by Sonka Hlavac Boyle
3) Image Processing Analysis by H Bunke

Mobile and Pervasive Computing

CSE 7141 **3-1-0=4**

Unit 1: Introduction
Introduction to mobile computing, Adaptability in mobile computing, mechanism for adaption, support to build adaptive applications, applications of mobile computing.
Unit 2: Mobility Management
Registration area**,** location management principles and techniques, Mobile IP and their classification,
Unit 3: Data Dissemination
Challenges, data dissemination, Mobile data caching, cache consistency, performance and architectural issues, Mobile Cache management techniques, broadcasting invalidation report, handing disconnection, energy and bandwidth efficiency algorithms.
Unit 4: Adhoc Networks
Introduction to Adhoc networks, routing issues, Body, Personal, and Local Ad Hoc Wireless Networks, Multicasting Techniques in Mobile Ad Hoc Networks, Quality of Service in Mobile Ad Hoc Networks, Power-Conservative Designs in Ad Hoc Wireless Networks, Energy efficient algorithms for routing in Adhoc networks, clustering techniques, Coding for the Wireless Channel, Unicast Routing Techniques for Mobile Ad Hoc Networks, Position-Based Routing in Ad Hoc Wireless Networks.
Unit 5: Sensor Networks
Introduction to sensor networks, Data aggregation and data dissemination techniques in sensor networks, localization in sensor networks, Energy saving issues for Wireless Sensor, Broadcast Authentication and Key Management for Secure Sensor Networks, Embedded Operating Systems for Wireless Microsensor Nodes, Time Synchronization and Calibration in Wireless Sensor Networks, The Wireless Sensor Network MAC, Topology Construction and Maintenance in Wireless Sensor Networks.
Unit 6: Security in Adhoc and Sensor Networks
Basic concepts of cryptography, Key generation and management techniques, D-H algorithm, DES, Algorithms for key generation and distribution, overhead issues in key management w.r.t. mobile clients, Hashing techniques.
Unit 7: Mobile Middleware
Introduction to mobile middleware, adaption, agents, and service discovery.

Recommended Books:
Sandeep K Gupta, Frank Adelstein, Golden G. Richard, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing: TMH

Robotics

CSE 7045 **3-0-0=3**

Computer vision. Introduction. The human eye and the camera. Vision as an information processing task. Homogeneous transformations. A geometrical framework for vision. 2D and 3D images interpretation. Industrial applications.
Digital Image. Basics of image processing. Image acquisition. Segmentation, Binary and grey morphology operations. Thresholding. Filtering. Edge and corner detection. Features detection. Contours.Tracking edges and corners. Object detection and tracking. Image data compression, Real time Image processing.
Lighting in Machine Vision. Introduction. Light used in machine vision. Basic rules and laws of light distribution. Filters. Light sources. Light techniques. Choice of illumination.
Camera and Optical System. Camera technology. Analog and digital camera. Camera model. CCD and CMOS Technology. Sensor size. Intrinsic and extrinsic camera parameters. Camera calibration.Systems of lenses The thin lens. Beam converging and beam diverging lenses. General imaging equation. Aberrations. Practical aspects.
Fundamental of Robot. Robotics. Introduction. Robot. Definition. Robot anatomy. Robot parts and their functions. Classification of robot and robotic systems. Laws of robotic. Co-ordinate systems. Drives and control systems, Power transmission systems. Planning for navigation. Different applications.
Robot actuator effectors. Types of end effectors. Types of grippers. Interface. Sensors. Touch and Tactile sensors.
Kinematics of Robot. Introduction. Definition. Open and closed kinematic mechanisms. Matrix representation. Homogeneous transformation, forward and inverse kinematics. Direct vs inverse kinematic task. Programming. Basics of Trajectory planning.
Industrial applications. Quality control. Mapping and robot guidance. Motion estimation. Passive navigation and structure from motion .Autonomous systems.
Books Recommended

- Computer Vision: Algorithms and Applications, Richard Szeliski, Ed. Springer, ISBN-10: 1848829345, ISBN-13: 978-1848829343, Publishing, 2010.
- Handbook of Robotics, Bruno Siciliano, Ed. Springer-Verlag Berlin and Heidelberg GmbH & Co. K, ISBN-10: 354023957X, ISBN-13: 978-3540239574,Publishing, 2008.

Embedded Systems

CSE 7057 **3-0-0=3**

Product specification : Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Selection Processes – Microprocessor Vs Micro Controller – Performance tools

Bench marking – RTOS Micro Controller – Performance tools – Bench marking – RTOS availability –Tool chain availability – Other issues in selection processes.
2. PARTITIONING DECISION : Hardware / Software duality – coding Hardware – ASIC revolution Managing the Risk –Co-verification – execution environment – memory organization – System startup –Hardware manipulation – memory mapped access – speed and code density.

3. INTERRUPT SERVICE ROUTINES
Watch dog timers – Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyser – Caches – Computer optimisation –Statistical profiling

4. IN CIRCUIT EMULATORS
Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.

5. TESTING
Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.
REFERENCE
1. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
2. Sriram Iyer, "Embedded Real time System Programming"
3. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.

Multimedia And Virtual Reality

CSE 7114 **3-0-0=3**

UNIT 1
Multimedia preliminaries and applications: Development and use of multimedia packages; introduction to virtual reality and modeling languages. CD-ROM and the Multimedia Highway, Introduction to making multimedia - The Stages of project, the requirements to make good multimedia, Multimedia skills and training, Training opportunities in Multimedia. Motivation for multimedia usage, Frequency domain analysis, Application Domain & ODA etc. Multimedia-Hardware and Software: Multimedia Hardware – Macintosh and Window production Platforms, Hardware peripherals – Connections, Memory and storage devices, Media software – Basic tools, making instant multimedia, Multimedia software and Authoring tools, Production Standards.

UNIT 2
Multimedia – making it work – multimedia building blocks – Text, Sound, Images, Animation and Video, Digitization of Audio and Video objects, Data Compression: Different algorithms concern to text, audio, video and images etc., Working Exposure on Tools like Dream Weaver, 3D Effects, Flash Etc.

UNIT 3
Multimedia and the Internet: History, Internet working, Connections, Internet Services, The World Wide Web, Tools for the WWW – Web Servers, Web Browsers, Web page makers and editors, Plug-Ins and Delivery Vehicles, HTML, Designing for the WWW – Working on the web, Multimedia Applications – Media Communication, Media Consumption, Media Entertainment, Media games.

UNIT 4
Multimedia-looking towards Future: Digital Communication and New Media, Interactive Television, Digital Broadcasting, Digital Radio, Multimedia Conferencing, Assembling and delivering a project-planning and costing, Designing and Producing, content and talent, Delivering, CD-ROM technology.

Recommended Books:
1. Steve Heath, 'Multimedia and Communication Systems' Focal Press, UK.
2. Tay Vaughan, 'Multimedia: Making it Work', TMH
3. Keyes, 'Multimedia Handbook', TMH
4. Steve Rimmer, 'Advanced Multimedia Programming', MHI
5. Ralf Steinmetz and Klara Naharstedt, 'Multimedia: Computing, Communication and Applications', Pearsons.

Dissertation (Preliminary) & Dissertation

CSD 7004 & CSD 7005 **0-0-8=4 & 0-0-40**

Research and development projects based on problems of practical and theoretical interest. Problem definition, background research, development of overall project plan. Evaluation will be based on student seminars, written reports, and evaluation of the developed system and/or theories

Program Structure of Master of Computer Application (M.C.A.) Program

Semester I **First Year**

Course code	Course Title	L-T-P	Credits
CSL 6014	Basics of Computers & IT	3-0-0	3
MTL 6191	Discrete Structures for computer science	3-0-0	3
BUL 6061	Business Economics for Managers	3-0-0	3
ECL 6010	Fundamentals of Electronics	3-0-0	3
CSL 6026	Concepts in 'C'	3-0-0	3
MTL 6211	Operation Research Techniques	3-1-0	4
ECP 6010	Fundamental Electronics Lab	0-0-2	1
CSP 6026	C Lab	0-0-2	1
CSP 6014	Basic IT Lab	0-0-2	1
	Total	**18-1-6**	**22**

Semester II **First Year**

Course code	Course Title	L-T-P	Credits
CSL 6033	Data Structure & Algorithm	3-0-0	3
CSL 6027	Object Oriented Analysis & Design	3-0-0	3
CSL 6043	Formal Language & Automata Theory	3-0-0	3
MTL 6192	Numerical Analysis	3-0-0	3
MTL 6193	Basics of Graph Theory	3-0-0	3
LNL 6143	Communication Skills-II	3-0-0	3
ECL 6071	Digital Electronics Fundamentals	3-0-0	3
CSP 6033	Data Structure Lab	0-0-2	1
ECP6071	Digital Electronics Lab	0-0-2	1
CSP6027	OOAD Lab	0-0-2	1
	Total	**21-0-6**	**24**

Semester I **Second Year**

Course code	Course Title	L-T-P	Credits
CSL7074	Computer Networking and Protocols	3-1-0	4
CSL7034	Algorithms Design & analysis	3-0-0	3
CSL7085	Advanced Database Concepts	3-0-0	3
CSL7063	Computer Organization	3-1-0	4
BUL7021	Org. Behavior & Management Practices	3-0-0	3
CSL7055	Operating system with Linux	3-0-0	3
CSP7034	Algorithms design Lab	0-0-2	1
CSP7085	Advanced Database concepts Lab	0-0-3	1.5
CSP7055	Linux Lab	0-0-2	1
	Total	**18-1-7**	**23.5**

Semester II **Second Year**

Course code	Course Title	L-T-P	Credits
CSL7105	Introduction to Artificial Intelligence	3-0-0	3
CSL7028	Programming concepts with Java	3-0-0	3
CSL7092	Software Engineering concepts	3-0-0	3
	Open Elective-I	3-0-0	3
CSL7115	Graphics design in C	3-0-0	3
	Elective- I	3-0-0	3
CSP7105	Artificial Intelligence Lab	0-0-2	1
CSP7115	Graphics Design Lab	0-0-2	1
CSP7028	Programming with Java Lab	0-0-2	1
CSP7092	Software Engineering Lab	0-0-6	3
	Total	**18-0-12**	**24**

Semester I **Third Year**

Course code	Course Title	L-T-P	Credits
CSL8058	Web application Design with .NET	3-0-0	3
CSL8056	Compiler design Principles	3-1-0	4
CSL8143	Mobile Computing	3-0-0	3
BUL8021	Human Resource Management in Practice	3-0-0	3
	Open Elective-II	3-0-0	3
	Elective – II	3-0-0	3
CSP8029	Web Application Design Lab	0-0-3	1.5
CSD9091	Major Project Part -I	0-0-8	4
	Total	**18-0-11**	**24.5**

Semester II **Third Year**

Course code	Course Title	L-T-P	Credits
CSD8008	Major Project Part-II		12
	Total		**12**

Elective –I

CSE7106 Neural Network & Fuzzy Logic
CSE7075 Network Programming
CSE7086 Data Warehousing and Mining
CSE7153 Parallel Processing

Elective -II

CSE8093 Enterprise Resource Planning
CSE8124 Cryptography & Network security
CSE8094 Software Project Management
CSE8116 Digital Image Processing
CSE8134 Research Methodology and Computer Applications
CSE8017 E-Commerce & Cyber Laws

Basics of Computers & IT

CSL6014 **3 – 0 – 0 = 3**

Introduction to Computer & Hardware: Basic concepts of Information Technology, Concepts of Data and Information, data processing, History of computers, organization of computers, input and output devices, storage devices and file organization.

Operating System: System software, application software, utility packages, compilers, interpreters, operating systems, Elementary commands of DOS, Windows and UNIX operating systems (file handling, directory management and general purpose user interfacing commands).

Programming Languages: Machine language, assembly languages, high level languages, forth generation languages, General concepts of OOPS (Object oriented programming) and SQL (Structured Query Languages); Computer Viruses, worms; Compiler, Interpreter, Assembler; Algorithm & Flowchart.

Communication Technologies: Communication system elements communication modes (analog and digital, synchronous and asynchronous, simplex, half duplex and full duplex, circuit switching and packet switching) Communication media : (speed and capacity, twisted pair, coaxial fiber optics, wireless), common network components, hosts and servers, work stations, network topologies and network protocols ^ (ISO/OSI Ref. Model and TCP/IP).

Applications of Information Technology: Applications of IT in business, industry, home education and training, entertainment, science and engineering and medicine, multimedia data types (graphics, images, audio video), Virtual reality applications, Internet, World Wide Web (WWW), Domain names, e-mail, teleconferencing, e-commerce, hypermedia, data warehousing.

Recommended Books:

1. Sanders. D.H. " Computers Today " McGraw Hill
2. S. K. Basandra "Computers Today" Galgotia Publication.
3.Leon & Leon "Computers Today "Leon Vikas Pub.
4. S Jaiswal, " Information Technology Today " Galgotia Pub.
5. P. K. Sinha ."Introduction to Computers "
6. V. Rajaraman "Fundamental of computer " PHI.

Programming Concepts in 'C'

CSL6026 **3 – 0 – 0 = 3**

Introduction to 'C' Language: Problem solving methods. Introduction to algorithms and flowcharts.. Top down design. Bottom up design. Structure of a C program. Constant and variable. Identifiers and keywords. Data types. Declarations. Operators and Expressions, Priority and associativity of operators. Type conversion and type casting. Symbolic constants. Input-Output functions - getchar, putchar, scant, printf, gets, puts. Control Statements : while, do-while, for statements, nested loops. If-else, switch, break, continue and goto statements, comma operator. Ternary operator.

Arrays and Functions: Arrays: Defining a array, Passing to a function, Multi dimensional arrays. Strings in C, Operations and Functions of Strings, Storage classes. Arguments; Return value; Parameter passing - Call by value, Call by reference; return statement, calling a function, Recursion basics. Library functions

Pointers and preprocessor directives: Pointers: Declarations. Passing to a function. Operations on pointers. Pointers and arrays, Array of pointers. C-preprocessor-basics-#include, #define, #undef, conditional compilation directive like #if, #else, #elif, #ifdef and #ifndef. Command line arguments.

Structures: Defining and processing. Passing to a function. Pointer to structures. Structure within structure. Array in structure. Array of structures. Unions Dynamic memory management functions like malloc() , callocQ, free(), string()

File handling and related functions: Data files: Open, close, create, process. Unformatted data files Different modes of accessing a file :fopen ,read ,write, fprintf and fscanf and all related functions of a file seekg, seekp,tellp, tellg.

Recommended Books:

1. Gottfried(schaum series), Programming and problem solving **in 'C',TMH.**
2. Kanetkar Y.P. Let us C, BPB Publications
3. The C programming language, by PHI Kernighan and Ritchie
4. The Spirit of C, Cooper Mullish, Jaico Publishing House, Delhi
5. Pointers in C, by Kanetkar Y.P. , BPB Publications
6. Programming in C , by McGraw Hill, New York. **1990.**
7. programming in C ,Jeeyapoovan,Pearson Education.
8. Programming in C, E.Balagurusamy.

C Lab

CSP6026 **0 – 0 – 2 = 1**

Programming exercises using C programming language. Concept of exercises to study various features of the language. Stress to be laid on writing well structured modular and readable programs accompanies by good documentation.

Programs should be made to cover the following areas:
Use of various control structure such as it-then, if-then-else, while-do, do-while, for-loop, switch-case, goto, Practice on arrays one dimensional two dimensional arrays, Strings and its operation, matrices and its operation, multi dimensional arrays Concept and programs on structures and union, Concept of function, Parameter passing, call by value and reference, passing of arrays as parameter, strings, structure, Practice on pointers, malloc() calloc() functions Program related to file handling concept.

Basic IT Lab

CSL6014 **0 – 0 – 2 = 1**

List of Experiments:
Experiment 1
Familiarizing with PC and MS WINDOWS commands.
Experiment 2
Learning to use Office Automation Tool
Experiment 4
MS WORD Complete word processing environment
Experiment 5
MS ACCESS concept of building up databases, developing queries, linking with front end tools
Experiment 6
MS Excel developing spread sheet and its manipulation
Experiment 7
PowerPoint presentation practice on developing a presentation

Data Structures & Algorithm

CSL6033 **3 – 0 – 0 = 3**

Stack & Queue: Contiguous implementation of stack; Various operation on stack; various Polish Notations prefix, postfix, infix, Conversion from one to another - using stack; Evaluation of post & prefix expression. Contiguous implementation of Queue; Linear queue, its drawback; Circular queue; Various operations on queue; Linked implementation of Stack &: Queue operations.

General List: List and its contiguous implementation, its drawback; Singly linked list-operations on it; doubly linked list- operations on it; Circular linked lists: Josephoes Problem; Linked list using arrays, polynomial Arithmetic: addition, Subtraction and Evaluation, Linked Stack and Queues.

Trees and Its Representation: Definitions- Height, depth, order, degree, parent & children relationship etc; Binary Tree- Various theorems, complete binary tree, almost complete binary tree; Tree Traversals-preorder, in order & post order traversals, their recursive and non recursive implementations; Expression tree-evaluation; Linked representations of binary tree operations. Threaded binary trees; Forrest, Conversion of forest into ^ tree Heap definition.

Searching, Hashing & Sorting: Requirements of a search algorithm; sequential search, binary search, indexed sequential search, interpolation search, Hashing- Basics, methods, collision, resolution of collision, chaining; Internal Sorting-bubble sort, selection sort, insertion sort, quick sort, merge sort on linked and contiguous lists, shell sort, heap sort, tree sort.

Graph: Related definitions; Graph representations- adjacency matrix, adjacency list, adjacency multi-list; Traversal schemes - depth first search, breadth first search; Minimum spanning tree; Shortest path algorithm; Kruskal & Dijkstra algorithms. Miscellaneous features: Basic idea of AVL Tree- Definition, insertion & deletion operation; Basic idea of B-tree definition, order, degree, insertion & deletion
operations; B+-tree-definition, comparison with B-tree; Basic idea of string processing.

Recommended Books:
1. Kruse R.L.: Data Structures and Program Design in C; PHI
2. Tennenbaum A.M. & others: Data Structures using C & C++; PHI
3. Horowitz & Sawhaney: Fundamentals of Data Structures, Galgotia Publishers.
4. Schaum Series Data Structure

Object Oriented Analysis & Design

CSL6027 **3 – 0 – 0 = 3**

C++ Basics: Data Hiding, Encapsulation, Data Abstraction, loops and decisions, structures and functions, object and classes, Scope of class and its member, Nested Class, object arrays, Pointers, Construction: parameterized construction, multiple constructor, default constructor, copy constructor, implicit constructor, destructor function, dynamic allocation operators : new(), delete().

Friend function, Friend class, Inline functions, Function overloading, Operator Overloading: Unary, Binary, Inheritance: Single inheritance, Multilevel inheritance, Hierarchical
Inheritance, Hybrid Inheritance, Multiple inheritance.

Virtual base classes, pointers to base and derived classes, virtual functions, early and late binding, templates, exception handling.

C++ I/O System, formatted I/O, creating insertors and extractors, file I/O basis, creating disk files working with file : files & streams, opening & closing a file, read() & write() functions, Detecting end-of-file. File manipulation using seekg(), tellg() functions.

Object Model, OOD and OOA, abstraction, encapsulation, modularity, hierarchy, state, behaviour and relationship among objects. Objects oriented design, identifying classes and object, object diagrams.

Recommended Books:
1. K. R. Venugopal, Raj Kumar & T. Ravi Shankar : Mastering C++, TMH Pub.
2. H. Schildt : C++ complete reference, TMH Pub.
3. Balaguruswami : Object Oriented Programming with C++
4. Robert Lafore : Object Oriented Programming in Turbo C++, Galgotia Pub.
5. Grady Booch : Object Oriented Analysis & Design, Pearson.
6. Stephen Prata: C++ Primer Plus, Galgotia Pub.
7. Bjarne Stroustrup : The C++ Programming Language, Pearson.

Formal Language & Automata Theory

CSL6043 **3 – 0 – 0 = 3**

Review of mathematical preliminaries, Relations, Functions, Set Theory, Predicate and Prepositional Calculus, Principle of mathematical induction/strong mathematical induction.

Formal Languages, Phrase structured grammar and their classification, Chomsky hierarchy, closure properties of families of languages, regular grammar, properties of regular sets, finite automata NFA, DFA & 2DFA, FSM with output Determinism and Non determinism, FA minimization and related theorems.

Context free grammar and their properties, derivation tree, simplifying CFG, unambigufying CFG, CNF and GNF of CFG, push down automata, Two way PDA, relation of PDA with CFG, Determinism and Non determinism in PDA and related theorems.

Concept of Linear Bounded Automata, Context sensitive grammar and their equivalence; unrestricted grammars and their equivalence with TM, determinism and non determinism in TM, TM as acceptor/generator/algorithms and related theorems, Multi tape, multi track TM, automata with two push down store and related theorems.

Introduction to Complexity theory, Introduction to recursive function theory, Recursively enumerable sets, recursive sets, partial recursive sets, Russell's paradox, Church's hypothesis, post correspondence problem, undecidability and some non-computable problems.

Recommended Books:
1. Hopcropft and Ullman: Introduction to automata theory, Languages & Computation, Narosha Publication house.
2. Mishra & Chandrashekharan: Theory of Computer Science, Automata Lanauages & computation, 2nd Ed PHI, New Delhi.
3. Lewish Papadimitra: theory of Computations, Prentice Hall of India, New Delhi.
4. Liu C.L.: Elements of Discrete Mathematics, Mc Graw Hill.
5. Hopcropt, Rajeev Motwani and Ullman: Introduction to Automata Theory, Languages and Computation.

Data Structures Lab

CSP6033 **0 – 0 – 2 = 1**

List of Experiments:
Experiment 1

Programs for implementation and operations on Arrays - one-dimensional, two-dimensional, Multidimensional: Creation, Insertion, and deletion of information elements from various array locations.

Experiment 2

Concept of C - Structures, Nested Structures, Recursion & Iteration Loops.

Experiment 3

Programs for implementation and operations on STACKS & QUEUES -Initializing Stack Structures using Arrays, Creation, Insertion, deletion of information elements from array locations in stacks, Implementation of Double-ended stacks, Double-ended queues, Elementary application programs: (stacks) postfix/ prefix expression evaluation, conversion of infix - to - postfix/ prefix expressions; (queues) - Airport Simulation program.

Experiment 4

Programs for implementation and operations on LINKED LISTS -Initializing node structures for Linear, Circular, Doubly- linear, Doubly-circular lists (with / with out header nodes), creation, insertion, deletion, sorting, reversal, of information nodes from any location in the lists, Elementary application programs: long integer addition / subtraction, Polynomial arithmetic, Classical Josephus problem.

Experiment 5

Programs for implementation and operations on TREES - Initializing node structures for Binary trees, Binary search trees, Expression trees, Threaded binary trees. General trees & forests and their traversal algorithms.

Experiment 6

Programs for implementation and operations on GRAPHS - Initializing node structures forming adjacency matrices & adjacency lists, traversal algorithms - depth-first search, breadth-first search, Construction of minimal spanning trees, shortest-paths from given graphs.

Experiment 7

Programs to implement SEARCHING: Sequential, Binary, Hashing algorithms.

Experiment 8

Programs to implement SORTING: Selection-sort, Bubble-sort, Insertion-sort, Quick-sort, Binary-tree, Heap-sort, Shell-sort, Merge-sort & Radix-sort algorithms.

Definition of Database (create, desc, alter, creating duplicate tables, constraints (primary key, foreign key, check, not null).

OOAD Lab

CSP6027 **0 – 0 – 2 = 1**

List of Experiments:

Experiment 1

Write a program to define a class book that will contain Title, Author and Price of the book as data members. Define Null Constructor, parameterized constructor and copy constructor for the class and a function to display the details of an object. Use the new operator to initialize object of this class through a pointer and display the data member through a member function.

Experiment 2

Write a program to define two classes Alpha and Beta containing an integer each as data members. Define a function Sum() that will be a friend to both Alpha and Beta, That will take one object from each class as argument and return the sum of the data members of the argument objects.

Experiment 3

Write a program to define a class Sample containing a static data member count that will maintain the total number of objects of this class initialized so far.

Experiment 4

Write a program to define a class Complex that will contain real and imaginary as the data members. Define appropriate constructors and a display functions. Overload the binary + and the * operator to add and multiply two complex numbers respectively.

Experiment 5

Write a program to define a class time that will represent a time period in minutes and seconds. Define member functions and overload the following operators for the following:

- ++ Operator that will increment the seconds by 1
- + Operator that will and two objects of time class

Experiment 6

Write a program to define a class Array that will contain an array of integers as a private data member of the class. Overload the subscript operator [] so that it will take an integer index as an argument and return the reference of element at that index in the array.

Experiment 7

Write a program to overload the comma operator for a class such that for the instruction a = (b, c) the larger object of 'c' and 'b' is assigned to 'a'.

Experiment 8

Write a program to define a class Base that will contain a protected integer data member and inherit this class in class called Derived. Override the display function of Base class and add a new member function in the Derived class so that it returns the factorial of the Base class member.

Experiment 9

Write a program to define a class Two dimensional that will represent a point in the plane by its x and y coordinates. The class will contain constructors and member function that can calculate the distance between any two points in the plane. Derive a new class Three dimensional from the class Two dimensional that will add a new member, the z coordinate. Override the function that calculates distance so that kit can calculate the distance between two points in the space.

Experiment 10

Write a program to define an abstract class person that will contain the essential information like name, age and sex of a person. Now derive two classes student and Employee both from the class person. The class Student will contain the academic information such as roll number; school etc. and the class Employee will contain information such as department and salary. In the main function declare and array of Person pointers that can hold the address of either Student or Employee object. The program will ask the user to enter the details of students/Employees, create dynamic objects of these classes using new operator and store them in the array. The program will then display the contents of these objects.

Experiment 11

Write a program to read the contents of a text file and count the number of characters read from the file.

Experiment 12

Write a program that will ask the user to input a file name and copy the contents of that file into another file

Experiment 13

Write a program that will ask the user to enter the details of 5 students and transfer those details into a binary file Stud.dat. Write another file that will read the details of the students and print the names of all those students who have total marks greater that a particular given value.

Experiment 14

Write a program that will take the details of 10 students as input and transfer it into a binary file Write a another program that will be provide a menu to the user for the following purposes:

- To display details of all the students
- To display details of all the students having total marks greater than a given value
- To sort the file on the basis of Roll number of students
- To sort the file on the basis of Total marks of students
- To update the record for a particular student
- To delete the record for a particular student
- To search the details of a particular student on the basis of Roll Number or Name

Experiment 15

Write a program that will take any number of integers from the command line as argument and print the sum of all those integers.

Recommended Books:

1. K. R. Venugopal, Raj Kumar & T. Ravi Shankar : Mastering C++, TMH Pub.
2. H. Schildt : C++ complete reference, TMH Pub.

Second Year

Computer Networking & Protocols

CSL7074 **3 – 1 – 0 = 4**

Introduction

Layered Network Architecture, Review of ISO-OSI Model, Introduction to CP/IP Model.; Data Communication Techniques; Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM).; Multiplexing Techniques; Frequency Division, Time Division, Statistical Time Division Multiplexing.; Physical Layer: Transmission Media: Wires, Cables, Radio Links, Satellite Link, Fiber Optic.; Error Detection and Correction: Single and Burst Error, parity Check Codes, Cyclic Redundancy Code & Hamming Code.

Data Link Layer Protocols

Stop and Wait Protocols: Noise free and Noisy channels, performance and efficiency, Sliding Window Protocols: Go Back and Selective Repeat ARQS, performance and efficiency, verification of protocol., HDLC and ATM: HDLC data link protocol, ISDN, Channel Structure, Asynchronous Transfer Mode (ATM), ATM Cells, Header and Cell Format. Layers in ATM Class 1,2,3,4 traffic.

Medium Access Control Sub layer

Concept of Random Access, Pure ALOHA throughput characteristics of ALOHA Throughputs for finite and infinite populations S-ALOHA., LAN: IEEE 802.3, 802.4 and 802.5 Protocols performance of Ethernet. Token Ring Protocol, FDDI Protocol, Distributed Queue Dual Bus (DQDB) Protocol.

Network and Transport Layer Protocols

General Principles, Virtual circuits and datagram's, Windows flow control, Packet Discarding, Traffic Shaping, Choke RSVP, Network Layer in ATM, Internetworking using Bridge, Routers and Gateways, Routing Algorithms: Optimality principle, shortest path routing-Dijkstra, Flooding and broadcasting, distance vector routing, link state routing, flow based routing, Multicasting routing flow and congestion control. Internet Architecture and Addressing. Transport Layer: Design issues, Quality of Services, Primitives Connection Management: Addressing, Connection Establishment and Releases. Flow control and Buffering, Crash recovery, Element of TCP/IP protocol: User Data gram Protocol, (UDP/TCP) Layering.

Presentation And Application Layer Protocols

Presentation concepts SNMP Abstract Syntax notation. I (ASN-I), Cryptography: Substitutions and Transposition, Ciphers, Data Encryption Standard (DES), DES Chaining, Breaking DES, Public Key Cryptography, Authentication Protocols.

Recommended Books:
1. D. Berekas an R. Gallager, "Data Networks:, second Ed. Prentice Hall, India.
2. D. E. Coner, "Intertworking with TCP/IP", Vol-I.Prentice Hall India.
3. G. E. Keiser, "Local Area Network", Mc Graw Hill, International Ed.
4.W. Stalling, "Data & Computer Communications", Maxwell Macmillan Internation Ed.
5. A. S. Tanenbaum "Computer Network: Second Ed. Prentice Hall, India (tan).
6. B. A. Frouzan, Data Communication, Tata Mc Graw Hill.

Algorithms Design & Analysis

CSL7034 **3 - 0 – 0 = 3**

Algorithm Analysis - Time Space Tradeoff , Asymptotic Notations: Conditional asymptotic notation, Removing condition from the conditional asymptotic notation. Properties of big-Oh notation, Recurrence equations, Solving recurrence equations, Analysis of linear search.

Divide and Conquer: General Method, Binary Search, Finding Maximum and Minimum, Merge Sort.
Greedy Algorithms: General Method, Container Loading, Knapsack Problem, Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Algorithm for Minimum Spanning Tree problem.

Dynamic Programming: General Method, Multistage Graphs, All-Pair shortest paths, Optimal binary search trees - 0/1 Knapsack, Travelling salesperson problem .

Backtracking: General Method, 8 Queens problem, Sum of subsets, Graph coloring, Hamiltonian problem, knapsack problem.

Graph Traversals - Connected Components, Spanning Trees, Bi-connected components, Breadth First Traversal, Depth First Search Traversal.

Branch and Bound: General Methods (FIFO & LC) - 0/1 Knapsack problem - Introduction to NP-Hard and NP-Completeness

Recommended Books:
1. Horowitz E- Computer Algorithms, Galgotia Publication, New Delhi -2000
2. Aho A.V, Hopcrofd J.E & Ullman J.D - The Design and Analysis of Computer Algorithm, Addison Wesley, 1998.

Data Base Design

CSL7085 **3 – 0 – 0 = 3**

Basic concepts
Database & Database Users. Characteristics of the Database Approach advantages of using DBMS. Data Models, Schemas & Instances. DBMS Architecture & Data Independence. System Architecture for DBMS and Data Dictionary, Database Users Data Base languages & Interfaces. Data Modeling using the Entity-Relationship Model -Entity types, Entity Sets, Attributes and Keys, Relationship, Relationship Types, Week Entity Types, Structural Constraints, Enhanced ER Model- Specialization Generalization, Constraints on Specialization Generalization.

Relational Model, Languages & Systems
Relational Data Model Concepts and Constraints. Relational Algebra - select, project, set theoretic, join operations. Overview of Relational Calculas. SQL - A Relational Database Language. Data Definition commands, View and Queries, transaction commands, Specifying Constraints & Indexes in SQL.

Relational Data Base Design
Function Dependencies & Normalization for Relational Databases. Informal design guidelines for relation schemas, Functional Dependencies. Normal forms based on primary keys (INF, 2NF, 3NF& BCNF). Lossless join & Dependency preserving decomposition. Multivalued dependencies, join dependencies (4NF & 5NF), Denormalization.

Transactions, Concurrency Control, Recovery Techniques
Basic concept; ACID properties; transaction state; implementation of atomicity and durability; concurrent executions; basic idea of serializability; view and conflict serializabllity Recovery Techniques Failure Classification , Storage Structure, Recovery and Atomicity Log Based Recovery, Shadow Paging ,stable storage implementation, data access; recovery and atomicity - log based recovery, deferred database modification, immediate database modification, checkpoints.

Emerging fields in DBMS
Distributed databases; Basic idea; distributed data storage; data replication; data fragmentation horizontal, vertical and mixed fragmentation. Concepts of Multimedia databases, Object oriented data base management systems. Data Warehousing&mining.

Recommended Books:
1. Date. CJ, "An Introduction to Database System", Narosa Publishing House. New Delhi.
2. Desai, B, "An Introduction to Database Concepts", Galgotia Publications. New Delhi.
3. Ullman. J.D, "Principles of Database Systems", Galgotia Publications, New Delhi.

4. Elmsari and Navathe, "Fundamental of Database System", Addison Wesley. New York.
5. H.Korth & A. Silberschatz, "DATABASE SYSTEM CONCEPTS", TMH.

Computer Organization

CSL7063 **3 – 1 – 0 = 4**

Data Representation and Digital Components
Number systems, integer and floating point representation, character codes (ASCII, EBCDIC), Error detection and correction codes, Boolean algebra, map simplification, logic gates; combinational circuits: half and full adders, multiplexers, decoders and encoders; sequential circuits: flip-flops, registers, counters; basic computer components and their function.

Principles of Computer Design:
Machine language instructions, Memory address structure, register organization, Instruction fields, instruction types, instruction set selection, Micro operations, Register transfer language, Instruction cycle and Interrupt cycle, Instruction formats and addressing modes.

CPU & Control Unit
Stack, Instruction formats, Addressing Modes, Data Transfer, Data path and control path design, microprogrammed and hardwired control, RISC vs CISC, pipelining in CPU design, super scalar processors.

Computer Arithmetic & I/O Techniques:
Addition, Subtraction, Multiplication and Division Algorithms, I/O addressing, Synchronization, I/O interfacing, Programmed I/O, Interrupt mechanism, DMA, I/O processors.

Memory System & Multiprocessor:
Basic cell of static and dynamic RAM, building large memories using chips, memory array organization', memory hierarchy, memory interleaving, associative memory, cache memory organization, and virtual memory organization, cache coherence, interconnection structure, interprocessor arbitration communication and synchronization.

Recommended Books:
1. Computer organization and architecture by Willian Stallings (PHI)
2. Computer Organization and Architecture by J.P.Hayes (TMH)
3. Computer Architecture by Chaudhary, IIT-Kharagpur.
4. Computer System Architecture by Morris Mano (PHI 3rd edition**)**
5. Digital Computer Logic Design by Morris Mano (PHI)

Operating System with Linux

CSL7055 **3 – 0 – 0 = 3**

Introduction to operating system, Functions provided by operating system, Introduction to multiprogramming. Time sharing and real time systems. Introduction to file systems, Access and allocation methods of file systems, Directory structure of a file system on a disk and tape, File protection.

Introduction to scheduling, CPU scheduling, Various types of CPU scheduling algorithms and their evaluation. Meaning of disk and drum scheduling, Various types of disk and drum scheduling algorithms like FCFS, SCAN etc., CPU protection.

Introduction to memory management. Various types of memory management schemes like paging, Segmentation etc. Concept of virtual memory, Meaning of demand paging, Various page replacement algorithms, Meaning of thrashing and methods to tackle it, Memory protection.

Meaning of deadlocks, Various methods to avoid deadlocks like deadlock avoidance, Deadlock prevention etc., Banker's algorithm for deadlock avoidance. Introduction to concurrent processing, Precedence graphs, Critical section problem, Semaphore concept, Study of classical process co-ordination problem.

Introduction to distributed systems and I/O Subsystem Principles of I/O Hardware: I/O devices, device controllers, direct memory access. Principles of I/O Software: Goals, interrupt handles, device drivers, device independent I/O Software. User space I/O software, I/O protection. Distributed file systems: Design, Implementation, and trends. Performance Measurement, important trends affecting performance issues, performance measures evaluation techniques, bottlenecks and saturation feedback loops. Case study of UNIX/Linux operating system.

Recommended Books:
1. Operating System Concepts by James L. Peterson, Abraham Silberschatz (Addison-Wesley)
2. Operating System Concepts &. Design by Milan Milenkovic (MGH).
3. Modern Operating System by Andrew .S. Tanenbaum (PHI)
4. An Introduction to Operating Systems by Haevey M Dietel(Addison V/esley)

Algorithm Design Lab

CSP7034 **0 – 0 – 2 = 1**

List of Experiments

Experiment 1 : Write a program for Kanpsack Problem using Greedy Method
Experiment 2: Write a program for finding the Maximum Minimum using Divide & Conquer strategy
Experiment 3: Write a Program for Merge Sort using Divide & Conquer Strategy
Experiment 4: Write a Program for Quick Sort using Divide & Conquer Strategy
Experiment 5: Write a Program for constructing minimum cost spanning tree using Prim's Approach
Experiment 6: Write a Program for constructing minimum cost spanning tree using Kruskal's Approach
Experiment 7: Write a program for solving single source shortest path problem using Dijkstra's Algorithm.
Experiment 8: Write a program for Matrix Chain Multiplication using Dynamic Programming Approach.
Experiment 9: Write a program for generating Longest Common subsequence using dynamic programming approach.
Experiment 10: Write a program for implementing all pair shortest path algorithm using Floyd Warshall Approach.

Database Design Lab

CSP7085 **0 – 0 – 3 = 1.5**

List of Experiments:

Experiment 1
Definition of Database (create, desc, alter, creating duplicate tables, constraints (primary key, foreign key, check, not null)
Experiment 2
Creation and modification of Database (insert & interactive input, update, delete)
Experiment 3
Retrieval of Database - select: where, distinct, in, between-and, like, is null, group by-having, order by, column: (format, heading, justify, wrap trunc), nested queries: (any, all, in, not in, exists), joins: (simple, selfjoin, outer join, between joins)
Experiment 4
Views(create,update,drop),sequences(create,alter,drop), synonyms(create, drop), index(create, drop)
Experiment 5
Transaction control (commit, rollback, save point)
Experiment 6
Data control (grant, revoke)
Experiment 7
PL/SQL programming: (Exceptions, cursors, records, tables, triggers, procedures, functions)

Linux Lab

CSP7055 **0 – 0 – 2 = 1**

List of Experiments:
Experiment 1
Write shell script for the following
It should display menu for following
i) Display file contents with line number
ii) Display the file contents with page break
iii) quit.
Experiment 2
Write a shell script for accepting the following information and storing in file.
i) customer name
ii) item description
iii) quantity
iv) rate
the user should get the facility to enter as many record as he wants.
Experiment 3
Calculate factorial value of any number using awk command.
Experiment 4
Write awk command to count the number of times each word occurs in a
sorted list containning one word per line.
Experiment 5
Suppose we have table with following structure
item name no. of item sold,cost/item.write a shell script that will display
i) Total no. of item sold
ii) Total cost of individual item
iii) Total cost of all item
Experiment 6
Write c shell shell script to check the no is prime or not
Experiment 7
Find greatest among three no. using c-shell script
Experiment 8
Write interactive shell script to copy the contents of one file to another
Experiment 9
Display the output of ls-l command in user friendly way.
Experiment 10

Write a shell script to search a word in list of file .two arguments will be used ,one will contain words to searched and another will contain name of files.

Experiment 11

Write menu driven shell script to execute 5 basic command of unix

Experiment 12

Write shell script to check whether the string is having vowel
i) 'unix' or 'UNIX'
ii) Count the length of string

Experiment 13

Write shell script to perform following for each file of current directory
i) delete a file if its extension is .old
ii) copy a file it its extension is .c
iii) move a file it its extension is .Cobol
iv) display the contents of file if it has read permission

Experiment 14

Delete one of one file if two file are similar, if not display proper message. write shell Script using command line argument ,without command line argument.

Experiment 15

Write shell script to generate multiple answer type question.

Introduction to Artificial Intelligence

CSL7105 **3 – 0 – 0 = 3**

General Issues and overview of AI

The AI problems: what is an AI technique; Characteristics of AI applications Problem Solving, Search and Control Strategies General Problem solving; Production systems; Control strategies; forward and backward chaining Exhaustive searches: Depth first Breadth first search.

Heuristic Search Techniques

Hill climbing; Branch and Bound technique; Best first search and A* algorithm; AND/OR Graphs; Problem reduction and AO* algorithm; Constraint Satisfaction problems Game Playing Min Max Search procedure; Alpha-Beta cutoff; Additional Refinements.

Knowledge Representation

First Order Predicate Calculus; Skolemnisation; Resolution Principle and Unification; Inference Mechanisms Horn's Clauses; Semantic Networks; Frame Systems and Value Inheritance; Scripts; Conceptual Dependency AI Programming Languages Introduction to LISP, Syntax and Numeric Function; List manipulation functions; Iteration and Recursion; Property list and Arrays, Introduction to PROLOG.

Natural Language Processing and Parsing Techniques

Context – Free Grammar; Recursive Transition Nets (RTN); Augmented Transition Nets (ATN); Semantic Analysis, Case and Logic Grammars; Planning Overview – An Example Domain: The Blocks Word; Component of Planning Systems; Goal Stack Planning (linear planning); Non-linear Planning using constraint posting; Probabilistic Reasoning and Uncertainty; Probability theory; Bayes Theorem and Bayesian networks; Certainty Factor.

Expert Systems

Introduction to Expert Systems, Architecture of Expert Systems; Expert System Shells; Knowledge Acquisition; Case Studies; MYCIN, Learning, Rote Learning; Learning by Induction; explanation based learning.

Recommended Books:

1. Nils J. Nilsson: Principles of Artificial Intelligence – Narosa Publication house.
2. Artificial Intelligence : A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
3. Elaine Rich and Kevin Knight: Artificial Intelligence – Tata McGraw Hill.
4. Dan W.Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hall of India.
5. Artificial Intelligence, Winston, Patrick, Henry, Pearson Education.
6. Artificial Intelligence by Gopal Krishna, Janakiraman.

Programming concepts with JAVA

CSL7028 **3 – 0 – 0 = 3**

Overview of Java: Features of Java, Byte-code & JVM, data-types, Variables & Arrays, Control statements, Introduction to Java class & object, main () function, garbage collection & finalize () method, this, Inheritance, method overriding, Dynamic method dispatching, super, final, package, Interface, Abstract class, Class path, String Class.

Exception and Multithreads: Exception-type, Uncaught Exception, Using trycatch, throw, throws, finally, Throwable class and object, Exception classes, Create own exception subclass. Creating multiple threads, isAlive(), join(), Thread priorities, synchronization, - Deadlock, wait(), notify(), notify All() methods, Inter-Thread Communication, suspend, resume & stop the threads.

Stream and Socket : I/O classes & Interfaces, File, The Stream Classes, The Byte stream (InputStream, OutputStream, FileInputStream, File Output Stream), Serialization, Network basics, Networking classes and Interfaces, InetAddress, TCP/IP Client/Server socket, URL, URL Connection, Datagram , RMI.

Event handling & working with windows : Delegation event model, event classes, Event listener interface, AWT Classes, Window fundamental, AWT Controls, Layout managers, Menus, Swings:- benefits of swing over AWT , Frames panels and borders ,labels and buttons , tabbed panes , scrolling panes, split
panes , combo boxes , list boxes , text component, menu, toolbar and actions , progress bars, sliders and scrollbars , dialogs.

Web development ; The Applet class, Applet Architecture, Applet skeleton, HTML APPLET Tag, Passing parameter to Applet, get Document Base (), get Code Base (), Applet Context, show Document(). A simple servlet, Javax. servlet package, Reading servlet parameter, web/application server, javax.servlet. http pakage, using cookies, session tracking.

Recommended Books:
1. Michael Morgan, "Java 2 for Professionals Developers", Ed. 01, SAMS Techmedia.
2. Bruce Echel, " Thinking in Java, The Definitive Introduction to Object-Oriented Programming in the Language of World-Wide-Web", Ed-03, PEARSON Education,
3. Philip Heller and Simon Roberts, "Java 2 Developer's Hand Book", BPB Publication
4. Herbert Schildt (2006), "The Complete Reference Java 2 (Updated to Cover J2SE 1.4)", Ed. 05, Tata McGraw-Hill
5. Cay S. Horstmann Gary Cornell, " Core Java 2 Volume-I Fundamentals", Ed-07, PEARSON Education

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Software Engineering Concepts

CSL7092 **3 – 0 – 0 = 3**

Introduction
The software and software engineering problem, approach and goals of software engineering. Software Processes and Models: Processes, projects and products, component software processes, characteristics of a software process, software development process, project management process, software configuration management process. Models: Linear sequential, prototyping, RAD, incremental, spiral, WINWIN spiral, concurrent development model.

Software requirement Analysis and Specification
Software requirement, need for SRS, characteristics and component of SRS, specification languages. Requirement analysis, formal & informal approach, structured analysis, object oriented modeling, Structure of a requirement document, validation of SRS, requirement reviews, size measures, quality metrics.

Manning a software project
Cost estimation, uncertainties in cost estimation, building cost estimation, Size estimation: COCOMO model. Project scheduling, average duration estimation, project handling and milestones, staffing and personnel planning, Rayleigh curve, team structure, software configuration management plans, quality assurance plans, verification and validation, resources monitoring plans, risk management. Function oriented design: Design principles, coupling, cohesion, design notation and specification, structured design technology, verification, network metrics, stability metrics, information flow metrics.

Software Testing Techniques and Strategies
Software testing objectives & principles, test case design, white box testing, black box testing.: A Strategic Approach to software testing, strategic issues, unit integration testing validation testing system testing, the art of debugging.

Software Re-engineering
Software reengineering, software maintenance, a software reengineering process model, reverse engineering, restructuring code, data restructuring, forward engineering, the economics reengineering. Computer Aided Software Engineering: What is CASE, building blocks for CASE, taxonomy of CASE tools, integrated CASE environment, the integration architecture, the case repository. Component Based Software Engineering: CBSE process, domain engineering, Component based development, economics of CBSE.

Recommended Books:
1. Pressman Roger, Software Engineering: A Practitioner's Approach TMH, Delhi.
2. Jalote Pankaj: An Integrated Approach to software Engineering, Narosa, Delhi.
3. R.E.Fairly, Software Engineering Concepts, Mc Graw Hill, Inc 1985.
4. Poyce, Software Project Management, Addison Wesley.

Graphics Design in C

CSL7115 **3 – 0 – 0 = 3**

Computer Graphics and output primitives

Concepts and applications, Random and Raster scan devices, Refresh Cathode ray tubes, LCD monitors, Laser, Printers, Keyboards, Mouse, Scanners, Graphics Software output primitives: Line drawing algorithm : DDA along with Bresenhan's. Circle generating algorithm, Midpoint algorithms: ellipse and other curves. Attributes of output primitive, Antialising, Area filling: Filled area primitive: Scan-line Polygon fill Algorithm, boundary fill algorithm, flood fill algorithm.

2-D-Transformation, Viewing, Clipping
Two-dimensional Transformations: Translation, scaling, rotation, reflection, shear, matrix representation of all homogeneous coordinates, composite transformation. 2D-projections– parallel and perspective projection. Two dimensional viewing, Viewing pipeline Window-to-view port transformation. Clipping operations. Line Clipping: Cohen Sutherland, Nicholl-lee-Nichol land Liang-barsky, Polygon Clipping.

3-D Transformation and Visible surface detection
Three dimensional object representations: Polygon Surface, Tables, Plane Equation. Curved lines and Surfaces: Spline representation, Interpolating and approximation curves, continuity conditions Cubic Splines, Bezier curves B-Spline curves: characteristics and generation, 3-D Transformation. Visible Surface detection Algorithm: Object based and image based methods, depth comparison, A-Buffer, Back face removal, Scan-line method, Depth Sorting Method Area subdivision method.

Overview of multimedia
Overview of multimedia, Classification, basic concept of sound/audio MIDI: devices, messages, software. Speech, Video and Animation: Basic concept, computer-based animation, methods of controlling animation, display of animation, and transmission of animation.

Data Compression
Storage space, coding requirements. Source, entropy and hybrid coding some basic compression technique: runlength code, Huffman code. JPEG: Image preparation, Lossy sequential DCT – based mode, expanded lossy DCT based mode, Lossless mode, Hierarchical mode. MPEG, Huffman Encoding, LZW compression.

Recommended Books:
1. Principles of Interactive Compo Graphics; W.M.Newman & Robert F Sproull.
2. Computer Graphics by Rogers TMH.
3. Introduction to Computer Graphics Anirban Mukhopadhyay & Arup Chattopadhyay.
4. Schaum's outlines – Computer Graphics Mc Graw Hill International Edition.5
5. Computer Graphics by Donand Hearn & M. Pauline Baker PHI.
6. Multimedia Computing Communication & Applications " By Ralf Steimnety & Kerla Neshtudt." Prince Hall.
7. Principles of Multimedia by Ranjan Parekh TMH.
8. "Multimedia Systems Design", P.K.Andleigh & K. Thakrar, Prentice Hall Pvt. Ltd.

Artificial Intelligence Lab

CSP7105 **0 – 0 – 2 = 1**

List of Experiments:

Experiment 1
Write a prolog program to find the rules for parent, child, male, female, son, daughter, brother, sister, uncle, aunt, ancestor given the facts about father and wife only.

Experiment 2
Write a program to find the length of a given list

Experiment 3
Write a program to find the last element of a given list

Experiment 4
Write a program to delete the first occurrence and also all occurrences of a particular element in a given list.

Experiment 5
Write a program to find union and intersection of two given sets represented as lists.

Experiment 6
Write a program to read a list at a time and write a list at a time using the well defined read & write functions.

Experiment 7
Write a program given the knowledge base, If x is on the top of y, y supports x.
If x is above y and they are touching each other, x is on top of y. A cup is above a book. The cup is touching that book. Convert the following into wff's, clausal form; Is it possible to deduce that `The book supports the cup'.

Experiment 8
Write a program given the knowledge base, If Town x is connected to Town y by highway z and bikes are allowed on z, you can get to y from x by bike. If Town x is connected to y by z then y is also connected to x by z. If you can get to town q from p and also to town r from town q, you can get to town r from town p. Town A is connected to Town B by Road 1. Town B is connected to Town C by Road 2.
Town A is connected to Town C by Road 3. Town D is connected to Town E by Road 4. Town D is connected to Town B by Road 5. Bikes are allowed on roads 3, 4, 5. Bikes are only either allowed on Road 1 or on Road 2 every day. Convert the following into wff's, clausal form and deduce that `One can get to town B from townD'.

Experiment 9
Solve the classical Water Jug problem of AI.

Experiment 10
Solve the classical Monkey Banana problem of AI.

Experiment 11

Solve the classical Crypt arithmetic problems such as DONALD + GERALD = ROBERT of AI.
Experiment 12
Solve the classical Missionary Cannibals problem of AI.
Experiment 13
Solve the classical Travelling Salesman Problem of AI.
Experiment 14
Solve the classical Blocks World Problem of AI.
Experiment 15
Write a program to search any goal given an input graph using AO* algorithm.

Recommended Books:
1.Ivan Bratko : Logic & prolog programming.

Graphics Design Lab

CSP7115 **0 – 0 – 2 = 1**

List of Experiments:
Experiment 1
Write a program to draw a Line Using DDA algorithm.
Experiment 2
Write a program to draw a Line Using Bresanham's algorithm.
Experiment 3
Write a program to draw polygon (Triangle, square, pentagon etc).
Experiment 4
Write a program to draw Circle/Ellips using Mid Point Circle algorithm.
Experiment 5
Write a program to implement Area filling using Scan Line Method.
Experiment 6
Write a program to implement Boundary fill 4-connected / 8-connected Algorithm using Recursion/Non Recursion.
Experiment 7
Write a program to implement Flood fill Algorithm using Recursion/ Non Recursion. OR Write a program to Fill a solid colored area./ Write a program to Fill a Multicolor Boundary area.
Experiment 8
Write a program to Translate a Line/Polygon.
Experiment 9
Write a program to Rotate and Scaling of a Line/Polygon With respect to
i) Origin
ii) Pivot Rotation
Experiment 10
Write a program to perform Shearing of Polygon with respect to
i) X-axes
ii) Y-axes
Experiment 11
Write a program to perform reflection of polygon with respect to
i) X-axes
ii) Y-axes
iii) With respect to origin
iv) With respect to line Y=X
v) With respect to line Y=mX+C
Experiment 12
Draw Bazier curve using Local Control Point (60,20),(80,100),(150,90),(180,50).
Experiment 13
Write a program to perform Clipping of Line using Cohen Sutherland Algorithm.
Experiment 14
Prepare a game using graphics basic object and various transformations.
OR Create a Paint Brush Like Application that include facility to draw all the basic object. OR Develop any useful tool (like watch) using graphics basic object and various transformations.
Experiment 15
Implementation of text compression using dynamic Huffman coding/ static Huffman coding

Recommended Books:
1. Graphics and programming in C Rogers T , Stevens BPB
2. Graphics under C by Yashwant Karnetkar BPB.

Programming with Java Lab

CSP7028 **0 – 0 – 2 = 1**

List of Experiments:
Experiment 1 Write a program to create a class called **PassObjectDemo** with two variables **a** and **b** of type integer and method with following prototype- **Pass Object Demo get Parameter To Sum (Pass Object Demo p, Pass Object Demo q)** Which will accept two parameter of object of same class two add the

individual member variable **a** and **b** of both the objects and returns the same class object in the called area. Store this retired object in the called area and display the value of variables of this object by using **void getDisplay()** method.**[*Passing object as a parameters and returning object*]**

Experiment 2 Create two classes called **A** and **B**. the class has two variables a, b and two function **void getData()**, **void getSum()**. Similarly class B has two variable c, d and two method **void getData()**, **void getSum()**. Now pass reference of class A into B, and reference of class B into class A to access members.

[Note: Program for two way communication within the classes]

Experiment 3 Write a program to create two classes called **A** and **B.** Class A has two variable **'a'** and **'b'** with two methods **void getData()** used to get values of **'a'** and **'b'** and **void getDisplay()** used to display the sum of relevant variables. Similarly class **B** has two variables **'c'** and **'d'** of type integer with two function **void getData()** used to get values of **'c'** and **'d'** and **void getDiv()** used to divide corresponding variables. Extend **A** by **B** and call methods of **B** in the class **A** by **dynamically**. Use **super()** to call constructor of B if require.

[Use of super]

Experiment 4 Write a program to generate own exception class called **MyException** used to generate exception during **execution**. Create **ExceptionDemo** class; inside this define one method named **void getAge (int a)** which will **throws MyException** if negative age is entered. Create another class **UsingMyException** used to call this method with an integer parameter for age.

Experiment 5 Write a program to define a method called **void call ()** in class **CallMe**. Create another class **Caller** which implements **Runnable** interface, to create multiple threads. These threads will call **void call ()** method of **CallMe** class synchronously by using **synchronized block or synchronized statement**.

Create another class **Synch** in which main () method will start execution of these threads as chilled threads.

[Synchronization]

Experiment 6 Write a program to demonstrate **Inter-thread communication** for two threads consider thread 1 generating one integer number & thread 2 accepting it via two method **wait ()** and **notify ().**

Experiment 7 Write a program to create I / O stream to read and write content of disc file.

Experiment 8 Write a program to create Client/Server socket to establish communication in bi-directional.

Experiment 9 Write a program to create URL connection to current find out status of a web site.

Experiment 10 Write a program to show all the AWT Components of the Java.

Experiment 11 Write a program to show all the Swing Components of the Java.

Experiment 12 Write a program to demonstrate Swing/AWT components with is corresponding event and listener interfaces, event registration, and called relevant event methods.

Experiment 13 Create an Applet for accepting parameters through **getParameter()** method of Applet class which is coming from **param** tag of relevant **HTML** file and display the gathered parameter through **public void paint(Graphics g) method** in the Applet. Also find out the location of applet & path by using **getDocumentBase(), getCodeBase()** methods of **Applet** class. And also use Applet Context interface and showDocument() method to context another applet.

Experiment 14 Write a program to create simple servlet and deploy by using tomcat server.

Experiment 15 Write a program to implement session tracking and cookies in the servelet.

Recommended Books:

(i) "Head First Java" by Kathy Sierra & Bert Bates O'Reilly Publication.

(ii) "Head First Servlets and JSP " Bryan Basham , Kathy Sierra & Bert Bates.

Software Engineering Concepts Lab

CSP7092 **0 – 0 – 2 = 1**

Hands on experience in working with the following Software Engineering tools:

1. Rational Unified Process (RUP): An iterative software development process framework.
2. Rational Requisite Pro: A Requirements Management tool.
3. Rational Rose: A Software Designing tool.
4. Rational Robot: A Fundamental Testing tool.
5. Rational Test Manager: A Test Management tool.
6. Rational Purify: A Performance Testing tool.
7. Rational Quantify: A Performance Testing tool.
8. Rational Pure Coverage: Performance Testing tool.
9. Rational Clear Case: A Configuration Change Management tool.
10. Rational Clear Quest: A Configuration Change Management tool.
11. Rational SODA: A Documentation tool.
12. Rational Project Console: A Project Monitoring tool.
13. Rational Software Architect (RSA): RSA is a modelling and development environment that uses the Unified Modelling Language (UML) for designing architecture for C++ and Java-EE applications and web services.

Third Year

Web Application Design with .NET

CSL8029 **3 – 0 – 0 = 3**

Integrated Development Environment: Introduction, Integrated Development Environment Overview, Project Window, Toolbox, Form Layout Window, Properties Window, Menu Bar and Tool Bar, A Simple Program: Displaying a Line of Text.

Introduction to Visual Basic Programming: Introduction, Visual Programming and Event-Driven Programming, A Simple Program: Printing a Line of Text on the Form, Another Simple Program: Adding Integers, Memory Concepts, Arithmetic, Operator Precedence, Decision Making: Comparison Operators.
Control Structures: Introduction, Algorithms, Pseudocode, Introduction to Control Structures, If/Then Selection Structure, If Then/Else Selection Structure, While Repetition Structure, Do While Repetition Structure, Do Until Repetition Structure, Essentials of Computer- Controlled Repetition, For Repetition Structure, Examples Using the For/Next Repetition Structure, Select Case Multiple-Selection Structure, Do/Loop While Repetition Structure, Do/Loop Until Repetition Structure, Exit Do and Exit For Statements, Data Type Boolean, Constant Variables, Logical Operators, Structured Programming Summary, Visual Basic Data Types.
Sub Procedures and Function Procedures: Introduction, Form Modules, Sub Procedures, Function Procedures, Call-by-Value vs. Call-by-Reference, Exit Sub and Exit Function, Storage Classes, Scope Rules.
Arrays: Introduction, Arrays, Declaring Arrays, Examples Using Arrays, Passing Arrays To Procedures, Sorting Arrays, Searching Array: Linear Search and Binary Search, Multidimensional Arrays, Control Arrays, Dynamic Arrays, Variable Arguments: ParamArray, Function Array.
Strings, Dates and Times: Introduction, Fundamentals of Characters and Strings, String Data Type, String Cop.catenation with & and +, C°I1!paring Character Strings, Operator Like, Manipulating the Individual Characters in a String: Mid$, Left$, Right$, and InStr, Searching for Substrings in String Using InStr and InStrRev, Ltrim$, Rtrim$, and Trim$, Sting$ and Space$, Replacing Substrings in a String with Function Replace, Reversing Strings with Function StrReverse, Converting Strings to Uppercase and Lowercase, Conversion Functions, String Formatting, Date and Time Processing, Date and Time Formatting, String Arrays.
Basic Graphical User Interface Concepts: Introduction, Controls, TextBox Control, MaslcEdit Control, ComboBox Control, ListBox Control, Scrollbars, Slider Control, Menus, Pop-Up Menus, Function MsgBox.
Advanced Graphical User Interface Concepts: Introduction, Multiple Document Interface (MDI), Multiple Forms.
Mouse and Keyborad: Introduction, Changing the Shape of the Mouse Pointer, Mouse Events, Mouse Buttons, Shift, Ctrl and Alt Keys, Drag-and-Drop, Key Events, KeyPreview Property.
Error Handling and Debugging: Introduction, When Error Handling Should be Used, A Simple Error-Handling Example: Divide by Zero, Nested on Error Statements, Err Object, Resume Statement.

Recommended Books:
1. Deitel & Deitel & T.R. Nieto-Visual Basic 6 How to Program, Pearson Education, New Delhi-2005.
2. Content Development Group, Visual Basic 6, Tata McGraw Hill, New Delhi.

Compiler Design Principles

CSL8056 **3 – 1 – 0 = 4**

Introduction
Introduction to Compiler, Single and Multi Pass Compilers, Translators, Phases of Compilers, Compiler writing tools, Bootstrapping, Back patching. Finite Automata and Lexical Analysis: Role of Lexical Analyzer, Specification of tokens, Recognition of tokens, Regular expression, Finite automata from regular expression to finite automata, transition diagrams, Implementation of lexical analyzer, Tool for lexical analyzer – LEX, Error reporting.

Syntax Analysis and Parsing Techniques
Context free grammars, Bottom-up-parsing and top down parsing, Top down parsing: elimination of left recursion, recursive descent parsing, Predictive parsing; Bottom Up Parsing: Operator precedence parsing, LR parsers, Construction of SLR, canonical LR and LALR parsing tables, Construction of SLR parse tables for ambiguous grammar, the parser generator – YACC, error recovery in top down and bottom up parsing.

Syntax Directed Translation & Intermediate code generation
Synthesized and inherited attributes, dependency graph, Construction of syntax trees, bottom up and top down evaluation of attributes, S-attributed and L-attributed definitions. Postfix notation; Three address code, quadruples, triples and indirect triples, Translation of assignment statements, control flow, Boolean expressions and Procedure Calls.

Runtime Environment
Storage organization, activation tree, activation record, allocation strategies, Parameter passing, symbol table, dynamic storage allocation.

Code Optimization & Code Generation
Basic blocks and flow graphs, Optimization of basic blocks, Loop optimization, Global data flow analysis, Loop invariant computations. Issues in the design of Code generator, register allocation, the target machine and a simple code generator.

Recommended Books
1. Compiler-Principles, Techniques and Tools by Alfred V.Aho, Ravi Sethi and J. D.Ullman, Addison Wesley.
2. Principles of Compiler Design, Alfred V.Aho and J.D.Ullman, Narosa Publication.
3. Compiler Design in C by A.C. Holub, Prentice Hall of India.
4. Compiler Construction (Theory and Practice) by A.Barret William and R.M.Bates (Galgotia Publication)
5. Compiler Design, Kakde, Compiler Design, Galgotia Publication.

Mobile Computing

CSL8143 **3 - 0 – 0 = 3**

Introduction to telecommunication systems

Introduction: Current Wireless Systems: Overview of Paging Systems, Cordless Phones, Cellular Telephone Systems, Satellite Communication, Wireless LANs, Blue tooth. Medium access control, Telecommunication Systems – SDMA, TDMA, CDMA, GSM Satellite Systems - Basics, Routing Localization, Handover. Broadcast Systems Overview, Cyclic Repetition of Data, Digital Audio Broadcasting, Digital Video Broadcasting.

Wireless Standards

Wireless LAN – IEEE 802.11 – Infrared vs Radio Transmission, Infrastructure Networks, Ad-hoc Networks, HIPERLAN, Bluetooth Wireless ATM – Working group, Services, Reference Model, Functions, Radio Access Layer, Handover, Location Management, Addressing Mobile Quality of Service, Access Point Control Protocol.

Mobile Network Layer

Mobile IP Goals, Assumptions and Requirements, Entities, IP packet Delivery Agent Advertisement and Discovery, Registration. Tunneling and Encapsulation, Optimization Reverse Tunneling, IPv6, DHCP. Adhoc Networks - Characteristics, Performance Issues, Routing in mobile hosts.

Mobile Transport Layer & Wireless Application Protocol

Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Transmission / Timeout Freezing Selective Retransmission, Transaction oriented TCP. Architecture, Datagram Protocol, Transport Layer Security , Transaction Protocol, Session Protocol , Application Environment , Wireless Telephony.

Application Issues

Dynamic DNS File System, Synchronization Protocol**,** Context aware applications**,** Security, Analysis of existing wireless network, GSM Systems Overview: Architecture, Location tracking, and call setup. Security, Data Services N/W Signaling, GSM mobility management, Operations, Administration and maintenance.

Recommended Books

1. J Schiller ,'Mobile Communication' , Addison Wesley, 2000
2. John Wiley,' Mobile Communication Design Fundamentals', 1993.
3.Wireless Communication and Networks, Pearson Education, 2003.
4.WAP-Wireless Application Protocol, Pearson Education, 2003

Web Application Design Lab

CSP8029 **0 – 0 – 3 = 1.5**

Experiment 1: Develop a Web Application for an educational institution. The master page should consist of Institution Name, Logo and Address. Also, it should provide hyperlinks to Departments, Facilities Available and Feedback. Each department page and facilities page should be designed as static pages. The hyperlinks should navigate to these static pages in the form of Content Pages associated with Master Page designed. The Feedback page should have fields to enter Name, Email and Message with Submit and Cancel Buttons. Database should be created to store these three data.

Experiment 2: Develop a Web Application for a Bank. The BANK Database should consist of following tables: tbl_Bank (BankID: int, BankName: string) tbl_Branch (BranchID: int, BankID: int, BranchName: string) tbl_Account (AccountNo: int, BankID: int, BranchID: int, CustomerName: string, Address: string, ContactNo: int, Balance: real) (Note: AccountNo and BankID together is a composite primary key). The master page of this web application should contain hyperlinks to New Bank Entry, New Branch Entry (of selected Bank), New Customer Entry (based on branch and bank) and Report Generation. The hyperlinks should navigate to respective content pages. These content pages provide the fields for respective data entry. The reports should be generated (display in grid) as below:

Display all records of particular bank.

Display all records of a branch of particular bank.

The balance should be displayed for the entered account number (Bank and Branch are input through ComboBox controls and Account number is input through TextBox).

Project Part – I

CSD9091 **0 – 0 – 8 = 4**

Design/ Implementation work under the guidance of a faculty member. Prior to registration a detailed plan of work should be submitted by the student to the Director of the School for approval by faculty board.

Project

CSD8008 **0 – 0 – 24 = 12**

During the last semester students would carry out project work under the supervision of a faculty member of the school. Student can also pursue his project work from industry/institution with the prior approval of Director. In such cases, one supervisor would be from industry and other from the school. The internal supervisor shall monitor progress of the student continuously. There will a final presentation of the project work at the end of the semester.

ELECTIVES

Neural Network & Fuzzy Logic

CSE7106 **3 – 0 – 0 - = 3**

Neural Networks Characteristics: History of Development in neural networks, Artificial neural net terminology, model of a neuron, Topology, Types of learning. Supervised, Unsupervised learning. Basic Learning laws, Hebb's rule, Delta rule, widrow and Hoff LMS learning rule, correlation learning rule instar and ouster learning rules.

Unsupervised Learning: Competitive learning, K-means clustering algorithm, Kohonen's feature maps. Radial Basis function neural networks- recurrent networks, Real time recurrent and learning algorithm. Introduction to Counter propagation Networks- CMAC Network, ART networks, Application of NN in pattern recognition, optimization, Control, Speech and decision making.

Fuzzy Logic: Basic concepts of Fuzzy logic, Fuzzy vs Crisp set, Linguistic variables, membership functions, operations of Fuzzy sets, Fuzzy if-then rules, Variables inference techniques, defuzzification techniques, basic Fuzzy interference algorithm, application of fuzzy logic , Fuzzy system design implementation , useful tools supporting design.

Recommended Books:

1.Patterson Dan W, "Introduction to artificial Intelligence and Expert systems", 3rd Ed., PHI
2. Simon Haykin, "Neural Networks" Pearson Education.
3. Yen and Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education.
4. Berkin Riza C and Trubatch, " Fuzzy System design principles- Building Fuzzy IF-THEN rule bases", IEEE Press.
5. Yegna Narayanan, "Artificial Neural Networks". 8th Printing. PHI(2003)
6. Jacek M Zaurada, "Introduction to artificial neural Networks Jaico Publishing Home, Fouth Impression.

Network Programming

CSE7075 **3 – 0 – 0 = 3**

Setting up a Counting Server, Port Testing and Protocol entries, Service Ports, Socket Addressing, Network byte-order, Setting up the Socket server, Binding a server's socket to a service, Exercise problems.
Setting up a Counting Client, Looking up a Domain Name, Connecting the socket to a server, Recv, Recvfrom and Recvmsg procedures, Compiling and Running a complete Client-Server code.
Framework of TCP Client Server Programs: The TCP Client Framework, TCP Server Framework, Socket API system Calls: Socket, Connect, Write, Read, Close, bind, listen, accept, recv, send, sendmsg, sendto, shutdown and getpeername. Concurrent Server Programs: concurrency mechanism-fork, master and slave processes of Server Programs, Echoing Network Communications, Passive Socket, The PassiveTCP( ) procedure, A Server program, Creating an Active Socket and Listing the contents of a directory on a remote Host

Recommended Books:

1. J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Addison-Wesley Publishing, 2nd edition, 2002
2. TCP/IP Illustrated Volumes 1, by W. Richard Stevens, published by Addison-Wesley, 1994.
3. Unix Network Programming, The Sockets Networking API, Volumes 1, by W Richard Stevens, Bill Fenner, Andrew M. Rudoff, published by Addison-Wesley.
4. D. E. Comer, Computer Networks and Internets, Prentice Hall, Englewood Cliffs, NJ, USA.
5. L. L. Peterson and B. S. Davie, *Computer Networks: A Systems Approach*, Morgan Kaufmann Publishers.
6. M. J. Donahoo and K. L. Calvert, TCP/IP Sockets in C: Practical Guide for Programmers (The Practical Guides Series), Morgan Kaufmann Publishers, January 2000
   K. L. Calvert and M. J. Donahoo,
7. TCP/IP Sockets in Java: Practical Guide for Programmers (The Practical Guides Series), Morgan Kaufmann Publishers, October 2001

Data Warehousing and Mining

CSE7086 **3 – 0 – 0 = 3**

DATA WAREHOUSING: Data warehousing Components, Building a Data warehouse, Mapping the Data Warehouse to a Multiprocessor Architecture, DBMS Schemas for Decision Support, Data Extraction, Cleanup, and Transformation Tools –Metadata.
BUSINESS ANALYSIS : Reporting and Query tools and Applications, Tool Categories, The Need for Applications, Cognos Impromptu, Online Analytical Processing (OLAP), Need – Multidimensional Data Model, OLAP Guidelines, Multidimensional versus Multi-relational OLAP, Categories of Tools, OLAP Tools and the Internet.
DATA MINING: Introduction, Data: Types of Data, Data Mining Functionalities, Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Data Warehouse, Issues, Data Preprocessing.
ASSOCIATION RULE MINING AND CLASSIFICATION: Mining Frequent Patterns, Associations and Correlations, Mining Methods, Mining Various Kinds of Association Rules, Correlation Analysis, Constraint

Based Association Mining, Classification and Prediction, Basic Concepts, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Back-propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction.
CLUSTERING AND APPLICATIONS AND TRENDS IN DATA MINING : Cluster Analysis, Types of Data, Categorization of Major Clustering Methods, K-means, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid Based Methods, Model-Based Clustering Methods, Clustering High Dimensional Data, Constraint Based Cluster Analysis, Outlier Analysis, Data Mining Applications.

Recommended Books:
1. Alex Berson and Stephen J. Smith, " Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition.
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Second Edition, Elsevier, 2007.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, " Introduction To Data Mining", Person Education, 2007.
4. K.P. Soman, Shyam Diwakar and V. Ajay ", Insight into Data mining Theory and Practice", Easter Economy edition, Prentice Hall of India, 2006.
5. G. K. Gupta, " Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India.
6. Daniel T.Larose, "Data Mining Methods and Models", Wile-Interscience, 2006.

Parallel Processing

CSE7153 **3 – 0 – 0 = 3**

Introduction to Parallel Processing: Flynn's classification, SIMD and MIMD operations, Shared Memory vs. message passing multiprocessors, Distributed shared memory, Hybrid multiprocessors.
Shared Memory Multiprocessors: SMP and CC-NUMA architectures, Cache coherence protocols, Consistency protocols, Data pre-fetching, CC-NUMA memory management, SGI 4700 multiprocessor, Network Processors.
Interconnection Networks: Static and Dynamic networks, switching techniques, Routers, Internet techniques Message Passing Architectures: Message passing paradigms, Grid architecture, Workstation clusters, User level software .
Scheduling: Multiprocessor Programming Technique, Scheduling and mapping, Internet web servers, P2P, Content aware load balancing.

Recommended Books:
1. John Hennessy and David Patterson, Computer Architecture: A Quantitative Approach, Morgan Kauffman Publisher.

Enterprise Resource Planning

CSE8093 **3 – 0 – 0 = 3**

ERP AND TECHNOLOGY: Introduction, Related Technologies, Business Intelligence, E-Commerce and E-Business, Business Process Reengineering, Data Warehousing, Data Mining, OLAP, Product life Cycle management , SCM, CRM
ERP IMPLEMENTATION: Implementation Challenges, Strategies, Life Cycle, Pre-implementation Tasks, Requirements Definition, Methodologies, Package selection, Project Teams, Process Definitions, Vendors and Consultants, Data Migration , Project management, Post Implementation Activities.
ERP IN ACTION & BUSINESS MODULES : Operation and Maintenance, Performance, Maximizing the ERP System, Business Modules; Finance, Manufacturing, Human Resources, Plant maintenance, Materials Management, Quality management, Marketing, Sales, Distribution and service.
ERP MARKET, Enterprise Application Integration: ERP and E-Business, Total quality management, Future Directions, Trends in ERP.

Recommended Books:
1. Jim Mazzullo,"SAP R/3 for Everyone", Pearson,2007.
2. Jose Antonio Fernandz, " The SAP R /3 Handbook", Tata McGraw Hill, 1998.
3. Alexis Leon, "ERP DEMYSTIFIED", Tata McGraw Hill, Second Edition, 2008.
4. Mary Sumner, "Enterprise Resource Planning", Pearson Education, 2007.
5. Biao Fu, "SAP BW: A Step-by-Step Guide", First Edition, Pearson Education, 2003.

Cryptography & Network security

CSE8124 **3 – 0 – 0 = 3**

Security trends, Attacks and services, Classical crypto systems, Different types of ciphers, LFSR sequences, Basic Number theory, Congruences, Chinese Remainder theorem, Modular exponentiation, Fermat and Euler's Theorem, Legendre and Jacobi symbols, Finite fields, continued fractions.
Simple DES, Differential cryptoanalysis, DES, Modes of operation, Triple DES, AES, RC4, RSA Attacks, Primality test – factoring.
Discrete Logarithms, Computing discrete logs, Diffie-Hellman key exchange, ElGamal Public key cryptosystems, Hash functions, Secure Hash, Birthday attacks, MD5, Digital signatures, RSA – ElGamal, DSA.
Authentication applications, Kerberos, X.509, PKI – Electronic Mail security, PGP, S/MIME, IP security, WebSecurity , SSL, TLS, SET.
System security, Intruders, Malicious software, viruses, Firewalls, Security Standards.

Recommended Books:
1.Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", 2nd ed, Pearson,
2.William Stallings, "Crpyptography and Network security Principles and Practices", Pearson/PHI, 4th ed, 2006.
3.W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007.
4.Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing Third Edition – Prentice Hall of India,

Research Methodology and Computer Applications

CSE8134 **3 – 0 – 0 = 3**

Introduction to Computer Science Research: What is Research?, Types of Research, Why Research?, Significance & Status of Research in Computer Science. Steps in Research: Having grounding in Computer Science, Major Journals & Publication in Computer Science, Major Research areas of Computer Science, Identification, Selection & Formulation of research problem, Hypothesis formulation, Developing a research proposal, Planning your research, The wider community, Resources and Tools, How engineering research differs from scientific research, The role of empirical studies.

Basis of Computer Science Research

Introduction to Formal Models and Computability: Turing Machine & Computability, Undecidability, Diagonalization and Self-Reference, Reductions.

Introduction to Basic Techniques for Designing Algorithms: Divide-and-Conquer, Dynamic Programming, Greedy. Analysis of Algorithms.

Complexity Theory: Resources and Complexity Classes, Relationship between Complexity Classes, Reducibility and Completeness, P vs NP problems.

Qualitative Reasoning: Qualitative Representations, Representing Quantity, Representing Mathematical Relationship, Ontology, State, Time and Behaviors, Space and Shape, Compositional Modeling, Domain Theories, and Modeling Assumptions, Qualitative Reasoning Techniques, Model Formulation, Causal Reasoning, Simulation, Comparative Analysis, Teleological Reasoning, Data Interpretation, Planning, Spatial Reasoning, Applications of Qualitative Physics.

Simulation: What is simulation? How a simulation model works? Time & randomness in simulation. Applications of simulations.

Research Data: What is data, Mathematical statistics and computer science views on data analysis, Methods for finding associations: regression and pattern recognition, Method for aggregation and visualisation: principal components and clustering, Hypothesis testing.

Literature Survey: Finding out about your research area, Literature search strategy, Writing critical reviews, Identifying venues for publishing your research.

Writing Papers and the Review Process: Preparing and presenting your paper. The conference review process, Making use of the referees' reports, The journal review process, Group exercise in reviewing research papers.

Thesis Writing: Planning the thesis, Writing the thesis, Thesis structure, Writing up schedule, The Oral examination and Viva Voce.

Only for additional reading:

Ethical issues and Professional Conduct Ethics in general, Professional Ethics, Ethical Issues that arise from Computer Technology, General Moral Imperatives, More Specific Professional Responsibilities, Organizational Leadership Imperatives.

Recommended Books:

1. Research Methods By Francis C. Dane, Brooks/ Cole Publishing Company, California.
2. Basic of Qualitative Research (3rd Edition) By Juliet Corbin & Anselm Strauss, Sage Publications (2008)
3. The Nature of Research: Inquiry in Academic Context By Angela Brew, Routledge Falmer (2001)
4. Research Methods By Ram Ahuja, Rawat Publications (2001)
5. The Computer Science and Engineering Handbook by (Editor-in-Chief) By Allen B. Tucker, jr. CRC Press, A CRC Handbook (only relevant parts of chapters of Chapter-2, Chapter-3, Chapter-4 Chapter-9,Chapter-10 & Chapter-32)

E-Commerece

CSE8017 **3 – 0 – 0 = 3**

Introduction to Electronic Commerce: E-Commerce**,** History of E-Commerce, Application of E Commerce in Direct Marketing and Selling, Value Chain Integration, Supply Chain Management, Corporate Purchasing, Financial and Information Services, Obstacles in adopting E-Commerce Applications, EDI, Future of E Commerce.

E-Commerce and Online service industries: Online financial services. Online travel services. Online career services.

E-Commerce Marketing Concepts: Basic marketing concepts for internet marketing, Ecommerce marketing and branding strategies, Strengthening the customer relationship.

Customer –effective Web design: Requirements of Intelligent Websites, Website Goals and Objectives, planning the budget, analyzing website structure, fixed versus flexible webpage design, choosing a page size ,website development tools, design alternatives, outsourcing web design, testing and maintaining websites.

Overview of E-Commerce Technologies: Encryption overview, Elements of an encryption system, Secret key encryption, Public-key encryption, Digital signatures, Digital Certificates, Cryptography export restrictions, Secure Sockets Layer(SSL), Secure Electronic Transactions (SET),Smart Cards and its applications.

Security Issues in E-Commerce Technologies: Introduction to Security, Passwords, Viruses, Firewalls, Encryption (PGP, SHTTP, SSL).

Electronic Payment Systems: Overview of Electronic Payment Systems, Cybercash (Customer to Merchant Payments, Peer to Peer Payments, Security). Smart Card (Card Types, Closed or Open Security, Privacy, Card Costs, Non Card Costs), Electronic Banking, Electronic Fund Transfers.

Recommended Books:

1. Doing Business on the Internet E-COMMERCE (Electronic Commerce for Business): S. Jaiswal, Galgotia Publications.
2. E-Commerce An Indian Perspective: P.T.Joseph, S.J., PHI.
3. E-Commerce Business.Technology. Society, Kenneth C. Laudon, Carol Guerico Traver, Pearson Education.
4. E-Commerce: Schneider, Thomson Publication
5. Electronic Commerce: Greenstein, Merylin, Tata Mc.Graw Hill

Digital Image Processing

CSE8116 **3 – 0 – 0 = 3**

DIGITAL IMAGE FUNDAMENTALS: Elements of digital image processing systems, Vidicon and Digital Camera working principles, Elements of visual perception, brightness, contrast, hue, saturation, machband effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD.

IMAGE ENHANCEMENT: Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement.

IMAGE RESTORATION: Image Restoration - degradation model, Unconstrained restoration - Lagrange multiplier and Constrained restoration, Inverse filtering-removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations-spatial transformations.

IMAGE SEGMENTATION: Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and Merging – Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

IMAGE COMPRESSION: Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.

Recommended Books:

1. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing', Pearson ,Second Edition, 2004.
2. Anil K. Jain, , Fundamentals of Digital Image Processing', Pearson 2002.

Software Project Management

CSE8094 **3 – 0 – 0 = 3**

INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT: Project Definition, Contract Management, Activities Covered By Software Project Management, Overview Of Project Planning, Stepwise Project Planning.

PROJECT EVALUATION: Strategic Assessment, Technical Assessment, Cost Benefit Analysis, Cash Flow Forecasting, Cost Benefit Evaluation Techniques, Risk Evaluation.

ACTIVITY PLANNING: Objectives, Project Schedule, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass, Backward Pass, Activity Float, Shortening Project Duration, Activity on Arrow Networks, Risk Management, Nature Of Risk, Types Of Risk, Managing Risk, Hazard Identification, Hazard Analysis, Risk Planning And Control.

MONITORING AND CONTROL: Creating Framework, Collecting The Data, Visualizing Progress, Cost Monitoring, Earned Value, Priortizing Monitoring, Getting Project Back To Target, Change Control, Managing Contracts Introduction, Types Of Contract, Stages In Contract Placement, Typical Terms Of A Contract, Contract Management, Acceptance.

MANAGING PEOPLE AND ORGANIZING TEAMS: Introduction, Understanding Behavior, Organizational Behaviour: A Background, Selecting The Right Person For The Job, Instruction In The Best Methods, Motivation, The Oldman Hackman Job Characteristics Model, Working In Groups, Becoming A Team, Decision Making, Leadership, Organizational Structures, Stress, Health And Safety – Case Studies.

Recommended Books:

1. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.
2. Royce, "Software Project Management", Pearson Education, 1999.
3. Jalote, "Software Project Management in Practice", Pearson Education, 2002.
4. Bob Hughes, Mikecotterell, "Software Project Management", Third Edition, Tata McGraw Hill, 2004.

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Electronics & Communication Engineering

Introduction

The field of electronics is the fastest growing and the most rapidly changing area of technology in the current times. Electronics has become the all-pervasive technology, which finds application in all spheres of engineering including computers, communication, defense, mechatronics, instrumentation, automation, robotics, artificial intelligence, computer networks, satellites, education etc. The use of electronics has brought about a drastic change in the way human civilization exists today.

The School currently offers a 4 Year (8 Semester) B.Tech(Electronics & Communication Engineering) program, M.Tech(Electronics & Communication Engineering) program and PhD. The field of communication has benefited significantly because of the growth of electronics technology. Currently it is possible to communicate using computers and mobile phones across cities, deserts, and oceans via satellites orbiting in space but there is more to come. Latest technologies in the communication field are entirely dependent on the field of electronics.

Objectives

The school of Electronics & Communication engineering has been set up to impart training of the highest standards to the students, in the field of electronics, thus preparing them to meet the exacting demands of the highly competitive global industrial market. The objectives of the B.Tech Programme are:

- The progressively impart training starting from the basic fundamentals of electronics and covering the entire spectrum of current technologies being used in the field of communication, digital design, chip design and industry in general.
- To instill in the students a sense of curiosity about the field of electronics and make them confident to explore and innovate.

To ensure that the students develop strong work ethics, organizational skills, team work and understand the importance of being a thorough professional.

Training Methodology

The emphasis of the program is on practical, hands-on learning. Significant part of the curriculum is dedicated to ensuring that the students get to work with latest equipment and explore the implementation of the knowledge learnt through the class-work. Besides regular class-work, skills of the students are honed by their participation in group discussions, presentations, group assignments and project work which is mandatory 5th semester onwards. The students face continuous evaluation based on these activities. The students are also required to undergo summer training in an industrial environment to learn industrial standards of project management, teamwork, quality considerations and documentation.

Infrastructure

State-of-the-art laboratories, containing the latest equipment have been set up to ensure that the students get complete facilities to thoroughly understand and explore the concepts of electronics as learnt in the class-room. Specifically keeping in mind the fact that the University is located in a region where day-to-day industrial interaction is not feasible, the latest equipment is provided in the laboratories itself to ensure that the students are kept abreast of the newer technologies being used in the industry. The school has established laboratories in collaboration with Multi-national companies like Xilinx Inc., USA & Freescale Semiconductors Ltd., USA. The School has also established the **"Center for Embedded Instrumentation & Networked Controls"** with funding from UGC. The following laboratories have been established to provide the students with the best possible facilities for enhancing the value of the learning process:

1. **Analog Electronics Lab**
   - Basic Electronics & Electrical Engg.Lab
   - Linear Integrated circuits Lab
   - Electronics Circuits Lab
2. **SMVDU Xilinx Lab - Established with support from M/s Xilinx Inc., USA**
   - Digital Electronics Lab
   - VHDL & FPGA Lab
   - Electronic Measurement & Instrumentation Lab
   - Control Systems Engineering Lab
3. **SMVDU Freescale Systems Lab - Setup in collaboration with Freescale Semiconductors Inc.(Erstwhile Motorola Semiconductor)**
   - Microprocessor Lab
   - Microcontrollers Lab
   - Embedded Systems Lab
4. **Communication Engineering Lab**
   - Analog Communication Lab

- Digital Communication Lab
- Microwave Lab
- Optical Fiber Communication Lab
- Switching Networks Lab

5. **Electrical Machines Lab**
   - Power Electronics Lab
   - Electrical Machines Lab
6. **PCB Fabrication & Project Lab**
7. **Center for Embedded Instrumentation & Networked Controls (Research Lab)**
   - Embedded Systems Lab
   - Image processing
   - Wireless Networks Lab
   - Signal Processing Lab
8. **Microelectronics Lab (Research Lab)**
   - VLSI Lab
   - MEMS Lab

Program Structure of the
B. Tech (Electronics & Communication Engineering) Program (2014-18)

Semester I **First Year**

Course Code	Course Title	L-T-P	Credit
MTL 1012	Calculus & Linear Algebra	3-0-0	3
ECL 1010	Basic Electronics	4-0-0	4
PHL 1011	Fundamental of Physics	3-0-0	3
ECL 1020	Basic Electrical Engineering	3-0-0	3
MEL 1039	Engineering Graphics with CAD	1-0-2	2
LNL 1411	Communication Skills	3-0-0	3
ECP 1200	Programming using MATLAB	0-0-2	1
PHP 1011	Physics Lab	0-0-2	1
ECP 1021	Electrical & Electronics Lab	0-0-2	1
	NSS (Non-Credit)	40 Hours	0
	Total Credits	**17-0-8**	**21**

Semester II **First Year**

Course Code	Course Title	L-T-P	Credit
MTL 1022	Differential Equations & Vector Calculus	3-0-0	3
CSL 1021	Introduction to 'C' Programming	3-0-0	3
ECL 1030	Electronic Circuits & Simulation	4-0-0	4
ECL 1022	Network Analysis & Synthesis	3-1-0	4
BUL 1061	Engineering Economics & Management	3-0-0	3
LNP 1142	Language Lab-I	0-0-2	1
MEP 1115	Workshop Practice	0-0-2	1
CSP 1021	Programming Lab	0-0-2	1
ECP 1030	Circuits & Simulation Lab	0-0-2	1
	Total Credits	**16-1-8**	**21**

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credit
MTL 2023	Integral Transforms & Complex Analysis	3-0-0	3
ECL 2020	Industrial Electronics	4-0-0	4
ECL 2040	Electromagnetic Field Theory	4-0-0	4
ECL 2151	Analog Communication Engineering	4-0-0	4
ECL 2070	Digital Electronics	4-0-0	4
PCL 2042	Introduction to Logic	3-0-0	3
ECP 2201	Electronics Workshop Lab	0-0-2	1
ECP 2070	Digital Electronics Lab	0-0-2	1
ECP 2020	Industrial Electronics Lab	0-0-2	1
ECP 2151	Analog Communication Engineering Lab	0-0-2	1
	Total Credits	**22-0-6**	**26**

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credit
ECL 2030	Linear Integrated Circuits & Applications	4-0-0	4
ECL 2152	Digital Communication Engineering	4-0-0	4
ECL 2041	Antenna & Wave Propagation	3-0-0	3
ECL 2060	Microprocessor Systems	4-0-0	4
ECL 2071	Digital System Design using VHDL	4-0-0	4
	Environmental Studies	3-0-0	NC
ECP 2030	Linear Integrated Circuits Lab	0-0-2	1
ECP 2060	Microprocessor Lab	0-0-2	1
ECP 2071	VHDL Lab	0-0-2	1
ECP 2152	Digital Communication Engineering Lab	0-0-2	1
	Total Credits	**20-0-8**	**23**

Semester V **Third Year**

Course Code	Course Title	L-T-P	Credit
	Open Elective-I		**3**
ECL 3180	Signals Processing & Linear systems	3-1-0	4
ECL 3090	Control Systems	4-0-0	4
ECL 3080	Embedded Electronics & Microcontrollers	3-0-0	3
ECL 3091	Electronic Measurement & Instrumentation	3-0-0	3
ECL 3100	Communication & Data Networks	3-0-0	3
ECP 3090	Instrumentation & Control Lab	0-0-2	1
ECP 3080	Microcontroller Application Lab	0-0-2	1
ECD 3990	Minor Project-I (ECE)		1
	Total Credits	**19-1-6**	**23**

Semester VI **Third Year**

Course Code	Course Title	L-T-P	Credit
	Open Elective-II		3
ECE XXXX	**School Elective-I**	3-0-0	3
ECL 3050	Microwave Engineering	3-1-0	4
ECL 3181	Real Time Digital Signal Processing	3-1-0	4
ECL 3130	IC Fabrication & VLSI	4-0-0	4
ECP 3050	Microwave Engineering Lab	0-0-2	1
ECP 3130	VLSI Lab	0-0-2	1
ECP 3181	DSP Lab	0-0-2	1
ECD 3991	Minor Project-II (ECE)		3
	Total Credits	**16-2-6**	**24**

Note: *Practical Training* to be performed in the summer vacation following the sixth semester

Semester VII **Fourth Year**

Course Code	Course Title	L-T-P	Credit
ECC 4980	Colloquium		3
	Open Elective-III(HM)		3
ECL 4170	Optical Fiber Communication	3-0-0	3
ECE XXXX	School Elective – II		3
ECE XXXX	School Elective-III		3
BUL 4021	Industrial Psychology	3-0-0	3
ECP 4170	OFC Lab	0-0-2	1
ECP 4202	Simulation/EDA Tool	0-0-2	1
	Total Credits	**15-0-4**	**20**

Semester VIII **Fourth Year**

Course Code	Course Title	L-T-P	Credit
ECD 4992 / ECC 4982	(Major Project + **Open Elective-IV**) (9+3) / Internship (12)		12
	Total Credits		**12**

Total Credits **= 170 credits**

List of School Electives

For School Elective-I, II & III
ECE 3101 Introduction to Wireless Networks
ECE 4191 Speech Processing
ECE 4192 Image & Video Processing
ECE 4190 Multimedia Communications
ECE 4140 Introduction to MEMS Design
ECE 4171 Optoelectronic Devices
ECE 425B Object Oriented Programming
ECE 4082 Advanced Embedded Systems
ECE 4160 Satellite Communication
ECE 3100 Pervasive Computing & WSN
ECE 4161 Radar & Navigational Guides
ECE 3091 Virtual Instrumentation using LABView
ECE 404B Digital Integrated Circuits

Basic Electrical Engineering

ECL 1020 **3 – 0 – 0 = 3**

UNIT - I

Introduction to Electrical Engineering: Essence of electricity, Conductors, semiconductors and insulators (elementary treatment only); Electric field; electric current, potential and potential difference, electromotive force, electric power, ohm's law, basic circuit components, electromagnetism related laws, Magnetic field due to electric current flow ,force on a current carrying conductor placed in a magnetic field, Faradays laws of electromagnetic induction. Types of induced EMF's, Kirchhoff's laws. Simple problems.

UNIT-II

Network Analysis : Basic definitions, types of elements , types of sources, resistive networks, inductive networks, capacitive networks, series parallel circuits, star delta and delta star transformation , Network theorems- Superposition , Thevenins's, Maximum power transfer theorems, Norton theorem and simple problems.

UNIT-III

Alternating Quantities : Principle of ac voltages , waveforms and basic definitions, relationship between frequency, speed and number of poles, root mean square and average values of alternating currents and voltage, form factor and peak factor, phasor representation of alternating quantities, the J operator and phasor algebra, analysis of ac circuits with single basic network element, single phase series circuits, single phase parallel circuits, single phase series parallel circuits, power in ac circuits. Fundamentals of AC- Average value, RMS value, form factor, crest factor, AC power and power factor, phasor representation of sinusoidal quantities. Simple series, parallel & series-parallel circuits containing R-L, R-C, R-L-C parameters. Active, Apparent & Reactive power, Resonance in series & parallel circuits.

UNIT-IV

Transformers : Principles of operation, Constructional Details, Ideal Transformer and Practical Transformer, Losses, Transformer Test, Efficiency and Regulation Calculations.

Recommended Books:

- Electrical & Electronic Technology, Hughes, Pearson Education
- Basic Electrical Engineering, Cathey, Nasar, TMH
- Basic Electrical Engineering, Mittal, TMH
- Basic Electrical Engineering, B. L. Theraja
- Electrical Engineering Fundamentals, Vincent Deltoro, PHI
- Network & Systems, D Roy Choudhary
- Circuit Analysis, A.K. Chakrabarti

Basic Electrical & Electronics Engineering

ECL 1021 **4 – 0 – 0 = 4**

Introduction to Electrical Engineering: Essence of electricity, Conductors, semiconductors and insulators (elementary treatment only); Electric field; electric current, potential and potential difference, electromotive force, electric power, ohm's law, basic circuit components, electromagnetism related laws, Magnetic field due to electric current flow ,force on a current carrying conductor placed in a magnetic field, Faradays laws of electromagnetic induction. Steady State Solution of DC Circuits – Introduction to AC Circuits –Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops –Registers and Counters – A/D and D/A Conversion (single concepts)

Recommended Books:

- Electrical & Electronic Technology, Hughes, Pearson Education
- Basic Electrical Engineering, Cathey, Nasar, TMH
- Basic Electrical Engineering, Mittal, TMH
- Basic Electrical Engineering, B. L. Theraja
- Electrical Engineering Fundamentals, Vincent Deltoro, PHI
- Digital Fundamentals, Thomas L. Floyd, Prentice Hall, Inc
- Digital logic and computer design: M Morris Mano –PHI
- Modern digital electronics: R.P. Jain. TMH
- *Digital Design: Principles and Practices, by* Wakerly J F, Prentice-Hall,
- "Digital Experiments Emphasizing Systems and Design," by David Buchla, Prentice Hall, Inc,

Basic Electronics

ECL 1010 **4-0–0=4**

Introduction:- Semiconductor Classification ,Semiconductor bonds, Energy band description ,Semiconductor types, Hall effect.

Diodes:- P-N junction-I/V characteristics, diode equivalent circuits, semiconductor diodes, rectifiers-(efficiency, ripple factor),filters,clipers,clampers.

Transistors:- BJT construction, characteristics (cb,ce,cc), load line. BJT biasing. FET, JFET, MOSFET (Depletion and enhancement), FET biasing.
Transistor Modeling:- BJT small signal model, hybrid equivalent model,FET small signal model.
Amplifiers:- Single stage amplifiers, voltage gain, effect of frequency on Gain, multistage amplifier.
Other Semi-conductor devices- SCR'S , Diacs, triacs, and other thyristors, basic theory of operation, characteristics, Theory and operation of UJT,
Oscillators:- Feedback BH criteria, oscillator types, sinusoidal oscillator, Hartley oscillator,Collpitts Oscillator, Phase shift,Wein bridge oscillator, crystal oscillator.

Recommended Books:
- Basic Electronics: Devices, Circuits & IT Fundamentals, Kal, PHI
- Basic Electronics for Scientists
- Electronic Devices & Circuits: An Introduction, Mottershead,
- Electronic Devices & Circuits, Boylestad, Nashelky, PHI
- Semiconductor Devices , Nandita Dass, PHI
- Electronic Devices & Circuits, Milman & Halkias
- Electronic Devices & Circuits, Theodore Bogart, Jr

Electronic Circuits & Simulation

ECL 1030 **4 – 0 – 0 = 4**

Bias stability: - Operating point, Q point variation due to changes in β & temperature, Stability factor, stability factor analysis (variation of I_{CO}, V_{be})
Small signal Analysis:-BJT small signal analysis, h parameters, FET small signal analysis, small signal high frequency model (π model), Millers theorem.
Large Signal Amplifiers: Classification of power amplifiers (Class A, B, C & D), push pull amplifier,
Multistage Amplifier:-General cascade system, configuration of RC coupled, transformer coupled, direct couple multistage amplifier, General frequency consideration, Effect of cascading on the bandwidth of an amplifier.
Frequency response of Amplifier:-Frequency response characteristics, the high frequency response of CE stage, the gain bandwidth product, common source stage at high frequency, Emitter and source followers at high frequency, the time constant method of obtaining the response.
Feedback Amplifiers:-Feedback concepts, the transfer gain with feedback, general characteristics of feedback amplifier. Input resistance, output resistance, voltage series feedback pair, current series feedback, current shunt feedback, voltage shunt feedback.
Regulated power supplies:- ordinary DC power supply, voltage regulators, Zener as voltage regulator, series voltage regulators, principle of switching voltage regulator, IC voltage regulator, its specification and performance characteristics
Circuit Simulation using PSPICE: SPICE and its types, limitations; Circuit Descriptions: Input files, Element values, Nodes, Circuit elements, Sources, Types of Analysis, Output Variables and commands; Format of circuit and output files, simulation of simple DC circuits.

Recommended Books:
- Integrated Electronics, Millman & Halkias,Tata Mc Graw Hill
- Microelectronics, Millman & Grabel, Tata Mc Graw Hill
- Electronics Circuits, Schilling & Belove, McGraw Hill
- Introduction to PSpice using OrCad for Circuits & Electronics, Rashid, Pearson Education

Digital Electronics

ECL 2070 **4 – 0 – 0 = 4**

Basic concepts of Boolean Algebra: Review of number systems - Binary, Hexadecimal, conversion from one to another, complement arithmatic, Signed and unsigned numbers and their arithmetic operations. BCD, Excess-3, Gray and Alphanumeric codes. Review of Boolean algebra, De-Morgan's Theorems, Standard Forms of Boolean Expressions, Minimization-Techniques: K-MAPS, VEM Technique, Q-M (Tabulation) method.
Logic Gates & families: Logic Families: TTL, MOS, CMOS, Bi-CMOS; Performance parameters of IC families: input and output loading, fan-in, fan-out, tri-state, current drive, voltage levels, noise margins, power-speed tradeoff; Unused inputs; Interfacing between logic families.
Combinational Logic Circuits: Problem formulation and design of Basic Combinational Logic Circuits, Combinational Logic Using Universal Gates. Basic Adders, ALU, Parity-Checkers and Generators, Comparators, Decoders, Encoders, Code Converters, Multiplexer (Data Selector), De-multiplexers
Sequential Circuits: Latches, Flip-flops (SR, JK, T, D, Master/Slave FF,) Edge-Triggered Flip-Flops, Flip-Flop Operating Characteristics, Basic Flip-Flop Applications, Asynchronous Counter Operation, Synchronous Counter Operation, Up/Down Synchronous Counters.
Shift registers & Memories
Shift Register Functions, Serial In - Serial Out Shift Registers, Serial In - Parallel Out Shift Registers, Parallel In - Serial Out Shift Registers, Parallel In - Parallel Out Shift Registers, Bidirectional Shift Registers,Basics of Semiconductor Memories, Random-Access Memories (ROM), Read Only Memories (ROMs), Programmable ROM's (PROMs and EPROM's), PAL, PLA.
A/D and D/A convertor
Characteristics of ADC, Types of ADC- SAR, Dual Slope, Flash ADC. Characteristics of DAC, R-2R Ladder, Weighted Resistance Type
Circuit and electrical interfacing considerations
Transmission line effect, reflection, crosstalk, Noise sources, shielding and decoupling

Recommended Books:

- "Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc
- "Digital Systems - Principles and Applications" by Tocci, R. J. and Widner, Prentice Hall,
- Switching and finite automata theory: Z V Kohavi.–TMH
- Digital Logic Circuit Analysis & Design, by Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and J. David Irwin, Prentice Hall,
- Digital logic and computer design: M Morris Mano –PHI
- Modern digital electronics: R.P. Jain. TMH
- *Digital Design: Principles and Practices, by* Wakerly J F, Prentice-Hall,
- "Digital Experiments Emphasizing Systems and Design," by David Buchla, Prentice Hall, Inc,

Digital Electronics Fundamentals

ECL 2073 **3 – 0 – 0 = 3**

Logic gates: Transfer characteristics, propagation delays, power consumption, fan-in, fan-out. TTL, ECL and MOS logic circuits.
Number systems and codes: Signed and unsigned numbers and their arithmetic operations. BCD, Excess-3, Gray and Alphanumeric codes
Boolean Algebra: SOP, POS, Min-term & Max-term, Minimization of Boolean equations using Boolean algebra & K-maps
Combinational and Arithmetic circuits: Multiplexers, De-multiplexers, decoders, encoders, parity checkers, half and full adders.
Sequential circuits: Flip-flops- RS, JK, D-type and master-slave flip-flops. Flip-Flop specifications. Counters – Binary, ripple, synchronous, Mod-K and decade counters and their design, Shift registrars and multi-vibrators.
Semiconductor memories: ROM, PROM, EPROM, Static and dynamic RAM, memory addressing
DAC and ADC: Weighted resistance DAC, R-2R ladder network, flash ADC, single and dual slope ADC, successive approximation ADC.
Recommended Books:
- "Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc,
- OP-AMP and Linear IC's By Ramakant A. Gayakwad, Prentice Hall
- Digital Integrated Electronics, By Taub and Schilling, McGraw Hill
- Op-Amp and Linear IC's, By Coughlin and Driscoll, PHI

Fundamentals of Digital Electronics

ECL 6071 **3 – 0 – 0 = 3**

Logic gates: Transfer characteristics, propagation delays, power consumption, fan-in, fan-out. TTL, ECL and MOS logic circuits.
Number systems and codes: Signed and unsigned numbers and their arithmetic operations. BCD, Excess-3, Gray and Alphanumeric codes
Boolean Algebra: SOP, POS, Min-term & Max-term, Minimization of Boolean equations using Boolean algebra & K-maps
Combinational and Arithmetic circuits: Multiplexers, De-multiplexers, decoders, encoders, parity checkers, half and full adders.
Sequential circuits: Flip-flops- RS, JK, D-type and master-slave flip-flops. Flip-Flop specifications. Counters – Binary, ripple, synchronous, Mod-K and decade counters and their design, Shift registrars and multi-vibrators.
Semiconductor memories: ROM, PROM, EPROM, Static and dynamic RAM, memory addressing
DAC and ADC: Weighted resistance DAC, R-2R ladder network, flash ADC, single and dual slope ADC, successive approximation ADC.
Recommended Books:
- "Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc
- OP-AMP and Linear IC's By Ramakant A. Gayakwad, Prentice Hall
- Digital Integrated Electronics, By Taub and Schilling, McGraw Hill
- Op-Amp and Linear IC's, By Coughlin and Driscoll, PHI

Network Analysis & Synthesis

ECL 1022 **3 – 1 – 0 = 4**

Foundations of Network Analysis
Passive elements and their circuit properties, Voltage & Current Sources, Source Transformations, Network Theorems (Tellegen's, Reciprocity, Compensation Theorem), Duality, Concept of Complex Impedance
Network Graph Theory: Concept of a network graph terminology used in network graph, relation between twigs and links, Properties of a tree in a graph, Formation of incidence matrix, No. of trees in a graph, Cut set matrix and tie set matrix

Laplace Transform
Definition, Inverse L.T, Properties of L.T, Solution of Linear Differential equations, Transformed Circuit Components Representation, Independent Sources, Resistance Inductance and Capacitance Parameters, Transfer Functions
Transient Response
Initial Conditions, Transient and Steady State Responses, Transient responses of RL, RC and RLC Networks
Two-port Networks
Two-port parameters (z, y, h, ABCD), Transfer functions using two-port parameters. Interconnection of two-ports, Analysis of Ladder Networks
Network Synthesis

Causality and Stability, Hurwitz polynomials. Positive real functions, Frequency Response of Reactive One – ports, Synthesis of Reactive One-ports by Foster's method, Synthesis of Reactive One-ports by Cauer's Method.

Filters

Determination of pass and attenuation bands constant K-type, Low pass, High pass, Band pass, Band stop, M-derived filters, Lattice filter

Recommended Books:

- M E Van Valkenburg, "Network Analysis", Prentice Hall of India,
- F F Kuo, "Network Analysis and Synthesis", Wiley,
- K.M.Soni, " Circuits & Systems" Kataria & Sons,

Industrial Electronics

ECL 2020 **4 – 0 – 0 = 4**

Unit I: Power Diodes and Transistors

Power Diodes: Construction, Switching characteristics Power BJT: Construction, Operation, Steady state characteristics, Switching characteristics. Switching limits, Break down voltages, Second breakdown, Thermal runaway. Power MOSFET: Construction, Operation, Static characteristics, Switching characteristics, Forward and reverse bias Safe Operating Area

Unit II: Thyristors

SCR: Construction, Operation, Transistor analogy, Static characteristics, Switching characteristics, SCR ratings, Gate Characteristics, Triggering requirements, Triggering techniques

TRIAC: Construction, Operation, Steady state characteristics, Triggering modes, Principle of DIAC, Phase control using TRIAC.

Unit III: AC Power Converters

AC – DC converters: Concept of line & forced commutation Single phase Semi & Full converters for R & R-L loads, Effect of free wheeling diode, Three phase Semi & Full converters for R load.

AC – AC converters: Single phase AC voltage controller for R & R-L loads, Three phase AC voltage controller for R load.

Unit IV: DC Power Converters

DC - DC converters: DC Chopper: - Working principle of step down chopper and step up chopper, choppers for R-L load, DC- AC converters: Inverter: - Working principle of single phase, Bridge inverter for R & R-L load

Unit V: DC & AC Rotating Machines

Principle of Electromechanical energy conversion

DC machines: Construction, Induced emf & torque equations, Characteristics of shunt and series machines and Speed Control

Three phase induction motors: Construction, Working and Characteristics.

Synchronous machine: Construction, Working and Voltage/Speed Regulation

Unit VI: Transformers

Single Phase and Three phase Transformers: Construction, Working Principle, Equivalent circuit, Phasor Diagaram, Open/Short Circuit Tests, Voltage Regulation

Recommended Books:

- M. D. Singh & K B Khanchandani, "Power Electronics", TMH, New Delhi.
- Guru, Hiziroglu, "Electric Machinery & Transformer"
- M. H. Rashid, "Power Electronics circuits devices and applications", PHI, New Delhi.
- P.C. Sen, "Modern Power Electronics", S Chand & Co New Delhi.
- Ned Mohan, T. Undeland & W. Robbins, "Power Electronics Converters applications and design", John Willey & sons, Singapore.
- H. Cotton, "Electrical Technology", CBS.
- Nagrath Kothari, "Electrical Machines", TMH.

Electromagnetic Field Theory

ECL 2040 **4 – 0 – 0 = 4**

Unit I: Introduction

Vector Analysis, Coordinate System, Gradient, Divergence, Curl, Laplaceian in rectilinear, Cyllindrical, Spherical Coordinate System, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem

Unit II: Time varying fields and Maxwell's equations

Introduction, The Equation of Continuity For Time-Varying Fields, Inconsistency Of Ampere's Law, Maxwell's Equation in Integral and differential form, Physical Significance of Maxwell Equation, Boundary conditions.

ELECTROMAGNETIC WAVES

Solution For Free-Space Conditions, Uniform Plane Waves & Propagation, The Wave Equations For A Conducting Medium, Sinusoidal Time Variations, Conductors And Dielectrics, Polarization, Reflection By A Perfect Conductor Normal Incidence & Oblique Incidence, Reflection By A Perfect Dielectric — Normal Incidence & Oblique Incidence, Reflection At The Surface Of A Conductive Medium.

RADIATION

Potential Functions And Electromagnetic Field, Potential Functions For Sinusoidal Oscillations, Alternating Current Element, Power Radiated By Current Element, Application To Short Antennas, Radiation From A Monopole Or Dipole.

Transmission Line

Circuit theory analysis of Transmission Line, Loss less and Lossy transmission lines, Reflection coefficient, Transmission Coefficient, VSWR, Input Impedance, Matching of Transmission Line, pulse excitation. Group Velocity and Phase velocity.

Recommended Books:

- Fields & Wave Electromagnetics , DK Cheng
- Electromagnetic Waves and Radiating Systems, Jordan & Balmin
- Elements of Electromagnetics, Sadiku
- Engineering Electromagnetics: W H Hayt & J A Buck
- Advanced Engineering Electromagnetics: C A Balanis

Linear Integrated Circuits

ECL 2030 **4 – 0 – 0 = 4**

Differential Amplifiers

Basics of Differential Amplifier, Transistorized Differential Amplifier, Configurations of Differential Amplifier, Analysis of Dual Input Balanced Output Differential Amplifier, Constant Current Bias, Current Mirror Circuit, Cascading of Differential Amplifiers.

Introduction to Operational Amplifiers

The Ideal Op-Amp, Block diagram Representation of Op-Amp, Voltage Transfer Curve of Op-Amp, Integrated Circuit: Package Types, Pin Identification and Temperature- Ranges, Interpretation of Data sheets and Characteristics of an Op-Amp, Inverting and Non-Inverting Configuration, Ideal Open-Loop and Closed-Loop Operation of Op-Amp, Block diagram Representation of Feedback Configurations, Voltage-Series Feedback Amplifier, Voltage-Shunt Feedback Amplifier, Differential Amplifiers with One & Two Op-Amps.

Frequency Response of an Op-Amp

Introduction, Frequency Response, Compensating Networks, Frequency Response of Internally Compensated Op-Amp, Frequency response of Non-compensated Op-Amp, Closed-Loop Frequency Response, Circuit Stability, Slew Rate.

General Linear Applications

DC & AC Amplifiers, Peaking Amplifier, Summing, Scaling and Averaging amplifier, Instrumentation Amplifier, Voltage-to-Current Converter, Current-to-Voltage Converter, The Integrator, The Differentiator, Log and Antilog Amplifier, Peak Detector, Precision Rectifiers, Comparator, Zero Crossing Detector, Schmitt Trigger, Sample and Hold Circuit, Clippers and Clampers, A/D and D/A Converters.

Active Filters and Oscillators

Active Filters:- Butterworth Filters, Band-Pass Filters, Band Reject Filters, All-Pass Filters. Oscillators and Wave Generators:- Phase Shift Oscillator, Wien Bridge Oscillator, Voltage-Controlled Oscillator(VCO), Square Wave Generator, Triangular Wave Generator, Saw-tooth Wave Generator.

Specialized IC Applications

Introduction, Universal Active Filter, The 555 Timer, Monostable and Astable Multivibrator using IC 555, Phase-Locked Loop(PLL), Voltage Regulators.

Recommended Books:

- OP-AMP and Linear IC's By Ramakant A. Gayakwad, Prentice Hall
- Digital Integrated Electronics, By Taub and Schilling, McGraw Hill
- Integrated Electronics, By Millman J. and Halkias C.C., McGraw Hill.
- Op-Amp and Linear IC's, By Caughlier and Driscoll, PHI

Analog Communication Engineering

ECL 2151 **3 – 1 – 0 = 4**

Introduction: Historical Review, Elements of an Electronic Communication System, Communication Channel and their Characteristics, Mathematical Models for Communication Channels.

Frequency Domain Analysis of Signals and Systems: The Fourier Transform, Properties of the Fourier Transform, Rayleigh`s Energy Theorem, the inverse relationship between time and frequency, Dirac Delta Function, Fourier transform of Periodic signals, transformation of signals through Linear systems, Paley-Wiener Criterion, Hilbert transform, Band Pass signals, Transmission of Band Pass signals, Phase and group delay.

Analog Signals Transmission and Reception: Introduction, Amplitude Modulation, Double side Band Suppressed carrier Amplitude Modulation, Single side band Amplitude Modulation, Vestigial side band Modulation, Implementation of AM Modulators and De-Modulators, Frequency division Multiplexing, Analog Modulation, representation of FM and PM signals, Spectral Characteristic of Analog Modulated Signals, Implementation of Angle Modulators and De-Modulators, AM Radio Broadcasting, FM Radio Broadcasting

Effect of Noise on Analog communication System: White noise, shot noise, thermal noise, noise equivalent bandwidth, Effect of Noise on AM , Effect of Noise on DSB-SCAM, Effect of Noise on SSBAM, Carrier Phase Estimation with Phase Locked loop , Effect of Noise on Angle Modulation, Threshold Effect in Angle Modulation, Pre-emphasis and De-emphasis in FM.

Recommended Books:

- Communication Systems, Simon Haykin, John Willey & Sons
- Communication Systems Engineering, Proakis & Salehi, Pearson Education
- Radio Engineering, G.K. Mithal
- Electronic Communication, Roody & Coolen
- Electronic Communication, Kennedy

Microprocessor & Systems

ECL 2060 **3 – 0 – 0 = 3**

Introduction to 8085 Microprocessor: Functional block diagram – Registers, ALU, Bus systems, Memory & Instruction cycles Timing diagrams, Address Decoding techniques, Addressing modes, Instruction Set, Assembly Language Programming, Interrupts-Types & handling, ISR, Stack architecture

Memory and Peripheral interfacing: Basic interfacing concepts - Memory space partitioning - Buffering of buses – Timing constraints - Memory control signals - Read and write cycles, Interfacing RAM, ROM, 8255PPI, Interfacing applications using 8255. Need for direct memory access - DMA transfer types

Intel 16 bit Microprocessor: Register organization of 8086 – Architecture - Physical Memory organization - I/O addressing capability, Addressing modes of 8086 - Instruction set of 8086 - Assembler directives and operators, Assembly language programming, Interrupt Architecture

Freescale 32 bit ColdFire Processor:-Introduction to ColdFire Core, Comparison with 8085 & 8086 Architecture, Introduction to MCF5223X Microprocessor Architecture & Functional Blocks

Recommended Books:

- Gaonkar R. S, "Microprocessor Architecture: Programming and Applications with the 8085/8086A", New Age International (P) Ltd.,
- K. Ray, K. M. Bhurchandi – Advanced Microprocessors and Peripherals – Architecture, Programming and Interface – Tata McGraw Hill
- "ColdFire Microprocessors & Microcontrollers" – Munir Bannoura, Rudan Bettelheim and Richard Soja, AMT Publishing.
- Douglas V. Hall, "Microprocessors and Interfacing Programming and Hardware", Tata McGraw Hill,
- Daniel Tabak, "Advanced Microprocessors", McGraw Hill,
- David A. Patterson, John.L.Hennessey – Computer organization and design-the hardware/software Interface- Elsevier-Morgan Kaufmann Publishers-

Digital System Design using VHDL

ECL 2071 **4-0-0 = 4**

Review: Review of concepts of combinational and Sequential logic circuit design, design of digital systems with help of state machine charts and their realization through Gates, Multiplexers and other discrete digital ICs.

Synchronous and Asynchronous Sequential circuits

Sequential Circuits: Synchronous sequential circuits and finite state machines (FSM); Mealy machine; Moore machine; State table; State diagram; Synchronous Sequential circuit analysis; System design; State minimization; State assignment; ROM implementation; Asynchronous sequential circuits, Threshold functions , Hazards, Pulse Mode Circuits.

Introduction to VHDL: Basic language elements & behavioral modeling, Data flow modeling – structural, Generics and configurations - Subprogram and overloading – Packages and Libraries – Model simulation.
Design of Hardware using VHDL as examples – code converters, multiplexer, de-multiplexer, binary adders and multipliers, counters. Design of sequential circuits using VHDL, counters, shift registers

Basics of FPGA, CPLD and programmable devices in general. FPGA programming, design and implementation of digital system, ASIC design using CAD tools. Overview of ASM's realization through PLDs and design of FSM / simple microprocessor through Algorithmic State Machine concept.

Recommended Books:

- Daniel Gajski: Principles of Digital Design
- Bhasker: A VHDL Primer
- Pedroni: Circuit Design with VHDL
- Perry: VHDL: Programming by examples
- Palnitkar: Verilog HDL,

Antenna & Wave Propagation

ECL 2041 **3 – 0 – 0 =3**

Unit I: Antenna Fundamentals

Radiation pattern, Antenna gain, Effective joint of an antenna, Antenna aperture, relation between antenna gain and antenna aperture, elementary idea of self and mutual impedances in antenna, Antenna terminal impedance, reciprocity theorem of an antenna.

Unit II: Antenna arrays

Arrays of two point source, linear arrays of n-point sources, broad side and End fire arrays, Pattern multiplication Binomial arrays.

Unit III: Special purpose antennas

Loop antenna traveling wave antenna, Rhombic antenna, Yagi antenna, Horn and reflector type antennas, Helix antenna, and Lens antenna, Log Periodic antenna, Microstrip patch antenna

Unit IV: Ground wave propagation

Introduction to different region of the atmosphere. Various propagation paths, Basic ideas of ground wave propagation, space wave and surface wave, True Tropospharic refraction, radius of curvature of a ray in the troposphere. Concept of modified earth, Duct propagation.

Unit V: Sky wave propagation
Structure of the ionosphere, effective permittivity & conductivity of an ionized region. Effect of earth magnetic field. Critical frequency. MUF and OPWF. Virtual height, skip distance fading.

Recommended Books:
- Fields & Wave Electromagnetics , DK Cheng
- Fields & Wave in Communication Electronics, Ramo Whinnery & Duzer
- Electromagnetic Waves and Radiating Systems, Jordan & Balmin
- Antenna Theory:Analysis & Design, A. Balanis
- Elements of Electromagnetics, Sadiku
- Antenna & Wave Propagation, K.D. Prasad

Digital Communication

ECL 2152 **4 – 0 – 0 = 4**

Introduction: A historical perspective in the development of Digital Communication, elements of a digital communication system, analog versus digital communication system.
Pulse modulation: Introduction, sampling process, pulse amplitude modulation, TDM, PPM, PDM, bandwidth-noise trade-off, quantization process, PCM, DPCM, DM, Adaptive DPCM, sub-band coding, linear predictive coding,.
Base band pulse transmission: Introduction, matched filter, error rate due to noise, inter symbol interference, Nyquist's criterion for distortion less base band binary transmission, correlative level coding.
Digital pass-band transmission: Introduction, pass band transmission model, Gram Schmidt orthogonalization procedure, geometric representation of signals, response of bank of correlators, to noisy input, coherent detection of signals in noise, probability of error, correlation receiver, detection of signals with unknown phase, hierarchy of digital modulation techniques, coherent binary PSK, coherent binary FSK, coherent QPSK, coherent minimum shift keying, differential phase shift keying, comparison of binary & quaternary modulation schemes, M-ary modulation techniques, power spectra, bandwidth efficiency, synchronization.
Source coding: Mathematical models of information sources, a logarithmic measure of information, source coding theorem, source coding algorithms- the Huffman source coding algorithm & the LEMEPel-Ziv source coding.
Channel capacity & coding: Modeling of communication channels, channel capacity, bounds on communication, coding for reliable communication, linear block codes, cyclic codes, convolutional codes.

Recommended Books::
- Digital communication, Simon Hykins,ohn Willey & Sons
- Digital communication, John G Proakis, McGraw Hill
- Fundamental of Telecommunications, R G Freeman , John Wiley
- Telecommunications Systems Engineering , R G Freeman, John Wiley
- Telecommunication Transmissions Systems, R G Winch, McGraw-Hill
- Electronic Communication Systems, W Tomasi, PHI

Control Systems

ECL 3090 **4-0-0 = 4**

1. Introduction to Feedback Control System
Mathematical models of physical system , Open loop and closed loop systems, regenerative feedback, Transfer function, Block diagrams and reduction techniques including signal flow graphics, deriving transfer function of physical system one mechanical system and field controlled and armature controlled DC servo motors.
2. Time Response Analysis
Standard test signals, time response of second order system, steady state errors and error constants, design specifications of second order system.
3. Stability Analysis
Concept of stability, condition of stability, characteristic equation, relative stability, Routh-Hurwitz criterion, special cases for determining relative stability, Nyquist stability criterion, Nyquist plots
4. Root Locus Techniques.
Basic concept, rules of root locus, application of root locus technique for control systems.
5. Frequency Response Analysis
Bode plots, gain margin, phase margin, effect of addition of poles and zeros on bode-plots.
6. Compensators.
Preliminary design considerations, need of compensation, lead compensations, lag-compensation, lag-lead compensation.
7. Analysis of Control Systems in State – Space
Basic concepts of state, state variable and state models, transfer matrix, Controllability, absorbability, obtaining state space equations in canonical form.
8. Discrete control system: Z Transform and its properties, Basic structure of Digital Control systems, Description and analysis of Sampled-Data system, Stability analysis of Discrete-time systems

Recommended Books:
- Control System Engineering -- I.J. Nagrath, M.Gopal (Willey Eastern)
- Feedback Control Systems -- (Schaum's Series book)
- Modern Control System -- Dorf,Bishop (addison – Wesley Publication)
- Modern Control Engg.(II edition) – Katsuhiko Ogata
- Automatic Control Engg.(II edition)-Kuo

Signal Processing & Linear Systems

ECL 3180 **3 – 1 – 0 = 4**

Probability, Random Variables and Random Signals
Experiment, sample space, event, probability, conditional probability and statistical independence. Random variables: Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF, Central Limit Theorem. Statistical averages, mean, moments and expectations, standard deviation and variance. Probability models: Uniform, Gaussian, Poisson.

Introduction to Signals and Systems (CT & DT)
Fundamentals of signals, Elementary signals, Continuous-time and discrete-time (CT and DT) signals and systems. Classification of signals. Energy and power signals. Operating on signals to produce new signals. Sinusoids, complex exponentials, step and impulse functions. Classification of systems (linearity, time-invariance, causality, memory, invertibility).

Properties of Linear, Time-Invariant Systems
Convolution, Impulse response and superposition integral or sum for linear, time-invariant (LTI) systems. LTI systems characterized by differential or difference equations using time & transform methods, frequency response of LTI Systems.

Structures For Discrete-time Systems: Block diagram representation of linear constant coefficient difference equations - their interconnection schemes; direct form-I, direct form-II, cascade form and parallel form structures. Finite word-length effect-number representation, analysis of effect of coefficient quantization and rounding of noise; zero input limit cycles in fixed-point realizations of IIR digital filters.

Fourier Transform (Discrete): DTFT & DFT and properties of DFT; circular convolution; linear convolution using DFT.

Recommended Books:
- Signals and Systems, S. Haykin and B. Van Veen, New York: John Wiley and Sons,
- Signals and Systems, M. J. Roberts, McGraw-Hill,
- Signals and Systems, A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, Prentice-Hall
- Signals, Systems and Transformations, C. L. Phillips and J. M. Parr, Prentice-Hall
- Fundamentals of Signals and Systems using MATLAB, E. W. Kamen and B. S. Heck, Prentice-Hall
- Signal Processing and Linear Systems, B. P. Lathi, Berkeley Cambridge Press, ISBN 0-941413-35-7, 1998.

Microprocessor & Interfacing

ECL 3061 **3 – 0 – 0 = 3**

Introduction to 8085 Microprocessor: Functional block diagram – Registers, ALU, Bus systems, Memory & Instruction cycles Timing diagrams, Address Decoding techniques, Addressing modes, Instruction Set, Assembly Language Programming, Interrupts-Types & handling, ISR, Stack architecture

Memory and Peripheral interfacing: Basic interfacing concepts - Memory space partitioning - Buffering of buses – Timing constraints - Memory control signals - Read and write cycles, Interfacing RAM, ROM, 8255PPI, Interfacing applications using 8255. Need for direct memory access - DMA transfer types

Intel 16 bit Microprocessor: Register organization of 8086 – Architecture - Physical Memory organization - I/O addressing capability, Addressing modes of 8086 - Instruction set of 8086 - Assembler directives and operators, Assembly language programming, Interrupt Architecture

Recommended Books:
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- K. Ray, K. M. Bhurchandi – Advanced Microprocessors and Peripherals – Architecture, Programming and Interface – Tata McGraw Hill
- Douglas V. Hall, "Microprocessors and Interfacing Programming and Hardware", Tata McGraw Hill
- Daniel Tabak, "Advanced Microprocessors", McGraw Hill
- David A. Patterson, John.L.Hennessey – Computer organization and design-the hardware/software Interface- Elsevier-Morgan Kaufmann Publishers-

Embedded Systems & Microcontrollers

ECL 3080 **3 – 0 – 0 = 3**

Introduction: Introduction to Embedded Computing, Issues and Challenges in Embedded System Design, Trends: SoC, custom designed chips, configurable processors and multi-core processors.

Embedded Processor Architecture (Intel 8051 Platform-8 bit): Harvard Architecture, RISC v/s CISC, µProcessor v/s µController, CPU Architecture and instruction sets **:** Hardware architecture- program memory consideration – register file structure and addressing modes – CPU Register – instruction set – Port architecture, Timer/Counter Block Configuration & Interrupts, Serial Port Configuration & Interrupts, External interrupts

Embedded Processor Architecture (Freescale S12X Platform-16 bit): Introduction to the S12 and S12X Microcontroller, Core Architecture, Clock Generation & Resets, Port Architecture, Timer functions, Serial Communication Interface (SCI), Serial Peripheral Interface (SPI), Inter-Integrated Circuit (I^2C) Interface, Interrupts, Analog-to-Digital Converter, Controller Area Network (CAN), Internal Memory Configuration and External Memory Expansion

Development tools and Programming: Hardware and Software Development Tools, C Language Programming, Kiel µVision IDE & Simulator, CodeWarrior tools – Project IDE, Compiler, Assembler and debugger, JTAG and hardware debuggers, Code optimization.

Embedded Applications & Interfacing: Embedded System Applications using Keyboards, display, Relays, Motors, Sensor Interface, ADC, DAC, SCI, SPI, RTC, I^2C, Interrupts with 8051 & S12X

Recommended Books:
- Mazidi, "8051 Microcontrollers & Embedded systems", Pearson
- John B Peatman, " Design with PIC Microcontrollers", Pearson Education Asia, Low price edition
- The HCS12/9S12, An Introduction to Hardware and Software Interfacing By Han-Way Huang
- A.K. Ray, K.M. Bhurchandi, " Advanced Microprocessors and Peripherals – Architecture, Programming and Interface", Tata McGrawHill
- Myke Predko, "Programming and Customizing the 8051 Microcontroller", Tata McGrawHill
- Assembly and C Programming for the Freescale HCS12 Microcontroller Second Edition by Fredrick M. Cady
- Embedded Microcomputer Systems: Real Time Interfacing by Jonathan W. Valvano

Electronic Measurement & Instrumentation

ECL 3091 **3 – 0 – 0 = 3**

Unit I: Measurement and error
Accuracy and precision, sensitivity, resolution, Types of errors, Limiting errors, calibration and standards.
Unit II: Analog Instruments
PMMC, DC Ammeter, DC Voltmeter, Ohm Meter, Electronic Voltmeter, Unit I AC Voltmeter with rectifier and amplifier combination, Electronic Multimeter, AC current indicating instruments, Q Meters, Wave Analysers, Harmonic Distortion Analyser, Spectrum Analyser, Vector Impedance Meter,
Unit Bridge Measurement
Wheatstone bridge, Kelvin bridge, Maxwell's Bridge, Schering Bridge, Wiens bridge, LCR Measurement.
Unit III: Digital Instruments
Advantages of digital instruments over analog instruments, Digital voltmeters, Ramp type DVM, Integrating DVM, successive approximation DVM, Dual Slope DVM, Microprocessor Based DVM,
Unit IV: CRO
Basic block diagram, Horizontal deflection system, Vertical Deflection system, Special Purpose CRO: Dual beam, dual trace, sampling type, Digital storage, Storage target.,
Unit V: Transducers
Classifications of Transducers, Strain Gauge, Displacement Transducers, Linear variable differential transducers(LVDT), Photoelectric transducers, Temperature measurements, Thermocouples, Photosensitive device, Peizo electric transducer, Measurement of Non-electrical Quantities like Temperature, Pressure, Flow, pH, Thermal Conductivity, Humidity.
Unit VI: Signal Conditioning
Introduction, Basic Instrumentation Amplifier, Application of Instrumentation amplifiers, Modulators.
V/I Controllers, I/V Controllers, F/V Controllers, V/F Controllers, Linearization Technique, Noise Reduction technique in Instrumentation, Isolation Amplifier, Isolation Transformer.
Unit VII: Data Acquisition Systems
Introduction, objective, single channel data acquisition, multi channel data acquisition, computer based DAS, Data loggers. Analog and Digital Recorders, Introduction to various process control systems like SCADA,DCS, CCU etc.

Recommended Books::
- Modem Electric Instrumentation, Albert D. Cooper, PHI.
- Electronic Instrumentation , H S Kalsi , Tata Mc Graw Hill
- A Course in Electrical and Electronic Measurement and Instrumentation , A.K Sahwney
- Electronics and Electrical Measurement, G B Gupta, Kataria & Sons Publication

Electronic Measurement & Instrumentation

ECL 3100 **3 – 0 – 0 = 3**

Unit I: Physical Layer: Communication Medium (Copper, OFC, Wireless), Connectors and Cables (RJ11, RJ45, 8P8C, Cat5, Cat6, UTP, Coax, 10baseT etc.) Baseband and Passband Communications, Modulation schemes, Source coding, Channel coding, Line coding
Unit II: Data link Layer: Framing and Error Detection, Packet Multiple Access, Packet Switching, Aloha, CSMA (CA, CD), RTS CTS, Hidden/Exposed Terminals, ARQ Protocols, ARP, LAN, Ethernet, 802.11, 802.15.1, 802.15.4
Unit III: Network Layer: Network Addressing, Subnets, Packet Routing, Packet Fragmentation, Routing Protocols, WAN, IP, ICMP
Unit IV: Transport Layer: Datagrams, Segments, Bit Streams, Connection Oriented and Connectionless Protocols, Reliability, Error Detection and Correction, Flow Control, Congestion Control, TCP, UDP, RTP, Host to Host Communication

Recommended Books::
- D E Comer and M S Narayanan. *Computer Networks and Internets* 4th ed : Pearson Education: ISBN: 9788177589276
- Peterson and Davie. *Computer Networks (2nd Edition)*. San Francisco, CA: Morgan Kaufmann Publishers, 1999. ISBN: 1558605142 .

- Tanenbaum, A. S. *Computer Networks*. 4th ed. Upper Saddle River, NJ : Prentice Hall, 2003. ISBN: 0130661023.
- Stevens. *TCP/IP Illustrated*. Reading, MA: Addison-Wesley Pub. Co., c1994-c1996. ISBN: 0201633469.
- *Saltzer, J., D. Reed, and D. Clark. "End-to-end Arguments in System Design."* ACM Transactions on Computer Systems (TOCS) *2, no. 4 (1984): 195-206.*
- *Cerf, V., and R. Kahn. "A Protocol for Packet Network Interconnection."* IEEE Transactions on Communications *COM-22 (1974): 637-648.*
- *Clark, D. "Design Philosophy of the DARPA Internet Protocol."* Proc *ACM SIGCOMM (August 1988): 106-114. Stanford, CA.*
- *Paxson, V. "End-to-End Routing Behavior in the Internet."* IEEE/ACM Transactions on Networking *5, no. 5 (October 1997): 601-615.*
- *Jacobson, V., and M. Karels. "Congestion Avoidance and Control."* Proc *ACM SIGCOMM (August 1988). Stanford, CA.*
- *Bharghavan, V., A. Demers, S. Shenker, and L. Zhang. "MACAW: A Media Access Protocol for Wireless LANs."* Proc ACM SIGCOMM *(September 1994): 212-225. London, UK.*

Signal Processing

EECL 312B **3 – 1 – 0 = 4**

Probability, Random Variables and Random Signals
Review of probability theory, Random variables CDF, PDF, properties of CDF and PDF, Central Limit Theorem. Statistical averages, mean, moments and expectations, standard deviation and variance. Probability models: Uniform, Gaussian, Poisson.

Introduction to Signals and Systems
Fundamentals of signals, Elementary signals, Classification of Signals and Systems (Continuous-time and discrete-time (CT and DT). Basic operations on Signals.

Properties of Linear, Time-Invariant Systems
Convolution, Impulse response and superposition integral or sum for linear, time-invariant (LTI) systems. LTI systems characterized by differential or difference equations, Correlation.

Structures For Discrete-time Systems: Block diagram representation of linear constant coefficient difference equations - their interconnection schemes; direct form-I, direct form-II, cascade form and parallel form structures. Finite word-length effect-number representation, analysis of effect of coefficient quantization and rounding of noise; zero input limit cycles in fixed-point realizations of IIR digital filters.

Fourier Transform (Discrete): DTFT & DFT and properties of DFT; circular convolution; linear convolution using DFT.

Z- Transform: Bilateral and Unilateral Z-transform, ROC, Inversion of Z-transform, Solution of Discrete Time LTI systems using Z-transform.

Recommended Books:
- Linear Systems And Signals, B. P. Lathi, Oxford University Press
- Signals and Systems, A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, Prentice-Hall
- Probability, Statistics And Random Processes, T Veerarajan, Mcgraw-Hill
- Signals And Systems, M. J. Roberts, McGraw-Hill,
- Fundamentals of Signals and Systems using MATLAB, E. W. Kamen and B. S. Heck, Prentice-Hall

Real Time Digital Signal Processing

ECL 3181 **3 – 1 – 0 = 4**

Efficient Computation of DFT: Computational complexity; FFT algorithms - the decimation-in-time and decimation-in-frequency; signal flow graph-Butterfly computations, in-place computations; analysis of computational complexity.

Filter Design Techniques: Characteristics of practical frequency selective filter; design of FIR filters by windowing. Characteristics of Butterworth & Chebyshev filters-frequency transformation; design of IIR filters from continuous-time filters-Impulse invariance & bilinear transformation methods.

Introduction of DSP Processors: Review of need for DSP Processors, MAC, Modified Bus Structures, Memory access schemes, Harvard, VLIW architecture, On-chip peripherals, Addressing modes, Concept of Pipelining. Issues of Real Time DSP applications, Fixed point and Floating point Processors.

Introduction to TMS320C55x Fixed point DSP Processor: TMS320C55x Architecture, Interrupts and Interrupt Vector, TMS320C55x Peripherals, External Memory Interface, Direct Memory Access, Multi-Channel Buffered Serial Ports, Clock Generator and Timers, General Purpose Input/output Port, TMS320C55x Addressing Modes, Direct Addressing Modes, Pipeline, Instruction Set, Assembly Language Programming, Assembly Code Generation by C Compiler, Mixed C-and-Assembly Language Programming, Phase-Locked Loop and Timers, Direct Memory Access.

Introduction to Freescale DSP563xx fixed point DSP Processor: Introduction to Freescale DSP563xx family processors, Architecture of Freescale DSP5637, MAC, AGU, PCU, On-chip Memory, Internal Buses, Direct Memory Access, Comparison of features of DSP56300 family processors.

Real Time Applications of DSP: Filtering, Modulation, Audio and Image Processing.

Recommended Books:
- Discrete-time Signal Processing , Oppenheim & Schafer , PHI
- Digital Signal Processing , Proakis & Manolakis, PHI
- Digital Signal Processing , Sanjit K. Mitra

IC Fabrication & VLSI

ECL 3130 **4 – 0 – 0 = 4**

Introduction: Overview of the VLSI technologies and ASIC Design Flow, VLSI Circuits and Analog IC Design Fundamentals.Detailed Design flow .

Fundamentals of Semiconductor Fabrication: Cleanroom technology - Clean room concept – Growth of single crystal Si, surface contamination, cleaning & etching. Oxidation – Growth mechanism and kinetic oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, charactrisation of oxide films, Use of thermal oxide and CVD oxide; growth and properties of dry and wet oxide, dopant distribution, oxide quality. Solid State Diffusion – Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon di-oxide diffusion systems. Ion implantation – Range theory, Equipments, annealing, shallow junction, high energy implementation. Lithography – Optical lithography, Some Advanced lithographic techniques. Physical Vapour Deposition – APCVD, Plasma CVD, MOCVD. Metallisation - Different types of metallisation, uses & desired properties.

CMOS: Introduction to CMOS, CMOS Capabilities and Limitations and CMOS Transistors and Logic . VLSI Circuits Design Theory. Process overview. Transistor device model, Circuit characterization. Technology libraries Overview. Pre-layout parasitics estimation. Post layout simulation techniques. VLSI Circuit Schematics and Simulation EDA Tool Flow.

Recommended Books:

- May G S and Sze S M, *"Fundamentals of Semiconductor Fabrication"*, John Wiley & Sons, India.
- Sze S M, "*VLSI Technology*", McGraw Hill International Edition
- Ghandhi S K, *"VLSI fabrication Principles"*, John Wiley Inc., New York
- Streetman BG, *"Solid State Electronics Devices"*, Prentice Hall of India, New Delhi,
- Chang C Y and Sze S (Ed),*"ULSI Technology"*, McGraw-Hill Companies Inc.
- Allen, Phillip E. & Holberg, Douglas R. "CMOS Analog Circuit Design" Oxford University Press
- J. Baker "CMOS: Circuit Design, Layout, and Simulation" Wiley IEEE Press
- Neil H. E. Weste, Kamran Eshraghian " Principles of CMOS VLSI Design ", Pearson
  - Education India
- Kang S.M, Leblebici Y,"CMOS Digital Integrated Circuits : Analysis and Design" Tata McGraw
  - Hill

Microwave Engineering

ECL 3050 **3 – 1 – 0 = 4**

Unit I: Introduction

Microwave Frequency Range, Characteristics features of microwaves, Microwave Systems.

Unit II: Transmission line and Waveguides

General solution for TEM, TE and TM waves, Rectangular waveguides, Circular Wave guides, Evanescent modes, Dominant modes, Power flow and energy storage in a waveguide, Planar transmission lines, Microstrip, Strip line, slot line, Smith Chart and its applications.

Unit III: Microwave Network and Passive Components

S- Parameters, Scattering Matrices for Some Typical Networks, Microwave cavities, Microwave Hybrid circuits, Waveguide Junctions, Magic Tee, Rat Race Circuits, Directional Couplers, Waveguide bends, Matched Loads, Coupling, Attenuators, Phase shifters.

Unit-IV: Microwave Solid State Devices and Application

Tunnel Diodes, Gunn Effect Diodes, Read Diodes, IMPATT Diodes, TRAPATT Diodes, PIN Diodes.

Unit-IV: Microwave Vacuum Tube Devices

Klystron, Reflex Klystron, Magnetron, TWT

Unit-V: Microwave Measurements

Slotted line arrangement and VSWR meter, Measurement of wave-guide impedance at load port by slotted line, Microwave power measurement, Microwave frequency measurement techniques.

Recommended Books::

- Liao Y.S. —Microwave Devices‖, PHI
- Collins R.E. Microwave Engine, McGraw Hill.
- Reich J.H. -Microwave Principles, East West Press
- Pozar, D M -Microwave Engineering` John Wiley & Sons
- Gupta, K.C- Microwave Engg: New Age Pub.
- M.L Sisodia and Vijaya Laxmi Gupta- Microwave : Introduction to circuits, devices and antennas , New Age publication
- P. A. Rizzy- Microwave Engineering: Passive Circuits: Prentice Hall Int.

Optical Fiber Communication

ECL 4170 **3-0-0 = 3**

Introduction

Introduction to Telecommunications and Fiber Optics, The Evolution of Fiber Optic Systems, Basic Optical Laws and Definitions, Propagation of light inside fiber, Critical-Angle, Numerical-Aperture, Acceptance-Angle ,Cut-off wavelength , V-Number, Mode Field Diameter, Leaky Modes , Single and Multi-Mode Fibers, Fiber Types, Waveguide Equations, Step-Index Fiber Structure, Graded-Index Fiber Structure, Splicing Techniques and Connectors, Elements of an Optical Fiber Transmission Link. Merits and Demerits of Fiber Optics over conventional copper wire systems

Losses and Dispersion
Attenuation, Absorption Losses, Scattering Losses, Bending Losses, Core and Cladding Losses, Total combined Losses.
Dispersion, Group-Delay, Material Dispersion, Waveguide Dispersion, Intermodal Distortion.
Optical Sources and Detectors
Light-Emitting Diodes (LEDs), LED Structures, Characteristics of LEDs, Laser Diodes, Laser Diode Modes and Threshold Conditions, Laser Diode Structures, Characteristics of Laser Diodes, Comparison between LED and Laser Diode. Physical Principles of Photodiodes, PIN Photodetector, Avalanche Photodiodes (APD), Photodetector-Noise, Noise-Sources, Signal-to-Noise Ratio, Comparison of Photodetectors. Optical Receiver.
Optical Fiber Network and its Components
Point-to-Point Links, System Considerations, Link Power Budget, Rise-Time Budget. Single and Multi-Hop Networks, SOA, EDFA, WDM-MUX/DEMUX, Optical-Switches, Couplers, Splitters, Photonic Switching.

Economics and Potential Applications of Optical Fiber Communication Systems
Economics with Optical Fiber Communication Systems, Prospects for Optical Fiber Communication, Fiber-Optic Applications, Applications of Integrated Optics.

Recommended Books:

- Keiser, "Optical fiber communication", Tata McGraw Hill
- John M Senior, "Optical Fiber Communication-Principles and Practice ", Prentice Hall International
- Joseph C Patios, "Fiber Optical Communications", PHI
- John Gowar, "Optical Communication System", Prentice Hall International
- Sharma, "Fiber Optics in Telecommunication", Tata Mc Graw Hill
- M K Liu, "Principles and applications of optical communication ", Tata Mc Graw Hill

Advance Communication System

EECL 407B **3 – 0 – 0 = 3**

Unit 1: Basic of Telephone switching System
Communication Network, Circuit switching, Connectionless and connection oriented Packet switching, Message switching, two and three stage switching network, Communication process and layered architecture, ISDN
Unit II: Cellular Concepts
Cellular concepts: Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards. Study of GSM .
Unit III: Multiple access schemes
Introduction to CDMA FDMA, TDMA, CDMA, Walsh codes, Variable tree OVSF for CDMA, PN Sequences, Multipath diversity, RAKE Receiver, CDMA Receiver Synchronization
Unit IV: Signal propagation & Fading
Propagation mechanism- reflection, refraction, diffraction and scattering, Multipath and small scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate

Lab Courses

Basic Electrical Engineering Lab

ECP 1020 **0 – 0 - 2 = 1**

1. Verification of Kirchoffs Voltage and Current law.
2. Verification of Superposition theorem.
3. Verification of Thevenin's' theorem/
4. Verification of Reciprocity theorem.
5. Verification of Maximum power transfer theorem.
6. To study transient response of RC low pass and high-pass filters and find out time constants.
7. To verify voltage, current relationship in series and parallel RLC circuit.
8. Measurement of current in various branches of RLC series –parallel circuit and verification of the same by calculation.
9. Study of voltage –current relationship of a series RLC circuit and obtaining series resonance.
10. Study of three phase A.C circuits with
    a. Star connected load. b) Delta Connected load.
11. Study of a single phase transformer-Determination of voltage ratio, turns ratio and polarity test.
12. Open –circuits and short –circuit test for a given single phase transformer. Determination of regulation and Efficiency
13. Phasor Diagram and Power factor of LCR circuit

Basic Electronics Lab

ECP 1010 **0 – 0 - 2 = 1**

1. To study CRO & function generator.
2. To find phase difference on CRO using RC filter.
3. To determine and plot operating characteristics of a PN junction diode.
4. To study the input / output waveform of Half wave rectifier and find its ripple factor and its efficiency.
5. To study the input / output waveform of bridge wave rectifier and find its ripple factor and its efficiency.
6. To study the clipper circuit using PN diode for positive and negative configurations.
7. To study clamper circuits using PN diode and clamper circuits.
8. To study the Zener characteristics and its application as voltage regulator

9. To plot characteristics of transistor in CE / CB configuration
10. To plot drain and transfer characteristics of a JFET.

Circuits & Simulation Lab

ECP 1030 **0 – 0 – 2 = 1**

1. Design a transistor bias circuit.
2. Study of h-parameters of Transistor
3. Design a two stage RC coupled amplifier-using BJT.
4. Design a bias circuit of FET
5. Design a single stage amplifier using FET.
6. Design a power supply with C filter.
7. Design a voltage regulator.
8. Design a push pull class B amplifier without input and output transformer.
9. Study of Feedback Amplifier
10. Input impedance output impedance of common emitter Amplifier and measurement of gain.
11. Exercises on circuit simulation using PSPICE

Digital Electronics Lab

ECP 2070 **0 – 0 – 2 = 1**

1. Study of PIN diagram of various ICs & to test the logic gates and verify their truth table.
2. Implementation of Half adder, Full adder & Half subtracter using NAND gates only.
3. Implementation of Boolean functions of three and four variables using 74153 (4:1) Mux.
4. Implementation of De-multiplexer, decoder and encoder.
5. To add two 4 bit binary numbers using 7483.
6. To compare two 4 bit binary number using 7485 (magnitude comparator).
7. To verify the operation of different modes of shift Register using 7495.
8. To design an asynchronous counter of any modulus using JK FF's (7473).
9. To design a synchronous counter of any arbitrary count using 7473.
10. Design of BCD to seven-segment display using logical gates ICs.
11. To study and verification by truth tables of SR, JK, MSJK, D & T flip flops.
12. To design and test non-sequential counter and study of shift registers.

Industrial Electronics Lab

ECP 2020 **0 – 0 – 2 = 1**

1. To study working and operating characteristics of D.C. machines.
2. To study working and operating characteristics of induction motors (Squirrel cage and Phase wound)
3. To study working, find the voltage regulation and efficiency of an alternator.
4. To find the static characteristics of an SCR and its operation as Half Wave Rectifier
5. Single Phase Full Wave Bridge Rectifier with DC motor as load
6. To Study SCR Firing Circuits.
7. To study working of Step Up and Step Down Chopper.
8. To study AC voltage regulation using anti parallel SCRs and Triac
9. To study operation of H-Bridge Inverter circuit with an AC motor as load.
10. To study Microprocessor based phase angle control of thyristors.

Electrical & Electronics Lab

ECP 1021 **0 – 0 – 2 = 1**

Introduction to various T&M equipment in Lab including Power Supplies, Function Generators & CRO's

14. To study & Verify Kirchoffs Voltage Law, Superposition Theorem & Thevenin's Theorem.
15. To study transient response of RC low pass and high-pass filters and find out time constants.
16. To verify voltage, current relationship in series and parallel RLC circuit.
17. Study of voltage –current relationship of a series & parallel RLC circuit and obtaining series resonance.
18. To determine and plot operating characteristics of a PN junction diode.
19. To study the input / output waveform of Half wave rectifier & bridge rectifier and find its ripple factor and its efficiency.
20. To study the Clipper & Clamper circuit using PN diode
21. To study the Zener characteristics and its application as voltage regulator
22. To plot characteristics of transistor in CE / CB configuration
23. To plot drain and transfer characteristics of a JFET.

Programming in MATLAB

ECP 1200 **0-0-2=1**

Introduction: Introduction to Matlab, Workspace, Windows, and Help, Scalar Mathematics, Basic Mathematical Functions, Computational Limitations, Display Options, Accuracy and Precision.
File Management: Definitions and Commands Saving and Restoring Matlab Information, Script M-Files, Errors and Debugging, Matlab Search Path, Path Management, and Startup.
Trigonometry And Complex Numbers: Trigonometry, Complex Numbers, Two-Dimensional Plotting.
Arrays And Array Operations: Vector Array, Matrix Array, Array Plotting Capabilities.
Mathematical Functions And Applications: Signal Representation, Processing, and Plotting, Polynomials, Partial Fraction Expansion, Functions of Two Variables, User-Defined Functions, Plotting Functions.

Data Analysis: Maximum and Minimum, Sums and Products, Statistical Analysis, Random Number Generation.
Selection Programming: Relational and Logical Operators, Flow Control, Loops, Selection Statements in User-Defined Functions, Update Processes.
Vectors, Matrices And Linear Algebra: Vectors, Matrices, Solutions to Systems of Linear Equations.
Integration And Differentiation: Numerical Integration, Numerical Differentiation.
Symbolic Processing: Symbolic Expressions and Algebra, Manipulating Trigonometric Expressions, Evaluating and Plotting Symbolic Expressions, Solving Algebraic and Transcendental Equations, Calculus, Linear Algebra.
SIMULINK: Building basic models using SIMULINK.

1. Analysis of circuits and networks using MATLAB and SIMULINK.

Electronics Workshop

ECP 2201 **0 – 0 – 2 = 1**

1. Identification of Components
2. Using Multi-meter for tracing existing circuits
3. Soldering & De-soldering of Components
4. Design, Simulation, PCB Design & Fabrication, Component Soldering & Testing of DC Regulated Power Supply circuit or Similar

Linear Integrated Circuits Lab

ECP 2030 **0 – 0 – 2 = 1**

1. To study and verify the op-amp parameters including Offset voltage, CMRR & Slew-Rate
2. To study and verify the Op-amp as an Inverting & Non-Inverting amplifier.
3. To study and verify the application of an Op-amp as a Differentiator & Integrator.
4. To study and verify the application of an Op-amp as a Comparator, Schmitt Trigger, Peak Detector, Zero crossing detector.
5. To study and verify the application of an Op-amp as a Clipper & Clamper.
6. To study and verify the application of an Op-amp as a Precision Rectifier.
7. To study and verify the application of an Op-amp as a Voltage-to-Current / Current-to-Voltage Converter.
8. To study and verify the application of an Op-amp as an Astable Multivibrator / Monostable Multivibrator using IC 555 timer.
9. To study and verify Phased Lock Loop(PLL)
10. To study the performance of a 3 pin fixed voltage regulator and a 3 pin variable Voltage regulator.
11. To study the working of Op-amp based filters.
12. To study and verify the application of op-amp as Wave-form generator
13. To study and verify the application of op-amp as log / anti-log amplifier.
14. To study and verify the application of op-amp as A/D & D/A convertor

Analog Communication Laboratory

ECP 2151 **0 – 0 –2 = 1**

1. To study and calculate the modulation index of AM wave
2. To study the demodulation of AM wave and find out modulation frequency
3. To study and observe frequency modulation
4. Study of various FM receivers
5. Study of modulation and detection of single side band modulation.
6. To find the selectivity & sensitivity of the AM receiver
7. To find and plot the fidelity of the AM receiver.
8. Study of various AM receivers
9. To study the sample and hold process.
10. To study PAM and its demodulation
11. To study PWM and its demodulation
12. Study of 3 –band superhetrodyne receiver.
13. Noise power spectral density measurement

Digital Electronics Fundamentals Lab

ECP 2072 **0 – 0 – 2 = 1**

1. Study of PIN diagram of various ICs & to test the logic gates and verify their truth table.
2. Implementation of Half adder, Full adder & Half subtracter using NAND gates only.
3. Implementation of Boolean functions of three and four variables using 74153 (4:1) Mux.
4. Implementation of Demultiplexer, decoder and encoder.
5. To add two 4 bit binary numbers using 7483.
6. To compare two 4 bit binary number using 7485 (magnitude comparator).
7. To verify the operation of different modes of shift Register using 7495.
8. To design an asynchronous counter of any modulus using JK FF's (7473).
9. To design a synchronous counter of any arbitrary count using 7473.
10. To study and verification by truth tables of SR, JK, MSJK, D & T flip flops.
11. To design and test non-sequential counter and study of shift registers.

Microprocessor & Interfacing Lab

ECP 3061 **0 – 0 –3 = 1**

25-30 Programs in 8085 & 8086 Assembly Language including Interfacing problems(using 8255PPI) to interface to LEDs, Switches, ADC, Stepper Motor, LDR etc.

Digital Design & VHDL Lab

ECP 2071 **0 – 0– 2 = 1**

Design of Simple combinational logic circuits like Adders, Subtractors, Multiplexers, De-multiplexers, Encoders, Decoders, Latches, Comparators,
Design of Flip-Flops, Counters, Registers, Shift Registers,
Design of ALU
Design of State Diagrams for Digital System Design
Design of 7 segment Driver circuit, Motor Drive, Traffic Light Control, Vending Machine
Implementation of Circuits on Spartan 3E/ Virtex-II boards

Embedded Systems & Microcontrollers Lab

ECP 3080 **0 – 0 – 2 = 1**

At least 25 practical based on the 8051 Microcontroller & S12X (Assembly Language, Embedded C, Interface of Keys, LED Matrix, ADC, DAC, Stepper Motor, SPI Protocol based interface)

Digital Communication Engg.Lab

ECP 2152 **0 – 0 – 2 = 1**

1. Study of Sample and hold circuit
2. Generation & detection of PAM / PWM / PPM
3. Generation & detection of ASK / FSK / PSK / APSK
4. Generation & detection of PCM, ADPCM, DM
5. Power spectrum analysis of various modulation techniques
6. Study of framing & marker with voice coding kit
7. Data conditioning & Carrier modulation kit
8. Data Re-conditioning & carrier de-modulation

Instrumentation & Control Lab

ECP 3090 **0 – 0 – 2 = 1**

Note: Five practical from each section to be performed

Measurement & Instrumentation Practicals

1. To measure the harmonic distortion in output of function generator.
2. To measure strain using strain simulators.
3. Measurement of temperature with various types of sensors.
4. Measurement of Linear displacement using LVDT.
5. Measurement of frequency and phase of input signal in CRO using Lissagious pattern
6. Study of various transducers for measurement of common physical parameters like pH, conductivity, pressure, flow whichever possible

Control Systems Practicals

1. Transient response of second order system comprising of R,L,C to find maximum overshoot, rise time, settling time, damping factors/ratio, natural undamped frequency.
2. Frequency response of first and second order system comprising RL, RLC. Draw Nyquist and Bode plots.
3. Transient response of first order, second order and higher order pneumatic servo system
4. Transient response of first order, second order and higher order hydraulic system
5. To find torque speed, torque voltage characteristics of servomotor and determine its transfer function.
6. Study of synchronous transmitter, receiver and control transfer.
7. To simulate a second and higher order system on analog simulator and find its transient response to step, ramp and other input functions.
8. Study of open and closed loop servo system loop comprising of error detector, amplifier and a motor cum load with techno feedback.

Study of phase lag and phase lead networks.

Digital Signal Processing Lab

ECP 3181 **0 – 0 – 2 = 1**

Using MATLAB

1. Representation of time-series; computation of convolution
2. Response of a difference equation to initial conditions; stability
3. DFT computation
4. Computational experiments with digital filtering

Using DSP processor

5. Sampling & Waveform generation
6. FIR & IIR Filters Implementation
7. Fast Fourier transforms
8. Quantization Noise
9. Adaptive Filters
10. Multirate Signal Processing

VLSI Laboratory

ECP 3130 **0 – 0 –2 = 1**

1. Introduction to VLSI software.
2. Study of Digital Design Flow.
3. Study of Analog Design Flow.
4. To design and simulate CMOS inverter on EDA tool.

5. To study layout design of CMOS inverter.
6. To study post layout simulation of CMOS inverter.
7. To implement a complete circuit on EDA Tool right from simulation to generation of GDS-II file.

Project I: To design and simulate a project utilizing a complete EDA tool package.

Instructor are suggested to make student aware of Digital and Analog Design flows on the given EDA Tools.

Microwave Engineering Lab

ECP 3050 **0 – 0 – 2 = 1**

1. To plot the characteristics of Reflex Klystron.
2. To plot the characteristics of Gunn Diode
3. To measure the Low, Medium & High VSWR of rectangular wave guide terminated with unknown load.
4. To determine the attenuation due to component under test
5. To study the isolater and circulator
6. To measure the input impedence of unknown load with the help of slotted line section
7. To draw the radiation pattern of HORN Antenna.
8. To verify the E-plane and H-Plane Tee.
9. To verify the Magic Tee.
10. To find the directivity and coupling factor of two hole directional coupler.
11. To measure dielectric constant of material
12. To study the phase shifter
13. To find the directivity, isolation , main line insertion loss and coupling factor of directional coupler

Optical fiber Communication Lab

ECP 4170 **0-0-2 = 1**

1. To Study and Verify Optical Communication Analog Link.
2. To Study and Verify Optical Communication Digital Link
3. Measurement of Numerical Aperture.
4. Measurement of Characteristics of Light-Emitting Diodes (LEDs).
5. Measurement of Characteristics of Laser Diodes.
6. To Study and Verify FDM & TDM.
7. To Study and Verify OTDM
8. Measurement of Bending Losses
9. Measurement with OTDR
10. To Study and Analyse Various Connectors and Splicing Mechanisms.
11. To Study ISDN Communication System (with sub-practicals)
12. To study EPABX System (with sub-practicals)
13. To Study Key Matrix (with sub-practicals)
14. To study DTMF (with sub-practicals)

Major Project

ECD 4992 **12 Credits**

The same student team continues working as per work plan of Phase-I. Design of PCB, procurement of components is to be carried out. Acceptance tests for hardware and software are to be carried out vis-à-vis specifications from Phase-I. Functioning product is displayed at an Open House. Professional quality documentation of all designs, data, drawings, and results, change history, overall assessment, etc. is mandatory, along with a final presentation.

Digital Integrated Circuits

EECE 404B **3 – 0 – 0 = 3**

Unit-I

MOS Inverter: Introduction to resistive - load inverter, inverter with n-type MOSFET load, CMOS inverter

Switching Characteristics and Interconnects Effects: Introduction, Delay time definitions, Calculation of delay

times, Inverter design with delay constraints, MOS Inverters: Switching Characteristics & Interconnect Effects. Estimation of interconnect parasitic.

Unit-II

Sequential MOS Logic Circuits: Introduction, SR latch circuits, Clocked latch and Flip-flop circuits, CMOS D-latch and edge -triggered flip-flop. Dynamic MOS Logic Circuit

Unit-III

Semiconductor Memories: Introduction, Dynamic random access memory (DRAM), Static random acces memory(SRAM),Non-volatile memory.

Low Power CMOS Logic Circuits: Introduction, Overview of power consumption, Switching power dissipation o

CMOS inverter, Estimation and optimization of switching activity.

Recommended Books:

1. Rabaey J.M, Chandrakasan A, Nikolic B , "Digital Integrated Circuits- A Design Perspective", Prentice Hall
2. S M Kang and Y Lebici,"CMOS Digital Integrated Circuits-analysis and design", McGraw Hill.
3. Pucknell D A and Eshraghian K, *"Basic VLSI Design"*, Prentice Hall India, New Delhi,
4. Glaser L and Dobberpuhl D, *"The Design and Analysis of VLSI Circuits"*, Addison Wesley,
5. Weste N and Eshranghian K, *"Principles of CMOS VLSI Design"*, Pearson Education Asia,

Introduction to Wireless Networks

ECE 3101 **3 – 0 – 0 = 3**

Unit 1: Review of Computer Networks & Data Communication, Wireless LANs: IEEE 802.11 WLANs - protocol architecture, Physical layer, MAC layer, analysis, deployment of 802.11 infrastructures.
Unit 2: WPANs: IEEE 802.15.4, Bluetooth, ZigBee. Protocol architecture, Physical layer, MAC layer, analysis, deployment of 802.15.4 infrastructure.
Unit 3: Introduction to MANETS; MAC Protocols, Routing Protocols, performance comparison; Quality of Service.
Unit 4: Wireless Sensor Networks (WSNs): Overview/Architectures; Data Dissemination/Data Gathering; Routing Protocol, Security, Power control; Cross layer design; Localization.

Recommended Books:

- Rappaport, "Wireless Communications – Principles & Practices", PHI, Latest Edition
- C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Pearson Education, Inc.,
- Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons,
- Charles E Perkins, "Ad Hoc Networking", Addison Wesley,
- Jochen Schiller, "Mobile Communications", Addison Wesley,
- Ramjee Prasad and Luis Munoz, "WLANs and WPANs towards 4G wireless", Artech House,
- Selected papers from IEEE & ACM to be provided by Faculty

Speech Processing

ECE 4191 **3 – 0 – 0 = 3**

UNIT I: NATURE OF SPEECH SIGNAL
Speech production mechanism, Classification of speech, sounds, nature of speech signal, models of speech production.
Speech signal processing: purpose of speech processing, digital models for speech signal, Digital processing of speech signals, Significance, short time analysis.
UNIT II: TIME DOMAIN METHODS FOR SPEECH PROCESSING
Time domain parameters of speech, methods for extracting the parameters, Zero crossings, Auto correlation function, pitch estimation.
UNIT III: FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING
Short time Fourier analysis, filter bank analysis, spectrographic analysis, Format extraction, pitch extraction, Analysis - synthesis systems.
UNIT IV: LINEAR PREDICTIVE CODING OF SPEECH
Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains.
UNIT V: HOMOMORPHIC SPEECH ANALYSIS
Central analysis of speech, format and pitch estimation, Applications of speech processing - Speech recognition, Speech synthesis and speaker verification.

Recommended Books:

1. L.R. Rabiner and R.E Schafer : Digital processing of speech signals, Prentice Hall, 1978.
2. J.L Flanagan : Speech Analysis Synthesis and Perception - 2nd Edition - Sprenger Vertag, 1972.
3. I.H.Witten :Principles of Computer Speech , Academic press, 1983.

Image and Video Processing

ECE 4192 **3 – 0 – 0 = 3**

This is a basic undergraduate-level class that covers fundamentals image processing, computer vision, and Multimedia computing. The students will be exposed to dealing with image and video data through programming assignments using Java and Matlab.

1. **Introduction to Multidimensional Signal Processing**
   Historical overview, multimedia representations, software tools, authoring tools. Multidimensional Fourier Transform, sampling and Filtering (including decimation and interpolation), Introduction to wavelet transformation
2. **Human Visual Perception**
   Human Visual System, visual masking, noise visibility, color vision
3. **Image Scanning and Display**
   Acquisition and Display of images (camera, digitizers, Film, printers); sampling and quantization issues
4. **Video Scanning and Display**
   Monochrome and Color TV, videoconferencing, videophone
5. **Image Analysis and Enhancement**
   Contrast and color adjustment, Noise Reduction, Edge Enhancement, Edge Detection, Texture, Image Segmentation
6. **Image Compression**
   Basics for Lossy Compression: Fourier Transform, Discrete Cosine Transform. Application to image compression (JPEG compression), VLC coding and Dictionary Codes
7. **Video Compression**
   Fundamental concepts of video, Video compression techniques, MPEG video coding, MPEG 4,7, and beyond. Introduction to CA VLC

Recommended Books

- R. Gonzalez and R. Woods, Digital Image Processing, Prentice-Hall
- A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall,
- W. K. Pratt, Digital Image Processing, Wiley
- A. M. Tekalp, Digital Video Processing, Prentice{Hall,
- M. Ghanbari, Video Coding - an introduction to standard codecs, IEE Telecommunica-tions Series, Burger & M. Burge"Digital Image Processing: An algorithmic introduction using Java", Springer 978-1-84628-379-6
- Z. Li and M. S. Drew, "Fundamentals of Multimedia", Prentice Hall 0-13-061872-1

Multimedia Communication

ECE 4190 **3 – 0 – 0 = 3**

Part I: Overview of Multimedia Processing & Coding

Multimedia Communication: Multimedia information representation. Multimedia Networks, Multimedia applications, Network QoS and application QoS.

Information Representation: text, image, audio and video. text and image compression, compression principles, text compression, image compression. Audio and Video compression Principles

Part II: Multimedia Coding Standards

Video compression standards: H.261. H.263.PI.323, MPEG 1, MPEG 2, Other coding formats for text, speech, image and video.

Detailed study of MPEG 4: coding of audiovisual objects, MPEG 4 systems. MPEG 4 audio and video, profile and levels. MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework, Significant features of JPEG 2000, MPEG 4 transport across the internet

Part III: Multimedia Networking

Synchronization: notion of synchronization, presentation requirements, reference model for synchronization, Brief Introduction to SMIL: Multimedia operating System, Resource management and process management techniques.

Multimedia communication across networks: Multipoint data conferencing: T.120 Layered video coding, error relevant video coding techniques, multimedia transport across IP networks and relevant products such as RSVP, RTP, RTCP, DVMRP, multimedia in mobile networks, multimedia broadcast networks, and content based retrieval in digital libraries Multicast, Multimedia over ATM

Recommended Books:

1. Ze-Nian Li & Mark S. Drew, "Fundamentals of Multimedia", Pearson Education
2. J.R. Ohm. "Multimedia Communication Technology", Springer International Edition,.
3. K.Sayood. "Introduction to Data Compressiojn", Morgan Kauffman. Indian Edition,
4. V.Bhaskaran and K. Konstantinedes. "Image and Video Compression Standards. Algorithms and Architecture." Kluwer publication,
5. Fred Halsall, "Multimedia communication", Pearson Education,
6. K.R. Rao, Zoram S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication System", Pearson Education,
7. Raif steinmetz, klara Nahrstedt. "Multimedia Computing, Communication and Application". Pearson Education,
8. Tay Vaughan. "Multimedia: Making it work". Tata McGraw Hill.
9. John Billamil, louis Molina." Multimedia: An Introduction". PHI,
10. Pallapa Venkataram, Multimedia information System, Pearson Education

Introduction to MEMS Design

ECE 4140 **3 – 0 – 0 = 3**

Module 01

Introduction to MEMS , MEMS and VLSI design , MEMS examples , overview of MEMS fabrication , Special MEMS materials and their properties . Potential of MEMS in Industry.

Module 02

Bulk Micromachining : Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA)

Module 03

Surface Micromaching: Surface micromachining techniques, Polysilicon surface micromachining, Characterisation of MEMS devices.

Module 04

Introduction to Smart MEMS sensors, Sensor Principles and Examples , Microactuators and examples . Mechanical design of microactuators,

Module 05

Design of MEMS Pressure sensors , Design of silicon accelerometers , Examples of MEMS actuators

Text Books: .

1. MEMS and Microsytems Design and Manufacture, Tai- Ran Hsu, *Tata McGraw Hill*
2. MEMS, Nitaigour Mahalik, *Tata McGraw Hill*

Recommended Books:

1. Stephen D. Senturia, Microsystem Design, *Kluwer Academic Publishers,*
2.M-H. Bao, Elsevier, Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, New York

Optoelectronic Devices

ECE 4171 **3 – 0 – 0 = 3**

Unit-I

Introduction: Semiconductor materials; Crystal lattices; Bulk Crystal growth, epitaxial growth.

Energy bands and Charge carriers in Semiconductors: direct and indirect semiconductors; variation of Energy bands with alloy composition. Charge carriers in semi-conductors-electrons, holes, effective mass; intrinsic and extrinsic materials. Drift of carriers in electric and magnetic fields.

Unit-II

Excess carries in Semiconductors: Optical absorption; luminescence - photoluminescence, electroluminescence ,electroluminescence. Carrier lifetime and photoconductivity, diffusion of carriers.

P-N Junction Diode: Current-Voltage Characteristics; hetrojunctions.

Unit-III

Optoelectronic Devices: Principle of operation and characteristics; Light emitting diodes, lasers, photo detectors, solar cells.

Relevance of III-V and IV-VI material-systems in optoelectronic devices.

Integrated Optics: Optical waveguides-passive, electro-optical; optical modulators and switches; optical storage devices.

Recommended Books:

1. Pallab Bhattacharya, "Semiconductor Optoelectronic Devices",
2. Street B G and Banerjee S, "Solid State Electronic Devices", PHI New Delhi,
3. Sze S M, "Physics of Semiconductors Devices", Wiley Eastern Limited, New Delhi.
4. Wilson and Hawkes, "Optoelectronics; An Introduction", PHI
5. Hummel R E, "Electronic Properties of Materials", Narosa Publishing House, New Delhi.

Object Oriented Programming

ECE 425B **3 – 0 – 0 = 3**

Principles of Object Oriented Programming

The Traditional Approach, Shortcoming of procedure oriented languages, Basic concepts of Object Oriented Programming, Benefits of OOP, Object Oriented Languages

Overview of Programming Basics

Input/Output using cin/cout, processor directives, basic and user defined data types, operators, loops, decision making, control statements, functions, pointers to functions

Classes

Definition, Class objects, Class member functions, Static Class Members, Class Scope, Nested Classes, Local Classes, Composite class, Constructor, Destructor, Friends, *this* Pointer

Operator Overloading

Overloading unary and binary operators, Special operators : Operator [ ], ( ), →, ++ and --, << and >>

Inheritance and Polymorphism

Class hierarchy : Definition, Identifying the members of the hierarchy, Base class member access, Base and derived class construction, Member wise initialization and assignment, virtual functions, multiple inheritance, class scope under inheritance, virtual classes.

Templates

Class Templates, Function Templates

Exception Handling

Throwing, The try…..catch block, Exception specifications

Recommended Books:

Object Oriented Programming with C++ ANSI/ISO Standards, R. Subburaj

Advanced Embedded System design

ECE 4082 **2-0-2 = 3**

Embedded Architecture: Embedded systems Overview, Design Challenge – Optimizing design metrics, Processor Technology, Embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration.

Embedded Processor and Computing Platform: Power PC processor- Power architecture and Programming model, Memory management, Interrupts and Exceptions and debugging, Communication Processor module, Interrupt controller, SCC, SMC, FEC, TSEC, UCC, MCC, QMC and Code Warrior Tools.

Networks: Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, TDM, ATM , Ethernet, HDLC, Wirelees Protocols – IrDA, Bluetooth, WI FI, WIMAX, Network-Based design- Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design . **Real-Time Characteristics:** Introduction to RTOS- Special considerations in an RTOS, Clock driven Approach, weighted round robin Approach, Priority driven Approach, Dynamic Versus Static systems, effective release times and deadlines, Optimality of the Earliest deadline first (EDF) algorithm, challenges in validating timing constraints in priority driven systems, Off-line Versus On-line scheduling.

System Design Techniques: Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance, Design Example: VOIP phone, Network based Appliance control-Hardware Design and Software Design.

Recommended Books:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2001.
2. Jane.W.S. Liu "Real-Time systems", Pearson Education Asia,
3. C. M. Krishna and K. G. Shin , "Real-Time Systems" ,McGraw-Hill,
4. Frank Vahid and Tony Givargi, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley
5. MPC885 PowerQUICC Family Reference by Freescale Semiconductor
6. MPC8323E PowerQUICC II Pro Integrated Communications Processor Reference Manual by Freescale Semiconductor

Satellite Communication

ECE 4160 **3-0-0 = 3**

Unit-I: Basic Principles.
General features, frequency allocation for satellite services, properties of satellite communication systems.
Unit-II: Satellite Orbits
Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.
Unit-III: Satellite Construction (Space Segment)
Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.
Unit-IV: Satellite Links
Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.
Unit-V: Earth Station
Introduction, earth station subsystem, different types of earth stations.
Unit-VI: The Space Segment Access and Utilization
Introduction, space segment access methods, TDMA, FDMA, CDMA, SDMA, assignment methods.
Unit-VII: The Role and Application of Satellite Communication.

Recommended Books:

1. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons.
2. Dennis Roddy, Satellite Communications, Mc. Graw-Hill International Ed
3. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice-Hall, Inc.,
4. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc. NY.

Pervasive Computing & Wireless Sensor Networks

ECE 3100 **3-0-0 = 3**

Introduction to concept of Pervasive Computing – characteristics & features of Pervasive Computing Systems, Components of such systems, Communication and network requirements, Personal Area Network as defined by IEEE 802.15.4, Potential applications of Pervasive computing systems. Introduction to context, Need for context, Relationship between sensors and context
Wireless Sensor Networks – Introduction to sensors, basic Concepts & characteristics, Need for wireless sensors, Advantages and disadvantages of wireless sensors, Self Organization of Networks, Self-healing capabilities, Network Formation
Routing Algorithms used in WSNs - Introduction to Routing algorithms, Criteria for "good" routing methods, Classification of routing algorithms based on their class, Destination based routing, All-pairs Shortest path Problem – the Floyd-Warshall Algorithm, Routing with Compact Routing Tables
Security Issues in WSNs – Security requirement, issues and goals. Security threats, types of attacks on sensor networks and countermeasures. Symmetric key, public-key, Hash function algorithms, Key Management issues
Localization & Target Tracking in WSNs - Concept of Distributed Digital Signal Processing in Wireless Sensor Networks, Localization techniques based on Signal strength, Angle of Arrival, Beacon based Triangulation. Issues involved in Tracking of moving targets, Collaborative signal processing, its need & challenges. Distributed estimation in sensor networks using Kalman Algorithm.
Recommended Books:

1. Fundamentals of Mobile & Pervasive Computing, Gupta, TMH

Radar Systems and Navigational-Aid

ECE 4161 **3 – 0 – 0 = 3**

Introduction:
Historical background, Radar terminology, Radar band designations, Basic Radar, Radar block diagram, Radar frequencies, Radar-clutter, Information from radar signals, propagation of Radar waves, Applications of Radar.
Radar Equation
Detection of signals in noise, receiver noise and signal to noise ratio, Radar cross-section of targets, transmitter power, PRF, Antenna parameters, other Radar equation considerations**.**
MTI and Pulse Doppler Radar
FM and CW-Radar**,** Doppler and MTI Radar, Delay-line cancelers, Digital MTI processing, moving target detector, Pulse Doppler Radar,
Tracking Radar
Tracking with Radar, Mono-pulse Radar, Conical and Sequential Lobing and ADT.
Detection of Signals in Noise
Detection, Matched filter receiver, Detectors, automatic detection, signal management.
Radar Antenna

Antenna parameters, Phased Array Radars ESPAA, MSPAA and Radiation pattern synthesis.
Radar Transmitters and Receiver
Linear beam power tubes, CFA, solid-state RF-power sources, Radar receiver.
Displays: A-scope, B-scope, PPI, modern displays.
Radio Navigation:
Radio direction finding, LORAN Radio ranges, Distance measuring equipments, Instrument and landing systems (ILS), MLS.

Textbooks:
1. Introduction to Radar Systems M.I. Skolnik- McGraw Hill
2. Radar Principles- N. Levanon- Wiley
3. Principles of Modern Radar- J.L. Eaves, and E.K. Reedy- Chapman & Hall
4. Elements of Electronic Navigation - N.S. Nagaraja (TMH publication)

Virtual Instrumentation using LabView

ECE 3091 **2 – 0 – 2 = 3**

Review of virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming.
VI Programming Techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.
Data Acquisition Basics: ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, interrupts, DMA, software and hardware installation.
Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: **USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & Industrial applications**, VISA and IVI, image acquisition and processing. Motion control.
Use of Analysis Tools: Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI applications in various fields.
Lab work will include practical based on learning & Utilizing LabView Software

Recommended Books:

1. Gary Johnson - Labview Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
2. Lisa K. wells & Jeffrey Travis - Labview for everyone, Prentice Hall, New Jersey, 1997.
3. Sokoloff - Basic concepts of Labview 4, Prentice Hall, New Jersey, 1998.
4. S.Gupta, J.P. Gupta - PC interfacing for Data Acquisition & Process Control, Second edition, Instrument Society of America, 1994.
5. LabView users manual.
6. National instruments Product catalog.
7. Virtual Instrumentation Using LabView, Gupta S., Tata McGraw Hill Publishing Company Limited.

Program Structure of the
M. Tech (Electronics & Communication Engineering) Programme

Semester I **First Year**

Course Code	Course Title	L-T-P	Credits
ECL 6150	Advanced Digital Communications	4-0-0	4
ECL 6182	Signal Processing Techniques & Applications	4-0-0	4
ECL 6221	Integrated Circuit Design	3-0-0	3
ECL 6110	Wireless Networks & Protocols	4-0-0	4
BUL 7	Research Methodology	4-0-0	4
ECP 6110	Wireless Networks Lab	0-0-2	1
ECP 6130	VLSI Lab	0-0-2	1
ECP 6182	Signal Processing Lab	0-0-2	1
Total Credits		**18-0-6**	**22**

Semester II **First Year**

Course Code	Course Title	L-T-P	Credits
ECL 6051	Microwave Circuit Design	3-0-0	3
ECL 6170	Optical Switching & Networks	3-0-0	3
ECL 6070	Synthesis & Optimization of Digital Circuits	3-0-0	3
ECE XXXX	School Elective-I	3-0-0	3
ECE XXXX	School Elective-II	3-0-0	3
ECP 6170	Optical Networks Lab	0-0-2	1
ECP 6051	Microwave Circuits Lab	0-0-2	1
Total Credits		**16-1-4**	**18**

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credits
	Open Elective-I		3
ECE XXXX	School Elective-III	3-0-0	3
ECL 7084	Embedded System Design	2-0-0	2
ECP 7084	Embedded System Lab	0-0-2	1
ECC 7981	Seminar	-	3
ECD 7990	Project-Synopsis (Phase-I)	-	8
Total Credits		**3-0-0**	**20**

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credits
ECD 7991	Project-Dissertation (Phase-II)		20
Total Credits			**20**

Total = 80 Credits

List of Electives

Elective –I	Elective –II & III
ECE 6193 Audio & Video Processing	EECE 201P Artificial Materials
ECE 6110 Wireless Sensor Networks & Applications.	ECE 6082 Real Time Embedded Systems
ECE 6150 Advanced Wireless Communications	ECE 6121 Wireless Networks & Security Issues
ECE 6195 Pattern Recognition	ECE 6065 Advanced Digital Signal Processors & its Applications
ECE 6194 Audio Engineering	ECE 6052 Microwave Antenna Design
ECE 6112 Advanced Computer Networks	EECE 6142 NEMS Design
ECE 6211 ASIC Design & FPGA	ECE 6160 Terahertz Electronics
ECE 6010 Semiconductor Device Modeling	ECE 6222 Digital integrated Circuits
ECE 6141 MEMS Design	ECE 6161 RFIC Design
ECE 6063 Advanced Computer Architecture	ECE 7170 Photonics Networks & switching
EECE 105P Detection & Estimation	ECE 7111 Advanced Wireless Sensor Networks
	ECE 6210P Mixed Signal Testing
	ECE 6230 Advanced CMOS VLSI Design

Fundamentals of Electronics

ECL 6010 **3-0–0=3**

Introduction:- Semiconductor Classification ,Semiconductor bonds, Energy band description ,Semiconductor types, Hall effect.
Diodes:- P-N junction-I/V characteristics, diode equivalent circuits, semiconductor diodes, rectifiers-(efficiency, ripple factor),filters,clipers,clampers.
Transistors:- BJT construction, characteristics (cb,ce,cc), load line. BJT biasing. FET, JFET, MOSFET (Depletion and enhancement), FET biasing.
Transistor Modeling:- BJT small signal model, hybrid equivalent model,FET small signal model.
Amplifiers:- Single stage amplifiers, voltage gain, effect of frequency on Gain, multistage amplifier.
Other Semi-conductor devices- SCR'S , Diacs, triacs, and other thyristors, basic theory of operation, characteristics, Theory and operation of UJT,

Recommended Books:

- Basic Electronics: Devices, Circuits & IT Fundamentals, Kal, PHI
- Basic Electronics for Scientists
- Electronic Devices & Circuits: An Introduction, Mottershead,
- Electronic Devices & Circuits, Boylestad, Nashelky, PHI
- Semiconductor Devices , Nandita Dass, PHI
- Electronic Devices & Circuits, Milman & Halkias
- Electronic Devices & Circuits, Theodore Bogart, Jr

Wireless Networks & Protocols

ECL 6110 **4 - 0 - 0 = 4**

Unit 1
Introduction to Fundamentals of Wireless Communication, Channel Diversity & Fading, Multiple Access Techniques, Wireless LANs: IEEE 802.11 WLANs - protocol architecture, physical layer, MAC layer, analysis, deployment of 802.11 infrastructure
Unit 2
WPANs: IEEE 802.15.4, Bluetooth, ZigBee, UWB. protocol architecture, physical layer, MAC layer, analysis, deployment of 802.15.4 infrastructure
Unit 3
Mobile Ad-Hoc Networks (MANETS): Introduction; MAC Protocols - classification, comparative analysis; Routing - reactive and proactive routing, power-aware routing, performance comparison; Quality of Service
Unit 4
Wireless Sensor Networks (WSNs): Overview/Architectures; Data Dissemination/Data Gathering; MAC Protocols; Routing Protocol, Security, Power control; Cross layer design; Localization

Lab Work: Simulation of Various Wireless Networks using Qualnet Simulation Software

Recommended Books:

1. Rappaport, "Wireless Communications – Principles & Practices", PHI, Latest Edition
2. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Pearson Education, Inc.,
3. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons,
4. Charles E Perkins, "Ad Hoc Networking", Addison Wesley,
5. Jochen Schiller, "Mobile Communications", Addison Wesley,
6. Ramjee Prasad and Luis Munoz, "WLANs and WPANs towards 4G wireless", Artech House,
7. Selected papers from IEEE & ACM to be provided by Faculty

Advance Digital Communication

ECL 6150 **4 - 0 - 0 = 4**

Unit I: Introduction
Digital communication system (description of different modules of the block diagram), Complex baseband representation of signals, Gram-Schmidt orthogonalization procedure. M-ary orthogonal signals, bi-orthogonal signals, simplex signal waveforms.
Unit II: Modulation
Pulse amplitude modulation (binary and M-ary, QAM), Pulse position modulation (binary and M-ary), Carrier modulation (M-array ASK, PSK, FSK, DPSK), Continuous phase modulation (QPSK and variants, MSK, GMSK).
Unit III: Receiver in additive white Gaussian noise channels
Coherent and non-coherent demodulation: Matched filter, Correlator demodulator, square-law, and envelope detection; Detector: Optimum rule for ML and MAP detection Performance: Bit-error-rate, symbol error rate for coherent and non-coherent schemes.
Unit IV: Band-limited channels
Pulse shape design for channels with ISI: Nyquist pulse, Partial response signaling (duobinary and modified duobinary pulses), demodulation; Channel with distortion: Design of transmitting and receiving filters for a known channel and for time varying channel (equalization); Performance: Symbol by symbol detection and BER, symbol and sequence detection, Viterbi algorithm.
Unit V: Synchronization
Different synchronization techniques (Early-Late Gate, MMSE, ML and spectral line methods)
Unit VI: Communication over fading channels

Characteristics of fading channels, Rayleigh and Rician channels, receiver performance-average SNR, outage probability, amount of fading and average bit/symbol error rate.

Signal Processing Techniques & Applications

ECL 6182 **4 - 0 - 0 = 4**

Continuous-Time and Discrete-Time Signals and Systems:
Continuous and discrete time signals: Some Elementary Continuous-time and Discrete-Time signals. Classification of Signals ,Periodic and a periodic even , odd ,energy and power signals ,Deterministic and random signals ,Causal and non-causal signals complex exponential and sinusoidal signals ,Simple Manipulations of Continuous and discrete time signals.
Continuous-Time Systems: Mathematical equation governing LTI Continuous-Time systems, Block diagram and signal flow graph representation, response of LTI Continuous-Time system in time domain, classification of Continuous-Time systems, convolution of Continuous-Time signals.
Discrete-Time Systems: Input-Output Description, Block Diagram Representation, Classification, Interconnection;
Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems;
Correlation of Discrete-Time Signals: Cross correlation and Autocorrelation Sequences, Properties. Understanding of SISO, SIMO, MISO and MIMO
Deterministic Discrete signal analysis:
Discrete Fourier transforms (DFT), Periodic and aperiodic signal analysis, limitations of DFT, Fast Fourier Transforms, Transform equivalence: Z, DTFT, CTFT, FS, DFT. DFT for long sequences, STFT. Practical aspects of DFT. Application of DFT: Filter banks. Stability analysis, Response of a stable system, marginal and asymptotic stability.
Random Discrete signal and systems:
Mathematical description of random signals, pseudorandom signals, stochastic processes. Brief review of probability. Spectral representation and analysis of nonstationary signals, random signals. Linear systems to random input. Parametric representation of Stochastic processes. Basic concept of processing random signals
Image Representation and compression:
Gray scale and colour Images, image sampling and quantization. Two dimensional orthogonal transforms: DFT, WHT, Haar transform, KLT, DCT. Fundamental Concepts of Image Compression: Compression models - Information theoretic perspective -Fundamental coding theorem - Lossless Compression: Huffman Coding- Arithmetic coding - Bit plane coding – Run length coding - Lossy compression: Transform coding - Image compression standards.
Video Processing:
Representation of Digital Video, Spatio-temporal sampling; Motion Estimation; Video Filtering; Video Compression, Video coding standards.
Recommended Books:
1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Pearson.
2. Alan V. oppenheim and Alan S. Willsky ,Signals and Systems---, PHI
3. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India,
4. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education.

Integrated Circuit Design

ECL6221 **3 - 0 - 0 = 3**

Unit I:
IC components - their characterization and design. Analysis and design of basic logic circuits. Linear ICs. Large Scale Integration.
Unit II:
Basics of MOSFET ,Introduction to digital IC design, MOS inverter-Resistive load ,Depletion load, CMOS inverter, Switching Characteristics of MOS inverter, design of combinational logic gates in CMOS- static and dynamic CMOS -design, CMOS Transmission gates, Power consumption in CMOS gates, Low power CMOS logic ckts ,MOS memory circuits, Bi-CMOS Logic ckts, Design of sequential logic circuits, Set up time, Hold time requirements.
Unit III:
Low power design:
Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. Physics of power dissipation in CMOS devices.
Device & Technology Impact on Low Power Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

Power estimation, Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems.
Recommended Books:
1. R.S. Muller and T.I. Kamins, "*Device Electronics for Integrated Circuits*", Wiley,
2. DA. And Eshrachian K, "*Basic VLSI design systems & circuits*", PHI,
3. Geigar BR, Allen PE & Strader ME, " *VLSI design techniques for analog & digital circuit*",Mc Graw Hill,
4. Carver Mead and Lynn Conway, "*Introduction to VLSI Systems*", BS Publications, Indian Reprint
5. Neil H. E. Weste & Kamran Eshraghian, "*Principles of CMOS VLSI Design*", Pearson education asia,

6. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP,
7. Rabaey, Pedram, "Low power design methodologies" Kluwer Academic,
8. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley,
9. Rabaey J.M, Chandrakasan A, Nikolic B , "Digital Integrated Circuits- A Design Perspective", Prentice Hall.
10. S M Kang and Y Lebici,"CMOS Digital Integrated Circuits-analysis and design", McGraw Hill.

Microwave Circuit Design

ECL6051 **3 - 0 - 0 = 3**

Unit -1

Introduction

Importance of RF Design, RF Behavior of Passive Components: High Frequency Resistors, High-Frequency Capacitors, High-Frequency Inductors. Chip Components and Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface-Mounted Inductors.

Unit -2

An Overview of RF Filter Design I

Basic Resonator and Filter Configurations: Filter Type and Parameters, Low-Pass Filter, High Pass Filter, Bandpass and Bandstop Filters, Insertion Loss, Special Filter Realizations: Butterworth –Type, Chebyshev and De-normalization of Standard Low-Pass Design.

Unit -3

An Overview of RF Filter Design II

Filter Implementations: Unit Elements, Kuroda's Identities and Examples of Microstrip Filter Design. Coupled Filter: Odd and Even Mode Excitation, Bandpass Filter Section, Cascading Bandpass Filter Elements, Design Examples.

Unit -4

Matching and Biasing Network

Impedance Matching using Discrete Components: Two Component Matching Networks, Forbidden regions, Frequency Response and Quality Factor, Microstrip Line Matching Networks: From Discrete Components to Microstrip Lines, Single-Stub Matching Networks, Double-Stub Matching Networks, Amplifier Classes of Operation and Biasing Network: Classes of Operation and Efficiency of Amplifiers, Bipolar Transistor Biasing Networks, Field Effect Transistor Biasing Networks.

Unit -5

RF Transistor Amplifier Design I

Characteristics of Amplifiers, Amplifier Power Relations: RF source, Transducer Power Gain, Additional Power Relations, Stability Considerations: Satbility Circles, Unconditional Stability, Stabilization Methods.

Unit -6

RF Transistor Amplifier Design II

Constant Gain: Unilateral Design, Unilateral Figure of Merit, Bilateral Design, Operating and Available Power Gain Circles. Noise Figure Circles, Constant VSWR Circles. Broadband, High Power and Multistage Amplifiers.

Unit -7

RF Oscillators and Mixers:

Basic Oscillator Model: Negative Resistance Oscillator, Feedback Oscillator Design, Design Steps, Quartz Oscillators. High Frequency Oscillator Configuration: Fixed Frequency Oscillators, Dielectric Resonator Oscillators, YIG-Tuned Oscillators, Voltage Controlled Oscillators, Gunn Element Oscillator. Basic Characteristics of Mixers: Basic Concepts, Frequency Domain Considerations, Single-Balanced Mixer Double-Balanced Mixer.

Text Book :

1. RF Circuit Design Theory and Application, Reinhold Ludwig and Pavel Bretchko, Ed. 2004, Pearson Education

Reference Book:

1. Radio Frequency & Microwave Electronics Illustrated, Radmanesh, Pearson,

Optical Switching & Networks

ECL 6170 **3 - 0 - 0 = 3**

Unit I: Optical Networking Introduction and Challenges

Advantages of optical network, telecom network overview and architecture, WDM optical networks, WDM network evolution, WDM network construction, broadcast and select optical WDM network, wavelength routed optical WDM network, Challenges of optical WDM network.

Unit II: Optical Networking Components/Building Blocks

Optical transmitters, semiconductor laser diode, tunable and fixed laser, laser characteristics, photo-detectors, tunable and fixed optical filters, channel equalizers, optical amplifiers and its characteristics, semiconductor laser amplifier, Raman amplifier, doped fiber amplifier, various switching elements, OADM, OXC, CLOS architecture, MEMS, wavelength convertors.

Unit III: Single and Multi-hop Networks

Introduction to single and multi-hop networks, Characteristics of single and multi-hop networks, experimental single hop networks: LAMBDANET, STARNET, SONATA, Rainbow, experimental multi-hop networks: Shufflenet, De Bruijn Graph, And Hypercube.

Unit IV: Optical switching

Optical packet switching basics, slotted and un-slotted networks, header and packet format, contention resolution in OPS networks, self routing, examples on OPS node architecture, optical burst switching, signaling and routing protocols for OBS networks, contention resolution in OPS networks, multicasting, implementation and application. MEMs based switching, switching with SOAs.

Unit V: Optical Access Network
Introduction to access network, PON, EPON and WDN EPON: overview, principal of operation, architecture; dynamic wavelength allocation, STARGATE: overview, need, architecture, operation and application, gigabit Ethernet, radio over fiber network.
Unit VI: Optical Multicasting and traffic grooming
Introduction to multicasting, Multicast capable switch architecture, unicast, broadcast and multicast traffic, multicast tree protection, traffic grooming overview, static and dynamic traffic grooming.

Synthesis & Optimization Of Digital Circuits

ECL6070 **3 - 0 - 0 = 3**

Unit-I
Introductions: Models for systems, characteristics of a signal processing system.
Unit-II
Design Space Exploration: Introduction to the fundamental architectural synthesis problems: scheduling, allocation, binding, estimation, and control-unit synthesis
Unit-III
Optimization: Introduction to graph theory and combinatorial optimization, optimization of digital signal processing systems, graph representation and annotation, mapping techniques, Optimizing timing/area.
Unit-IV
Scheduling: Various scheduling techniques, scheduling algorithms, as-soon-as-possible and as-late-as-possible, list scheduling, integer linear programming.
Unit-V
Binding and resource allocation: Resource sharing algorithms, interval graphs, graph colouring, integer linear program models, register sharing, Retiming, function approximation.
Unit-VI
Technology Mapping and logic optimization: Technology mapping, technology libraries, cost models, graph covers, Two-level, multilevel factorization, CAD tools.

Recommended Books:

1. Synthesis and Optimization of Digital Circuits – Giovanni De Micheli, McGraw Hill International edition,
2. Logic synthesis and verification, S. Hassoun and T. Sasao, Kluwer Academic Publishers,
3. Logic Synthsis, Srinivas Devadas et al, McGraw Hill,

Embedded System Design

ECL7084 **2 - 0 - 0 = 2**

Unit I: Introduction of Embedded Systems: Hardware/software systems and codesign, Hardware Software synthesis, Hardware Software Interface
Unit II: Modeling: Models of computation for embedded systems, Behavioral design, Requirement Specifications, System Architecture
Unit II: Architectural Aspects: Architecture selection, Hardware software partitioning, scheduling, and communication, resource allocation and binding. Optimization techniques.
Unit IV: Design: Implementation, Simulation, synthesis, and verification, Hardware/software implementation. System level low power and high performance techniques.
Unit V: Methodologies: Design methodologies and tools, Performance analysis and optimization.
Unit VI: Examples: Design examples and case studies

ecommended Books:

1. Embedded System Design by Peter Marwedel, Springer,
2. *Computers as Components* by Wayne Wolf, Morgan Kaufman
3. Readings in Hardware/Software Co-Design by G. De Micheli, Rolf Ernst, and Wayne Wolf, eds. Morgan Kaufmann, **Systems-on-Silicon Series**
4. Embedded System Design: A Unified Hardware/Software Introduction by Frank Vahid and Tony D. Givargis, Addison Wesley
5. Programming Embedded Systems in C and C++ by Michael Barr, O'Reilly,
6. An Embedded Software Primer by David E. Simon, Addison Wesley
7. The Art of Designing Embedded Systems by Jack Ganssle, Newnes

Lab Courses

Wireless Networks Lab

ECP 6110 **0 - 0 - 2 = 1**

Introduction to Simulation Tool & its features
Simulation & Analysis of IEEE 802.11 based network scenarios
Simulation & Analysis of IEEE 802.15.4 based Network scenarios
Design & Simulation of Simple Routing Algorithm (Modified AODV etc.)
Introduction to Programming of Motes to form simple WSN

Signal Processing Lab

ECP 6182 **0 - 0 -2 = 1**

- Basic Sampling Rate Alteration Devices
- Decimator and Interpolator Design and Implementation
- *Design of Digital Filter and Implementation*
- *IIR Filter Design*
- *FIR Filter Design*
- Simulation of IIR Digital Filters
- Simulation of FIR Digital Filters
- Design of Tunable Digital Filters
- Function Approximation

VLSI Lab

ECP 6130 **0 - 0 - 2 = 1**

Description of Analog & Digital Design flow. Circuit level simulation, pre-layout simulation, Layout , Design Rule Check, parasitic extraction, post layout simulation , generation of GDS-II format.
Digital Design implementation on EDA Tools.
Project covering detailed flows both and analog and digital need to submitted by students for evaluation

Embedded Systems Lab

ECP 7084 **0 - 0 - 2 = 1**

Introduction to Kiel IDE & its features
Introduction to Open Source Tools for Embedded system Design
Embedded Programs for utilizing on-board resources of ARM Processors
Interface of UART based Devices, SPI

Optical Networks Lab

ECP 6170 **0 - 0 - 2 = 1**

Practical Work pertaining to:

- Digital/optical link communication
- Propagation loss
- Intensity modulation
- NA/LED/LASER Performance analysis
- Computer to computer serial Port Communication
- Design an Optical Network in Optiwave
- Analyze the network on the basis of BER, SNR etc.
- Receiver response analysis
- Performance analysis of Different Amplifier

Microwave Circuits Lab

ECP 6051 **0 - 0 - 2 = 1**

Introduction to CAD Tool & its features
Simulation of Microwave Passive Components – Filters, Antennas, Couplers, Power dividers
Introduction to Measurement Techniques: Measurement of Passive Components using VNA & Spectrum Analyzer

List of Electives

Audio & Video Processing

ECE 6193 **3 - 0 - 0 = 3**

UNIT-I
Speech processing: Physiology of speech generation: characteristic of speech sounds; glottal excitation; speech production models: discrete time speech production model; discrete time filter model for speech production; source excitation model.
Linear prediction analysis: All-pole models; least-squares estimation; spectral matching; spectral envelopes; applications of LP analysis.
Speech coding: Coder's attributes; waveform coding; vocoders; analysis-by-synthesis coding; code-excited linear predictive vocoder; regular pulse-excited LPC.
UNIT-II
Image processing: Fundamentals of digital image: Digital image representation and visual perception, image sampling and quantization.
Image enhancement: Histogram processing; Median filtering; Low-pass filtering; High-pass filtering; Spatial filtering; Linear interpolation, Zooming.
Image coding and compression techniques: Scalar and vector quantizations; Codeword assignment; Entropy coding; Transform image coding; Wavelet coding; Codec examples
Image analysis and segmentation: Feature extraction; Histogram; Edge detection; Thresholding.
Image representation and description: Boundary descriptor; Chaincode; Fourier descriptor; Skeletonizing; Texture descriptor; Moments.
UNIT-III
Audio processing: Fundamentals of digital audio: Sampling; Dithering; Quantization; psychoacoustic model. Basic digital audio processing techniques: Anti-aliasing filtering; Oversampling; Analog-to-digital conversion; Dithering; Noise shaping; Digital-to-analog Conversion; Equalisation.

Digital Audio compression: Critical bands; threshold of hearing; Amplitude masking; Temporal masking; Waveform coding; Perceptual coding; Coding techniques: Subband coding and Transform coding; Codec examples.

UNIT-IV

Video processing: Fundamentals of digital video: Basics of digital video; Digital video formats. Basic digital video processing techniques: Motion estimation; Interframe filtering; Motion-compensated filtering; Error concealment.

UNIT-V

Video coding techniques: Temporal redundancy; Spatial redundancy; Block-based motion estimation and compensation; Coding techniques: Model-based coding, Motion-compensated waveform coding; Codec examples.

Recommended Books:

1. Alistair Mo_at and Andrew Turpin, Compression and Coding Algorithms, Kluwer Academic Publishers, Boston,
2. K.R. Rao & J.J. Hwang, Techniques & Standards for Image, Video & Audio Coding, Prentice Hall,

Wireless Sensor Networks & Applications

ECE 6110 **3-0-0 = 3**

Unit 1: Introduction to Pervasive Computing, Characteristics & features of Pervasive Computing Systems, Potential applications of Pervasive computing systems, Context, Context aware applications, Relationship between sensors and context, Personal Area Network as defined by IEEE 802.15.4, Introduction to Sensors, Need for Wireless Sensor Networks, Scope & Limitations of Wireless sensor Networks, Adhoc Networks v/s Sensor Networks,

Unit 2: Routing Algorithms: Need for routing mechanism, requirements & characteristics of routing algorithms, Traditional routing algorithms AODV, DSR, LMR. Concept of Network Lifetime, Categorisation of Routing algorithms – Flat, Hierarchical, Cluster based, Single-hop, Multi-hop & Energy Aware.

Unit 3: MAC Layer in Sensor Networks: Importance of Media Access Control (MAC) Protocols in Sensor Networks, Issues in designing MAC protocols , Classifications of MAC protocols, Popular MAC protocols

Unit 4: Localization: Need for localization, requirements,- hardware & software, Localization techniques based on Distance, Angle Measurements. Different localization algorithms – Triangulation, MDS, Probabilistic localization. Tracking of moving objects

Unit 5: Applications of Wireless Sensor Networks: Potential Application Areas of Wireless Sensor Networks, Data Acquisition Systems using WSN, Target Tracking, HVAC Applications using WSN, Intrusion Detection using WSN

Lab Work: Programming of Crossbow Motes, Creation of Wireless Sensor Network Testbed, Data Acquisition using WSN, Localization techniques using test bed

Recommended Books:

1.Adelstein, Sandeep Gupta "Fundamentals of Mobile & Pervasive Computing", Tata McGraw Hill

2.C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Pearson Education, Inc.,

3.Selected papers from IEEE & ACM to be provided by Faculty

Advanced Wireless Communication

ECE 6150 **3 - 0 - 0 = 3**

Unit I: Wireless Communications and Diversity

Fast Fading Wireless Channel Modeling, Rayleigh/Ricean Fading Channels, BER Performance in Fading Channels, Diversity modeling for Wireless Communications, BER Performance Improvement with diversity, Types of Diversity – Frequency, Time, Space.

Unit II: Broadband Wireless Channel Modeling

WSSUS Channel Modeling, RMS Delay Spread, Doppler Fading, Jakes Model, Autocorrelation, Jakes Spectrum, Impact of Doppler Fading

Unit III: Cellular Communications

Introduction to Cellular Communications, Frequency reuse, Multiple Access Technologies, Cellular Processes - Call Setup, Handover etc, Teletraffic Theory.

Unit IV: CDMA, OFDMA, MIMO

Introduction to CDMA, Walsh codes, Variable tree OVSF, Multipath diversity, RAKE Receiver, CDMA Receiver Synchronization, Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, Channel model and SNR performance, OFDM Issues – PAPR, Frequency and Timing Offset Issues, Introduction to MIMO, MIMO Channel Capacity, SVD and Eigenmodes of the MIMO Channel, MIMO Spatial Multiplexing – BLAST, MIMO Diversity – Alamouti, OSTBC, MRT, MIMO - OFDM

Unit V: Ultrawide Band

UWB Definition and Features, UWB Wireless Channels, UWB Data Modulation, Uniform Pulse Train, Bit-Error Rate Performance of UWB

Unit VI: 3G and 4G Wireless Standards

GSM, GPRS, WCDMA, LTE, WiMAX

Pattern Recognition

ECE 6195 **3 - 0 - 0 = 3**

Basics of pattern recognition;

Bayesian decision theory: Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete features;

Parameter estimation methods: Maximum-Likelihood estimation, Gaussian mixture models, Expectation-maximization method, Bayesian estimation; Hidden Markov models for sequential pattern classification;

Dimension reduction methods: Fisher discriminant analysis, Principal component analysis; Non-parametric techniques for density estimation;
Linear discriminant function based classifiers: Perceptron Support vector machines; Non-metric methods for pattern classification;
Unsupervised learning and clustering: Algorithms for clustering: K-means, Hierarchical and other methods

Recommended Books:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley,
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press,
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer,

Detection & Estimation

EECE 105P **3 - 0 - 0 = 3**

Review of random process, problem formulation and objective of signal detection and signal parameter estimation; Hypothesis testing: Neyman-Pearson, minimax, and Bayesian detection criteria; Randomized decision; Compound hypothesis testing; Locally and universally most powerful tests, generalized likelihood-ratio test; Chernoff bound, asymptotic relative efficiency; Sequential detection; Nonparametric detection, sign test, rank test. Parameter estimation: sufficient statistics, minimum statistics, complete statistics; Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, Bhattacharya bound; Linear models; Best linear unbiased estimation; Maximum likelihood estimation, invariance principle; Estimation efficiency; Least squares, weighted least squares; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

Recommended Books:

H. V. Poor, An Introduction to Signal Detection and Estimation, Springer,
S. M. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, Prentice Hall PTR,
S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall PTR,
H. L. Van Trees, Detection, Estimation and Modulation Theory, Part I, John Wiley
D. L. Melsa and J. L. Cohn, Detection and Estimation Theory, McGraw Hill,
L. L. Scharf, Statistical Signal Processing: Detection, Estimation, and Time Series Analysis, Addison-Wesley,
V. K. Rohatgi and A. K. M. E. Saleh, An Introduction to Probability and Statistics, Wiley,

Audio Engineering

ECE 6194 **3 - 0 - 0 = 3**

Sound and Hearing
The Basics of Sound, Waveform Characteristics, Loudness Levels, the Ear, Auditory Perception, Perception of Direction, Perception of Space, Doubling

Studio Acoustics and Design
Studio Types, Primary Factors Governing Studio and Control Room Acoustics, Frequency Balance, Reverberation, Acoustic Echo Chambers, Power- and Ground-Related Issues

Microphones: Design and Application
The Microphone: An Introduction, Microphone Design, Microphone Characteristics, Microphone Preamps, Microphone Techniques, Pickup Characteristics as a Function of Working Distance, Stereo Miking Techniques, Surround Miking Techniques, Recording Direct, Microphone Placement Techniques for different instruments like Brass, Strings, Keyboard, Percussion, Wood instruments, Voice etc. Microphone Selection

Multimedia Audio:
Data acquisition, Sampling and Quantization, Human Speech production mechanism, Digital model of speech production, Analysis and synthesis, Psycho-acoustics, Data structures used in audio files, Characteristics of sound waves, psycho, digital audio, MIDI and MIDI File format, CD and DVD formats.

Audio file formats: WAV, VOC, AVI, MPEG Audio, mp3, mp4 etc

Audio compression: Compression in audio, PCM, DM, DPCM study of different audio file formats and compression techniques Programming considerations for audio compression.

Advanced Computer Networks

ECE 6112 **3 - 0 - 0 = 3**

Chapter 1: Networks and need of Internetworking, PAN, LAN, WAN, MAN

Chapter 2: Physical Layer: Baseband Communication, Ethernet, Frame Relay: Electrical features, frame structure and principle of operation

Chapter 3: Network Layer: Routing and Routed Protocols, Best Effort Service, Distance Vector and Bellman Ford Algorithms, Routing Loops, OSPF, RIP and IP: Packet Structure, Fragmentation and Routing Tables

Chapter 4: Transport Layer: Connectionless and Connection oriented transports, Reliable and Unreliable Transports, Error Control, Flow Control, Congestion Control, Sliding Window and Handshaking, UDP & TCP and their implementations

Chapter 5: Other Protocols: ICMP, SNMP, IGMP, Multicasting and Broadcasting, DoS

ASIC Design and FPGA

ECE 6211 **3-0-0 = 3**

Introduction To ASICS, CMOS Logic And ASIC Library Design
Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort - Library cell design - Library architecture.

Review of VHDL/Verilog: Entities and architectures

Programmable Asics, Programmable ASIC Logic Cells And Programmable ASIC I/O Cells, Anti fuse -static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

Programmable ASIC Interconnect, Programmable ASIC Design Software And Low Level Design Entry Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 – Altera FLEX - Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools - EDIF- CFI design representation.

ASIC Construction, Floor Planning, Placement And Routing, System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow - global routing – detailed routing - special routing - circuit extraction - DRC. Design using Xilinx family FPGA

Recommended Books:

- M.J.S .Smith, - " Application - Specific Integrated Circuits " - Addison –Wesley Longman Inc.,
- Skahill, Kevin," VHDL for Programmable Logic", Addison-Wesley,
- John F. Wakherly, " Digital Design: Principles and Practices", Prentice Hall International
- Charles W. Mckay, "Digital Circuits a proportion for microprocessors", Prentice Hall

Semiconductors Devices & Modelling

ECE 6010 **3-0-0 = 3**

1. BASIC SEMICONDUCTOR PHYSICS

Introduction, Solis-state Structure, Band Structure, Electrons and Hole: Semiconductor Statistics, Intrinsic; Extrinsic and Compensated Semiconductors, Electron and Hole Mobilities and Drift Velocities, Hall Effect and Magnetoresistance.

2. P-N JUNCTIONS, SCHOTTKY BARRIER JUNCTIONS, HETEROJUNCTIONS AND OHMIC CONTACTS

Introduction, p-n Junction Under Zero Bias Condition, Current Voltage Characteristics of an Ideal p-n Junction (The Diode Equation), Tunneling and Tunnel Diodes, Junction Breakdown – Breakdown Mechanisms; Impact Ionization and Avalanche Breakdown, Schottky Barriers, Current Voltage Characteristics of Schottky Diodes – Thermionic

Emission Model; Current Voltage Characteristics : Thermionic Field Emission & Field Emission; Small-Signal Circuit of a Schottky Diode

3. BIPOLAR JUNCTION TRANSISTORS

Principle of Operation, Minority Carrier Profiles in a Bipolar Junction Transistor, Current Components and Current Gain, Base Spreading Resistance and Emitter Current Crowding in Bipolar Junction Transistor, Effects of Non-Uniform Doping in the Base Region: Graded Base Transistors, Output Characteristics of Bipolar Junction Transistors and Early effect, Ebers-Moll Model, Bipolar Junction Transistor as a Small Signal Amplifier: Cutoff Frequencies, Bipolar Junction Transistor as a Switch, Bipolar Junction Transistors in Integrated Circuits.

4. FIELD EFFECT TRANSISTORS

Introduction, Surface Charge in Metal Oxide Semiconductor Capacitor, Capacitance-Voltage Characteristics of an MIS Structure, Metal Oxide Semiconductor Field-Effect Transistors (MOSFETs), Velocity Saturation Effects in MOSFETs, Short Channel and Nonideal Effects in MOSFETs, Subthreshold Current in MOSFETs, MOSFET Capacitances and Equivalent Circuit, Enhancemment-and Depletion-Mode MOSFETs Complementary MOSFETs (CMOS) and Silicon on Sapphire, Metal Semi-conductor Field-Effect Transistors.

Recommended Books:

1. R.S. Muller and T.I. Kamins, "*Device Electronics for Integrated Circuits*", Wiley,
2. R. F. Pierret, Addison, "*Semiconductor Device Fundamentals*", Wesley,
3. S M Sze, "*Physics of Semiconductor Devices*", Wiley,
4. S M sze,G S May, "*Fundamentals of semiconductor fabrication*", Wiley
5. S. Wolf, "*The Submicron MOSFET, volume 3 of Silicon Processing for the VLSI Era*",Lattice Press,

MEMS Design

ECE 6141 **3-0-0 = 3**

Module 01: Historical Background: Silicon Pressure sensors, Micromachining, MicroElectro Mechanical Systems. Micro fabrication and Micromachining: Integrated Circuit Processes. Potential of MEMS in industry.

Module 02: Bulk Micromachining: Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA)

Module 03: Physical Micro sensors: Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor Principles and Examples: Thermal sensors, Electrical Sensors, Mechanical Sensors, Chemical and Biosensors.

Microactuators: Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors Microactuator systems: Success Stories, Ink-Jet printer heads, Micro-mirror TV Projector.

Module 04: Microstereolithography (MSL) for 3D fabrication, Two photon MSL, Dynamic mask MSL, scanning systems, Optomechatronics system for MSL. Ceramic and Metal Microstereolithography.

Module 05: Ceramic and Metal Microstereolithography. Scattering of light by small particles. Effect of particle properties on accuracy and resolution of component in Ceramic and Metal MSL. Monte carlo ray tracing method. Nanolithography.

Module 06: Surface Micromaching: One or two sacrificial layer processes, Surface micromachining requirements, Polysilicon surface micromachining, Other compatible materials, Silicon Dioxide, Silicon, Micromotors, Gear trains, Mechanisms. Characterisation of MEMS devices.

Recommended Books:

1. MEMS, Vijay Vardan, *Wiley Publication*
2. MEMS and Microsytems Design and Manufacture, Tai- Ran Hsu, *Tata McGraw Hill*
3. MEMS, Nitaigour Mahalik, *Tata McGraw Hill*

4. MEMS and MOEMS Technology and Applications, Rai Chaoudhary, PHI Learning
5. Stephen D. Senturia, Microsystem Design, *Kluwer Academic Publishers,*
6. Marc Madou, Fundamentals of Microfabrication, *CRC Press*
7. Kovacs, Micromachined Transducers Sourcebook, WCB *McGraw-Hill, Boston*
8.M-H. Bao, Elsevier, Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, New York,

Advanced Computer System Architecture

ECE 6063 **3 – 0 – 0 = 3**

Chapter 1
History of Calculation and Computer Architecture, Influence of Technology and Software on Instruction Sets: Up to the dawn of IBM 360, Complex Instruction Set Evolution in the Sixties: Stack and GPR Architectures, Microprogramming, Simple Instruction Pipelining, Pipeline Hazards
Chapter 2
Multilevel Memories – Technology, Cache (Memory) Performance Optimization, Virtual Memory Basics, Virtual Memory
Chapter 3
Complex Pipelining, Out of Order Execution and Register Renaming, Branch Prediction and Speculative Execution, Advanced Superscalar Architectures, Microprocessor Evolution
Chapter 4
Synchronization and Sequential Consistency, Cache Coherence, Cache Coherence (Implementation), Snoopy Protocols, Relaxed Memory Models
Chapter 5
VLIW/EPIC: Statically Scheduled, Vector Computers, Multithreaded Processors, Reliable Architectures, Virtual Machines

Artificial Material

EECE 201P **3 – 0 – 0 = 3**

Unit I Introduction
Definition of Metamaterials (MTMs) and Left-Handed (LH) MTMs, Theoretical Speculation by Viktor Veselago, Experimental Demonstration of Left-Handedness, Further Numerical and Experimental Confirmations, Backward Waves and Novelty of LH MTMs, Terminology, Transmission Line (TL) Approach, Composite Right/Left-Handed (CRLH) MTMs, MTMs and Photonic Band-Gap (PBG) Structures
Unit II Fundamentals of LH MTMs
Left-Handedness from Maxwell's Equations, Entropy Conditions in Dispersive Media, Boundary Conditions, Reversal of Doppler Effect, Reversal of Vavilov- Cerenkov Radiation, Reversal of Snell's Law: Negative Refraction, Focusing by a Flat LH Lens, Fresnel Coefficients, Reversal of Goos-Hanchen Effect, Reversal of Convergence and Divergence in Convex and Concave Lenses, Sub-wavelength diffraction.
Unit III TL Theory of MTMs
Ideal Homogeneous CRLH TLs, LC Network Implementation, Real Distributed 1D CRLH Structures, Experimental Transmission Characteristics, Conversion from Transmission Line to Constitutive Parameters.
Unit IV Two-Dimensional MTMs
Eigenvalue Problem, Transmission Line Matrix (TLM) Modeling Method, Negative Refractive Index (NRI) Effects, Distributed 2D Structures.
Unit V Application
Guided wave application: Power divider, couplers, Resonators, Filters, Radiated wave Application: Fundamental Aspects of Leaky-Wave Structures, Leaky wave antenna, meta interfaces.

Recommended Books:

- Christophe Caloz and Tatsuo Itoh, **"**Electromagnetic metamaterials: Transmission line theory and microwave applications," Wiley Interscience.
- Nader Engheta and R. W. Ziolkowski, "Metamaterials Physics and Engineering Explorations" John Wiley and Sons.
- T. J. Kui, D. R. Smith, and R. Liu, "Metamaterials theory, design, and applications" Springer.
- M. A. Noginov and V. A. Podolskiy, "Tutorials in Metamaterials," CRC Press.

Real Time Embedded Systems

ECE 6082 **3 – 0 – 0 = 3**

Chapter 1
Real-Time Scenarios, Computer as Real-Time Component, Embedded Processors in Real-Time Systems, Role of RISC technology, ARM and MIPS: Architecture, Versions, Instruction Sets
Chapter 2
Simultaneous Multitasking, Real-Time Constraints, Task Scheduling Policies (Rate Monotonic, Earliest Deadline First etc.), Preemption, Context Switching
Chapter 3
Real Time Operating Systems, flavors and the design approach, Linux as Real-Time OS, OS for Sensor Networks
Chapter 4
Simulation of Real Time Systems using TIME tool, Build Tools for Real-Time Embedded Systems, IDEs, Compilers, Debugger

Wireless Networks & Security Issues

ECE 6121 **3 – 0 – 0 = 3**

Introduction: Basic objectives of cryptography, secret-key and public-key cryptography, one-way and trapdoor one-way functions, cryptanalysis, attack models, classical cryptography.
Block ciphers: Modes of operation, DES and its variants, RCS, IDEA, SAFER, FEAL, BlowFish, AES, linear and differential cryptanalysis.
Stream ciphers: Stream ciphers based on linear feedback shift registers, SEAL, unconditional security.
Message digest: Properties of hash functions, MD2, MD5 and SHA-1, keyed hash functions, attacks on hash functions.
Public-key parameters: Modular arithmetic, gcd, primality testing, Chinese remainder theorem, modular square roots, finite fields.
Intractable problems: Integer factorization problem, RSA problem, modular square root problem, discrete logarithm problem, Diffie-Hellman problem, known algorithms for solving the intractable problems.
Public-key encryption: RSA, Rabin and EIGamal schemes, side channel attacks.
Key exchange: Diffie-Hellman and MQV.
Digital signatures: RSA, DSA and NR signature schemes, blind and undeniable signatures.
Entity authentication: Passwords, challenge-response algorithms, zero-knowledge protocols.
Standards: IEEE, RSA and ISO standards.
Network security: Certification, public-key infra-structure (PKI), secure socket layer (SSL), Kerberos.
Advanced topics: Elliptic and hyper-elliptic curve cryptography, number field sieve, lattices and their applications in cryptography, hidden monomial cryptosystems, cryptographically secure random number generators.

Recommended Books:

1. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press.
2. William Stallings, Cryptography and Network Security: Principles and Practice, Prentice Hall of India.
3. Neal Koblitz, A course in number theory and cryptography, Springer.
4. Johannes A. Buchmann, Introduction to Cryptography, Undergraduate Text in Mathematics, Springer.
5. Doug Stinson, Cryptography Theory and Practice, CRC Press.
6. A. Das and C. E. Veni Madhavan, Public-Key Cryptography: Theory and Practice, Pearson Education Asia.

Advanced Digital Signal Processors & Applications

ECE 6065 **3 – 0 – 0 = 3**

TMS320C6x Architecture: CPU Operation – Pipelined CPU- VelociTI – C6x DSP- Software tools: EVM – DSK Target C6x board – Assembly file – Memory management- Compiler utility- Code initialization – Code composer studio – Interrupt data processing.
Freescale DSP56XXX Architecture and Programming: Introduction, Core Architecture Overview, Data Arithmetic Logic Unit, Address Generation Unit, Program Control Unit, PLL and Clock Generator, Debugging Support, Instruction Cache, External Memory Interface, DMA Controller, Operating Modes and Memory Spaces, Instruction Set, Benchmark Programs.
FFT and Filter Implementation using DSP Processors: Implementation of FFT: Radix- 2 fast Fourier transforms – Block floating point scaling – Optimized radix- 2 DIT FFT, Filtering, Modulation, Audio and Image Processing.
Code optimization: Word – wide optimization – Mixing C and assembly- software pipelining – C64x improvements - Real time filtering – Circular buffering- Adaptive filtering.

Recommended Books:

1. Sen M Kuo, Bob H Lee, Wenshun Tian "Real-Time Digital Signal Processing Implementations and Applications" John Wiley.
2. User manuals of TI TMS320C55X from www.ti.com
3. User manuals of DSP 56371 from www.freescale.com
4. TMS320C55x DSP CPU Reference Guide
5. TMS320C55x DSP Mnemonic Instruction Set Reference Guide
6. Digital Signal Processing Applications With Motorola's DSP56002 Processor by Mohammed El-Sharkawy
7. Motorola Dsp Assembler Reference Manual

Microwave Antenna Design

ECE 6052 **3 – 0 – 0 = 3**

Unit I
Antenna Fundamentals and Definitions: Radiation mechanism - over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization
Unit II
Resonant Antennas: Wires and Patches, Dipole Antennas, wide band antennas, Helix antenna, Lens Antenna, Microstrip Antenna.
Unit III
Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques.
Unit IV
Aperture Antennas: Techniques for evaluating Gain, reflector antennas - Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations

for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice.

Unit V

Antenna Synthesis: Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods Dolph Chebyshev linear array, Taylor line source method.

Recommended Books:

1. Stutzman and Thiele, "Antenna Theory and Design", John Wiley and Sons Inc.
2. C. A. Balanis: "Antenna Theory Analysis and Design", John Wiley and Sons Inc.
3. Kraus, "Antennas", McGraw Hill, TMH, .
4. Kraus and R.J. Marhefka:, "Antennas", McGraw Hil.
5. V. F. Fusco, "Foundations of Antenna Theory and Techniques," Pearson Education Limited

NEMS Design

ECE 6142 **3 – 0 – 0 = 3**

UNIT I :

Nanoscale I/V: Quantum wells, Q wires and dots, density of states, electrical transport properties in semiconductor nanostructures, quantization of conductance, coulomb blockade, Kondo effect, ballistic transport, non relativistic dirac fermions (massless electrons) & their conductance, Quantum Hall effect, fractional Q Hall effect

UNIT II :

Nanofluid mechanics; flow of nanofluid, electrophoresis dielectrophoresis: Size selective sepration of dielectric nano particles, nano and micro fluid channels, low reynold number fluid dynamics, optical tweezer.

Unit-III

Nanosensors: Gas sensors, Pollution sensor, Photo sensor, Temperature sensor, IR detector, Biosensor, nanomaterial gas discharge devices, CNT based fluid velocity sensor. Turbo and ultra high vacuum, Clean room technology, class 1000,100,10 clean rooms.

Unit-IV

Nature of carbon bonds, Different allotropes of carbon, structure and properties of C60, Graphene, Carbon nanotubes and its types, Laser vaporization techniques, arc discharge method and chemical vapor deposition techniques for CNT preparation, purification techniques. Properties of Carbon Nanotubes and Graphene: Optical, Electrical and electronic properties, Mechanical, Thermal and vibrational properties. C NT nanoelectronics, FETs, SETs

Unit V:

Fundamentals of carrier transport in quantum structures, temperature effects, Resonant tunneling diodes, single electron transistor, modulation-doped field effect transistor MODFETs, and Heterojunction Bipolar Transistors (HBTs),

Recommended Books:

M. Madou, *Fundamentals of Microfabrication*, CRC Press
Stephen D. Senturia, *Microsystem Design*, Kluwer Academic Publishers
G. Kovacs, *Micromachined Transducers*, McGraw-Hill,
L. Ristic, *Sensor Technology and Devices*, Artech House,
S. M. Sze, *Semiconductor Sensors*, John Wiley and Sons,

Terahertz Electronics

ECE 6160 **3 – 0 – 0 = 3**

Unit I Introduction

Terahertz Terminology, Terahertz Applications and Opportunities, Terahertz components,

Unit II Terahertz Sources

Vacuum electronics, Semiconductor, Direct THz lasers, Photonic sources of THz radiation

Unit III Terahertz and Infrared Quantum Photodetectors

Detector Principles, Terahertz and Infrared Quantum Cascade Detectors, Terahertz Quantum Well Photodetector, Quantum Dots THZ-IR Photodetector, Terahertz and Infrared Photodetector based on Electromagnetically Induced Transparency

Unit IV Terahertz and Infrared Quantum Cascade Lasers

Quantum Cascade Laser Principles, Analysis of Transport Properties of THz QCLs, Dual-Wavelength Generation Based on Monolithic THz-IR QCL

Unit V Terahertz in communication

Broadband communication, Defense systems, High speed digital communication systems.

Recommended Books

- A. Rostami, H. Rasooli, and H. Baghban, "Terahertz Technology fundamentals and applications," Springer.
- D. Mittleman, "Sensing with terahertz radiation," Springer.
- Terry Edwards, "Gigahertz and Terahertz Technologies for Broadband Communications," Artech House.
- Yun-Shik Lee, "Principles of Terahertz Science and Technology," Springer.

Digital Integrated Circuits

ECE 6222 **3 – 0 – 0 = 3**

Unit-I

MOS Inverter: Introduction to resistive - load inverter, inverter with n-type MOSFET load, CMOS inverter

Switching Characteristics and Interconnects Effects: Introduction, Delay time definitions, Calculation of delay
times, Inverter design with delay constraints, MOS Inverters: Switching Characteristics & Interconnect Effects. Estimation of interconnect parasitic.

Unit-II

Sequential MOS Logic Circuits: Introduction, SR latch circuits, Clocked latch and Flip-flop circuits, CMOS D-latch and edge -triggered flip-flop. Dynamic MOS Logic Circuit

Unit-III

Semiconductor Memories: Introduction, Dynamic random access memory (DRAM), Static random acces memory(SRAM),Non-volatile memory.

Low Power CMOS Logic Circuits: Introduction, Overview of power consumption, Switching power dissipation o
CMOS inverter, Estimation and optimization of switching activity.

Recommended Books:

1. Rabaey J.M, Chandrakasan A, Nikolic B , "Digital Integrated Circuits- A Design Perspective", Prentice Hall
2. S M Kang and Y Lebici,"CMOS Digital Integrated Circuits-analysis and design", McGraw Hill.
3. Pucknell D A and Eshraghian K, *"Basic VLSI Design"*, Prentice Hall India, New Delhi
4. Glaser L and Dobberpuhl D, *"The Design and Analysis of VLSI Circuits"*, Addison Wesley
5. Weste N and Eshranghian K, *"Principles of CMOS VLSI Design"*, Pearson Education Asia

RFIC Design.

ECE 6161 **3-0-0 = 3**

Unit I: Introduction

Need of RFIC, Introduction to MOS, Models and History of BJT systems. RF systems – basic architectures.

Unit II: Transmission media and reflections Maximum power transfer. Parallel RLC tank, Qfactor, Series RLC networks, matching: Pi match, T match. Interconnects and skin effect Resistors, capacitors.

Unit III: MOS device review, Introduction to MOS, Transmission lines, reflection coefficient, The wave equation, examples, Lossy transmission lines, Smith charts – plotting gamma. Bandwidth estimation using open-circuit time constants. Risetime, delay and bandwidth, Zeros to enhance bandwidth, Shunt-series amplifiers, tuned amplifiers, Cascaded amplifiers.

Unit IV:

Thermal noise, flicker noise review, Noise figure, Noise figure, Intrinsic MOS noise parametes,
Power match versus noise match.

Unit V:

Large signal performance, design examples & Multiplier based mixers. Subsampling mixers Class A, AB, B, C amplifiers, Class D, E, F amplifiers, RF Power amplifier design examples, Resonators, Negative resistance oscillators, Linearized PLL models, Phase detectors, charge pumps, Loop filters, PLL design examples, GSM radio architectures CDMA, UMTS radio architectures.

Recommended Books:

1. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press,
2. RF Microelectronics by Behzad Razavi. Prentice Hall,

Photonic Networks & Switching

ECE 7170 **3-0-0 = 3**

Unit 1

Introduction: Overview of the architectures and principles of optical systems and networks; Access Network; LAN, WANS & MANS; SONET, SDH, ATM

Unit II

Components of Optical Networks: Fused fiber device such as couplers, WDMs, and WFC; Fabry perot etalons and Bragg grating; Optical Isolators, Integrated optic modulators and switches; Wavelength converters, Dispersion Compensating Techniques.

Unit III

Optical Amplifiers (EDFA and SOAs): Principles of operation; Gain characteristics; Wavelength characteristics; Cross talk and wavelength conversation; Noise characteristics and Noise figure; characteristics of amplifiers cascades; System performance analysis and power budget analysis for BER 10^{-9} for optically amplified links.

Unit IV Photonics and Switching Networks: Switching Network, Switch, Non-Blocking Switch,Connection States, Switching Cell, Two-State Switches, Interconnection Network, Unique-Routing Network, Nonblocking Network, Alternate-Routing Network, Nonblocking Properties of Alternate-Routing Networks, Strictly Nonblocking, Wide-Sense Nonblocking, Multi-Stage Networks, Banyan Networks, Baseline Networks, Omega Networks , Divide-and-conquer Networks, Recursive Application, Central Control

Advanced Topics in Wireless Sensor Networks

ECE 7111 **3-0-0 = 3**

Unit 1: Security Issues in Senor Networks: Security requirement, issues and goals. Security threats, types of attacks on sensor networks and countermeasures. Routing attacks and challenges. Security support for In-network processing. Symmetric key, public-key, Hash function algorithms, Key distribution and certification, Key distribution center (KDC), Network wide shared key, Pair-wise key using PKI, Preconfigured pair-wise shared key.

Unit 2: Unit 3: Data Fusion & Aggregation: Need for Data aggregation, Address Centric Model (AC), Data Centric Model (DC), Different types of data aggregation, Comparative analysis between AC & DC, Compression v/s aggregation, Aggregation algorithms. Need for Sensor Data fusion, impact on bandwidth and inter-node communication, impact on network lifetime & power control Assumptions ,

Unit 3: Wireless Sensor & Actuator Networks: Requirement of Actuation Action in Sensor Networks, Characteristics of Actuator Nodes, preferred topologies for WSAN, Model for Inter-Communication between Actuators & Nodes and for Communication between Actuators, Fault Tolerance in WSAN

Unit-IV: Signal Processing in WSN's: Concept of Distributed Digital Signal Processing in Wireless Sensor Networks, Coherent & non- coherent processing. Collaborative signal processing, its need & challenges. Estimation Techniques in sensor networks – Wiener filter, Kalman filter in WSN Environment

Recommended Books:

1. Holger Karl and Andreas Willig Protocols and Architectures for Wireless Sensor Networks WILEY (ISBN: 0-470-09510-5)
2. Ad Hoc Wireless Networks: Architectures and Protocols by C. Siva Ram Murthy and B. S. Manoj (Prentice Hall, 2004)
3. Wireless Sensor Networks: An Information Processing Approach by Feng Zhao and Leonidas J. Guibas (Morgan Kaufmann,
4. Selected papers from IEEE & ACM to be provided by Faculty

Mixed Signal Testing

ECE 6210 **3-0-0 = 3**

Overview of Mixed Signal Testing

Static Performance, Dynamic Performance, Digital Signals ,Digital Test Systems ,Analog Signals , Analog Test Systems ,Mixed Signal Devices ,Converters ,Datacom Devices
Telecom Devices.

Delay fault testing: path delay test, transition faults, delay test methodologies. IDDQ testing: basic concept, faults detected, test generation, limitations, IDDQ design for testability. Functional testing of arithmetic and regular arrays.

Functional testing of microprocessors and microcontrollers. Sequential circuit testing: time frame expansion and simulation-based approaches to ATPG, design of testable FSMs, use of coding theory. Advanced BIST techniques: theory of linear machines, practical BIST architectures.

System-on-chip design and test: SOC testing problem, core-based design and system wrapper, proposed test architectures for SOC, platform-based design and testability issues.

DSP-based analog and mixed-signal test: functional DSP-based testing, static ADC and DAC testing methods, realizing emulated instruments, CODEC testing, future challenges.

Model-based analog and mixed-signal test: analog fault models, levels of abstraction, analog fault simulation, analog ATPG. Analog test bus standard: analog circuit DFT, analog test bus, IEEE 1149.4 standard .

Recommended Books:

1.M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing, Kluwer Academic Publishers.
2.A. Osseiran, Analog and mixed-signal boundary scan: a guide to the IEEE 1149.4 test standard, Kluwer Academic Publishers.
3.A. Krstic and K-T. Cheng, Delay fault testing for VLSI circuits, Kluwer Academic Publishers
4.S. Chakravarty and P. J. Thadikaran, Introduction to IDDQ testing, Kluwer Academic Publishers

Advanced CMOS VLSI Design

ECE 6230 **3-0-0 = 3**

Design methodologies: VLSI Design flow, Design Hierarchy, Regularity, Modularity and Locality, VLSI design styles, Design quality, Packaging technology.MOS device design equations , Second order effects, the complementary CMOS Inverter DC characteristics.

Circuit Characterization and Performance Estimation: Parasitic effect in Integrated Circuits ,Resistance estimation, capacitance estimation, Inductance. Switching characteristics, CMOS - Gate transistor sizing, Power dissipation, CMOS Logic Structures, Clocking Strategies.

CMOS Process Enhancement & Layout Considerations: Interconnect, circuit elements, Stick diagram, Layout design rules, Latchup, latchup triggering, latchup prevention, Technology related CAD issues.

Subsystem Design: Structured design of combinational logic-parity generator, Multiplexer, code converters. Clocked sequential circuits-two phase clocking, charge storage, dynamic register element, dynamic shift register. Subsystem design process, Design of ALU subsystem, Adders, Multipliers. Commonly used storage/ memory elements.

Recommended books:

1. D.A. Pucknell, K. Eshraghian, Basic VLSI Design, PHI,.
2. John P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons.
3. Niel H.E. Weste, K. Eshraghian,, Principles of CMOS VLSI Design, Person,
4. Mead and L. Conway, Introduction to VLSI Systems, Addison-Wesley.

Project – Synopsis

ECD 7990 **8 Credits**

The project seminar is required to evaluate the problem statement of the project. Students must have completed their problem definition and are required to submit a synopsis of their work. The students will be called up for an oral examination or viva voce, the stress is placed on an academically sound, stylistically acceptable and error-free piece of work.

Project – Mid Semester Review

The project seminar is required to evaluate the problem statement of the project. Students must have come up with progress report and will be required to discuss the status of the project. The students are required to present and demonstrate their work. The design or model must have been completed for review. The students will be called up for an oral examination or viva voce, the stress is placed on an academically sound, stylistically acceptable and error-free piece of work.

Project-Dissertation

ECD 7991 **20 Credits**

A Master's dissertation is an advanced research project of defined scope and length (±120 pp., one and a half spacing, A4 paper). The criteria are: Technical competence, evidence of scholarly research, critical ability, understanding of relevant theoretical issues, lucidity and coherence. A dissertation should have a theme or 'thesis', usually stated in the title, and the success with which MTech candidates sustain that theme, thereby presenting a unified, cumulative argument, is an important consideration.

A dissertation can be an original contribution to knowledge. It is given a mark and the degree can be awarded based on the quality of the thesis/dissertation

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Biotechnology

Introduction

Biotechnology continues to expand rapidly with new discoveries at a breathtaking pace. This industry, a merger of science and business, demands a multi-disciplinary workforce skilled in basic-research, product development, regulatory affairs and commercialization.

Recognizing this wider impact of biotechnology education and research in the 21st century, School of Biotechnology at SMVDU has placed due emphasis in the curriculum on interdisciplinary convergence in modern biology, engineering and technology, applied orientation, quantitative approach, practical training, awareness of the broader social, economic, environmental, ethical, legal and managerial issues in biotechnology. Some of the distinguishing features of the School include highly qualified faculty, in-house teaching, quality laboratory infrastructure for teaching and research, individual projects, good library, etc.

School of Biotechnology, SMVDU offers students the ability to learn, advance and succeed in this exciting field with a variety of learning opportunities designed to meet the needs of working adults.

Objectives

- To provide impetus to the activity of knowledge acquisition and education of students in basic sciences and technological know-how associated with the field of biotechnology, and other relevant areas
- To focus our teaching and research activities strategically around national economic goals.
- To facilitate comprehensive learning combining the scientific, technological and social aspects
- To seek new models of collaboration with other institutes, universities and industries.
- To combine academic study and the thrill of innovation

Curriculum

The curriculum followed is broad-based, provides a solid foundation of basic and engineering sciences, encourages self-learning and helps develop a scientific temper and a spirit of inquiry.

A broad distribution of the various categories of courses to be taken up by the student is as follows:

	Category	Credits;%
A.	Humanities and Social Sciences	6 (3.5%)
B.	Basic Sciences (Physics, Chemistry & Mathematics)	22 (12.9%)
C.	Engineering Sciences- Applied Mechanics Computational Science & Programming Basic Electrical engineering Materials Science	12 (7.1)
D.	Applied Biological sciences	9 (5.2%)
E.	Chemical & Biochemical Engineering Science	38 (22.4%)
F.	Special Category Courses	71 (41.8%)
G.	Open Electives	12 (7.1%)
	Total Credits	170 (100%)

The School currently offers a 4 years B. Tech programme in Biotechnology, a 2 years programme of Masters in Biotechnology and Ph. D. (Biotechnology).

Course Structure of
B. Tech. Biotechnology programme

Semester I — **First Year**

Course Code	Course Title	L-T-P	Credit
BTL 1431	Physical Chemistry and Applied Biological Systems	3-0-0	3
BTL 1011	Principles of Modern Biology	3-0-0	3
MTL 1023	Differential Equations & Linear Algebra	3-0-0	3
PHL 1011	Fundamentals of Physics	3-0-0	3
CSL 1011	Computer Fundamentals and Information Technology	3-0-0	3
CSP 1011	Basic Computer Lab	0-0-2	1
LNL 1141	Communication Skills	3-0-0	3
PHP 1011	Physics Lab	0-0-2	1
BTP 1434	Physical Chemistry and Applied Biological Systems Lab	0-0-3	1.5
BTP 1012	Principles of Modern Biology Lab	0-0-3	1.5
	Total Credits	**18-0-10**	**23**

Semester II — **First Year**

Course Code	Course Title	L-T-P	Credit
BUL 1061	Engineering Economics & Management	3-0-0	3
BTL 1432	Inorganic & Organic chemistry	3-0-0	3
BTL 1041	Biochemistry I	3-1-0	4
BTL 1071	Microbiology	3-0-0	3
CSL 1021	Introduction To Programming with 'C'	3-0-0	3
LNP 1142	Language Lab-I	0-0-2	1
BTP 1435	Inorganic & Organic chemistry Lab	0-0-3	1.5
BTP 1045	Biochemistry I Lab	0-0-3	1.5
BTP 1074	Microbiology Lab	0-0-3	1.5
CSP 1021	Programming lab	0-0-2	1
	Total Credits	**15-1-13**	**22.5**

Semester III — **Second Year**

Course Code	Course Title	L-T-P	Credit
PCL 2042	Introduction to Logic	3-0-0	3
MEL 2231	Fluid Mechanics	3-1-0	4
EBTL 209B	Bioprocess Calculation	3-0-0	3
MTL 1024	Complex Analysis & Statistics	3-0-0	3
BTL 2231	Bioprocess Technology	3-0-0	3
BTL 2235	Bioprocess Technology Lab	0-0-3	1.5
BTL 2451	Biophysical Chemistry	3-0-0	3
XXEXXX	Open Elective - 1	3-0-0	3
	Total Credits	**21-1-3**	**23.5**

Semester IV — **Second Year**

Course Code	Course Title	L-T-P	Credit
BTL 2131	Molecular Biology and Genetics	3-0-0	3
BTL 2238	Chemical Engineering Thermodynamics	3-0-0	3
BTL 2233	Bioprocess Engineering	3-0-0	3
BTL 2251	Transport Process I	3-0-0	3
XXE XXXX	Open Elective-2	3-0-0	3
BTE 2XXX	School Elective 1	3-0-0	3
BTP 2236	Bioprocess Engineering Lab	0-0-3	1.5
BTP 2132	Molecular Biology and Genetics Lab	0-0-3	1.5
	Total Credits	**18-0-6**	**21**

Semester V — **Third Year**

Course Code	Course Title	L-T-P	Credit
BTL 3181	Immunology	3-0-0	3
BTL 3271	Enzyme Engineering and Technology	3-0-0	3
BTL 3151	Recombinant DNA Technology	3-0-0	3
BTL 2252	Transport Process- II	3-0-0	3
XXEXXXX	Open Elective –3	3-0-0	3
BTE 3XXX	School Elective -2	3-0-0	3
BTP 3184	Immunology Lab	0-0-3	1.5
BTP 3274	Enzyme Engineering and Technology Lab	0-0-3	1.5
BTP 3154	Recombinant DNA Technology Lab	0-0-3	1.5
	Total Credits	**18-0-9**	**22.5**

Semester VI		Third Year	
ourse Code	**Course Title**	**L-T-P**	**Credit**
BTL 3261	Chemical Reaction Engineering	3-0-0	3
BTL 3241	Downstream Processing	3-0-0	3
BTL 3221	Introduction to Bioinformatics	2-0-0	2
BTL 3021	Cell Culture Technology	4-0-0	4
BTE 3XXX	School Elective -3	3-0-0	3
	Bio-Business Planning and Management	3-0-0	3
BTP 3242	Downstream Processing Lab	0-0-3	1.5
BTP 3265	Chemical Reaction Engineering Lab	0-0-3	1.5
BTP 3224	Bioinformatics Lab	0-0-2	1
BTP 3025	Cell Culture Technology lab	0-0-3	1.5
	Total Credits	**18-0-11**	**23.5**

Semester VII		Fourth Year	
Course Code	**Course Title**	**L-T-P**	**Credit**
BTL 4262	Instrumentation and Process Control	3-0-0	3
BTL 4263	Bioprocess Plant Design	3-1-0	4
BTL 4301	Environmental Biotechnology	3-0-0	3
XXE XXXX	Open Elective – 4	3-0-0	3
BTC 4311	Colloquium		1.5
BTE 4XXX	School Elective -4	3-0-0	3
BTL 4411	IPR and Biosafety	3-0-0	3
BTP 4302	Environmental Biotechnology Lab	0-0-3	1.5
	Total Credits	**18-1-3**	**22**

Semester VIII		Fourth Year	
Course Code	**Course Title**	**L-T-P**	**Credit**
BTD 4011	Investigational project	0-6-12	12
	Total Credits	**0-6-12**	**12**

Total Credits= 170

Principles of Modern Biology

BTL1011 **(3-0-0=3)**

Biology- technology interface ,Cell structure and function, Cell metabolism and bioenergetics, Molecules in cell, Storage ,transmission and expression of information, transport processes in living cells, General systematics, Modern physical techniques used in biology.

Recommended Books:

1. Biology: Understanding Life,Sandra Alters, Brian Alters,Wiley February 2005
2. Modern Biology / Edition 1 by Holt Rinehart & Winston

Principles of Modern Biology Lab

BTP1012 **(0-0-3=1.5)**

Familiarization with common biological laboratory equipments, Preparation of solutions and buffers (molarity, molality, normality, acids, bases, and pH); Working of light microscope; Visualisation of cell (mitosis, meiosis); Distinguishing between gram positive and gram negative bacteria through staining method; Preparation of bacterial culture medium and study of the bacterial growth curve.

Bio-chemistry-I

BTL1041 **(3-1-0=4)**

Introduction-aims and scope; Non-covalent interactions in biological systems; proteins-structure and function; protein purification techniques; introduction to enzyme kinetics; inhibition and mechanism of action; carbohydrates-structure and function; vitamins and coenzymes; lipids and biological membranes; transport across cell membrane; signal transduction; design of metabolism concept of DGO, ATP-ADP cycle; metabolic pathways for the breakdown of carbohydrates; glycolysis; pentose phosphate pathway; citric acid cycle; electron transport chain; photophosphorylation; oxidation of fatty acids; gluconeogensis and control of glycogen metabolism.

Recommended Books:

1. Voet, Donald: Biochemistry.- 3rd ed.- London: John Wiley & Sons, 2004. 574.192 P04VOE Acc.No.41600
2. Lehninger, Albert L.: Biochemistry - Ludhiana: Kalyani,1975. 574.192 N75LEH Acc.No. 40828
3. Biochemistry by Jeremy Berg,, John Tymocyzo and Lubert Stryer, WH Freeman and comp. 6th edition.

4. Harper's Illustrated Biochemistry by Robert K. Murray ,Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell

Bio-chemistry-I Lab

BTP 1045 **(0-0-3=1.5)**

Estimation of carbohydrates, proteins and nucleic acids , Extaction of lipids, Separation of phospholipids, by thin layer chromatography, Chromatographic techniques-paper, gel-filteration ,ion exchange ,Gel electrophoresis, Enzyme Kinetics-determination of Km, Vm and Ki, Identification and estimation of EMP pathway, ell fractionation and biological oxidation, Membrane transport.

Microbiology

BTL 1071 **(3-0-0=3)**

Introduction-Aims and scope; organization and function of prokaryotic and eukaryotic cells; structure and function cell organelles-surface structure, special organelles, and cellular reserve materials; distinguishing features of various groups of microorganisms: actinomycetes, bacteria, *viruses,* molds, yeasts and algae in their broad classification; basic characteristics of various groups of microbes, bacteria, archaebacteria and microorganisms of extreme environment; microbial nutrition and growth principles; growth measurement techniques; assimilation of nitrogen and sulphur; isolation, long term preservation and improvement of cultures; energy transduction in microbial in microbial systems; phosphoketolase, Entner Doudoroff and glyoxylate pathways; anaerobic respiration; microbial pathogenicity: bioassays, recycling of carbon, nitrogen and sulphur; role of microbes in agriculture, public health, medicine and industry, detection of pathogens in food samples

Recommended Books:

1. Microbiology , Lansing M. Prescott, John P.Harley and Donald A. Klein, McGraw Hill Publishing House. Latest edition
2. Microbiology, Pelczar, Chan and Krieg, Tata McGraw Hill publishers. Fifth edition.
3. A Laboratory Mannual Of Microbiology, James G Cappucino and Natalie Sherman, Pearson publishers. Latest edition.
4. Bergey's Mannual of Bacteriology, Williams &Wilkins, Elsevier Publishers.Latest edition.
5. Alcamo's Fundamentals of Microbiology Dr.Jeffrey C Pommerville, Jones and Barlett publishers. Latest edition
6. Principles of Virology, Finkter, Elsevier publishers. Latest edition

Microbiology Lab

BTP 1074 **(0-0-3=1.5)**

Preparation and sterilization of media, Examination of possible sources of contamination, Microscopic examination of different groups of microorganisms, Aseptic techniques, Simple and differential staining, Isolation of pure culture –use of enrichment media, Growth and enumeration of microorganisms, Effect of physical and chemical environment on growth, selected biochemical tests, isolation of auxotrophic mutants ,Microbiological assay of antibiotics.

Recommended Books:

1. Microbiology: A laboratory Mannual, Cappuccino & Sherman, Pearson Education

Physical Chemistry and Applied Biological Systems

BTL 1431 **(3-0-0=3)**

Chemical thermodynamics – Free energy and entropy changes in chemical / biochemical changes. Nonelectrolytes and electrolytes solution. Phase equlibria. Chemical equilibrium and bioenergetics. Basic principles electrochemistry. Kinetics of chemical and enzymatic reactions. Quantum mechanism principles of structures and bonding in molecules. Inter\intramolecular forces. Homogeneous and heterogeneous catalysis. Principles of spectroscopy. stereoisomerism, conformations and conformational analysis. Resolution of racemic mixtures. Molecular symmetry and optical activity. Photo chemistry and photobiology.

Recommended Books:

1. Physical Chemistry With application to biological system by Raymond Chang
2. Physical Chemistry Principles and Applications in Biological Sciences by Tinco- Sauer-Wang-Puglisi.
3. Organic Chemistry Vol. I by S. M. Mukherji, S. P. Singh and R. P. Kapoor.
4. Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House

Physical Chemistry and Applied Biological Systems Lab

BTP 1434 **(0-0-3=1.5)**

Identification of organic compounds on the basis of functional group analysis and mealting point. Redox titrations, Determination of hardness of water by EDTA and soap titration methods.

Inorganic & Organic Chemistry

BTL 1432 **(3-0-0=3)**

Transition metal complexes: Organometallics: Bio inorganic chemistry: Phase rule, one component system (Water and carbon-dioxide). Structure of a range or organic molecules, conjugation and aromaticity,Linear and cyclic compounds.Reactivity of organic molecules. Kinetic versus thermodynamics control of reactions. Determination of reaction mechanism. Formation, stability and application of reactive intermediate. Use of

reactive intermediate in the design of synthesis of simple organic compounds. Chromatography, classification of methods, chromatic mechanisms and various types.

Recommended Books:

1. Undergraduate Organic Chemistry Vol. I Jagdamba Singh L. D. S Yadav, A Pragti's Edition
2. Organic Chemistry Vol. I by S. M. Mukherji, S. P. Singh and R. P. Kapoor.
3. Organic Chemistry Volume-II by S. M. Mukherji, S. P. Singh and R. P. Kapoor.
4. Organic Chemistry by Morrison and Boyd .
5. Advanced Inorganic Chemistry by J. D. Lee

Inorganic & Organic Chemistry Lab

BTP 1435 **(0-0-3=1.5)**

Synthesis of simple organic molecules, Thin layer and paper chromatography experiments for amino acids and carbohydrates, Interpretation of UV,IR and H-NMR spectral graphs of selected organic molecules. Isolation of cystine from human hair. Isolation of caffeine from spent tea leaves.

Bioprocess Technology

BTL2232 **(3-0-0=3)**

Bioprocess vs. chemical processing; substrates for bioconversion processes and design of media; cell culture techniques; inoculum development and aseptic transfers; process technology for the production of primary metabolites, e.g. baker's yeast, ethanol, acetone-butanol, citric acid amino acids, polysaccharides and plastics; microbial production of industrial enzymes-glucose isomerase, penicillin acylase, cellulase, amylase, lipase, protease etc.; production of secondary metabolites – penicillin, cephalosporins, streptomycin etc.; metabolites from plant and animal cell culture; biomass (mushrooms) production from agro-residues; biofertilizers and biopesticides.

Recommended Books:

1.W. Creuger and A. Creuger. Biotechnology- A textbook of Industrial Microbiology, Sinaeur Associates.
2. G Reed. Prescott & Dunn's Industrial Microbiology. CBS publishers
3. A.N. Glazer and H Nikaido. Microbial Biotechnology Fundamentals of Applied Microbiology. Cambridge University Press.
4. F.W. Richter. Biotechnology: Research, Technology and Applications.Nova Science Publishers.

Biprocess Technology Lab

BTL2235 **(0-0-3=1.5)**

In accordance with the theory subject.

Biprocess Calculation

BTL 2231 **(3-0-0=3)**

Units and dimensions; fundamentals of material balance; balances on unit processes and reactive systems; behavior of ideal gases: vapour pressure, humidity and saturation; energy balance; heat capacity of gases, liquids and solids; latent heat; heat of reaction, formation and combustion; solution and dilution; energy balance of reactive and non-reactive processes; stoichiometric relations and yield concepts; maintenance coefficient; mass balance based on available electron concept.

Biophysical Chemistry

BTL2451 **(3-0-0=3)**

Introduction: Chemistry, physics and biology interaction; characteristic features of biological systems; structure-function relationships in bio-molecules; characterization of macromolecules; molecular shape and size; molecular weight; transport properties of solutions-application in deducing conformation of bio-molecules; viscosity: measurement, relation to macromolecular, geometry and correlation with hydrodynamic properties; diffusion: Fick's laws of diffusion, diffusion coefficient and its interpretation; Frictional coefficient; ultracentrifugation: Svedberg equation, sedimentation equilibrium, density gradient sedimentation; electrophoresis; optical properties of biomacromolecules; spectroscopic methods; light scattering; optical rotary dispersion and circular diachroism; NMR; chemical equilibrium and bioprocesses: Ligand binding, affinity interactions and biocatalysis; Solubility of biomolecules: as solutions of polyelectrolytes, Debye-Hiickel theory, applications to protein purification; stability of biomolecules in solution; denaturation; stabilization methods; structure and biological functions of polysaccharides and lipids.

Recommended Books:

1. Biophysical Chemistry by Upadhyay-Upadhyay. Nath
2. Physical Biochemistry: Applications to Biochemistry and molecular biology by David M. Freifelder
3. Analytical biotechnology (methods and Tools in Biosciences and medicine)
4. Principles and Techniques of Biochemistry and molecular biology by Keith Wilson and John Walker.

Molecular Biology & Genetics

BTL2131 **(3-0-0=3)**

Gene – its concept and inheritance; Development of molecular biology; DNA structure, forms and replication; Mutation, repair and SOS response; RNA-types and functions; Transcription; ribosome and translation; regulation of transcription and translation; chromosomal theory of heredity ; chromosome and gene organization in eukaryotes; chromatin structure; cell division and cell cycle; recombination bacteria; conjugation, transduction and transformation; mapping bacterial genes; genome mapping in eukaryotes; RNA tumor viruses replication and functions.

Recommended Books:

1. Molecular Biology of the Gene by James Watson, Richard Losick, Michael Levine, Alexander Gann, Tania Baker, Stephen Bell; 5th Edition; Benjamin-Cummings Publishing Company, 2003.
2. Essentials of Molecular Biology by George Malacinski, David Freifelder; 3rd Edition; Jones & Bartlett Pub.; 1998
3. Principles of Genetics by Gardner, Simmons and Snustad, 8th Edition; John Wiley & Sons Inc., 1991
4. Gene V, Benjamin Lewin, Oxford press.

Molecular Biology & Genetics Lab

BTP 2132 **(0-0-3=1.5)**

Induction and catabolite repression of beta-galactosidase in *Escherichia coli;* Isolation and purification of DNA from bacteriophage and plasmid; restriction mapping of DNA; gene cloning in bacteria; recombination in bacteria through conjugation; isolation and analysis of chromatin and histones.

Recommended Books:

1. Maniatis, T., Fritch. E.F. and Sambrook, 1. (2001). Molecular cloning 3rd ed.: A laboratory manual, 1st edition. Cold Spring Harbour Laboratory, Cold Spring Harbour, New York

Bioprocess Engineering

BTL 2233 **(3-0-0=3)**

Microbial growth; substrate utilization and product formation kinetics; simple structured models; air sterilization; media sterilization; batch, fed-batch and continuous processes; aeration and agitation; Rheology and fermentation fluids; Scale-up concepts; design of fermentation media; aseptic transfer, various types of microbial and enzyme reactors; instrumentation in bioreactors.

Recommended Books:

1. P. M. Doran; Bioprocess Engineering Principles, Academic Press
2. M. Shuler, F. Kargi; Bioprocess Engineering, Prentice Hall
3. J.E. Bailey and D. F. Ollis; Biochemical Engineering Fundamentals
4. D.G Rao; Introduction to Biochemical Engineering, McGraw Hill Companies.
5. P.F. Stanbury, S.Hall and A. Whitaker. Principles of Fermentation Technology. Butterworth-Heinemann

Bioprocess Engineering Lab

BTP 2236 **(0-0-3=1.5)**

In accordance with the theory subject.

Transport Process-I

BTL 2251 **(3-0-0=3)**

Description of velocity fields; stream functions; irrotational flow; application of Bernoulli's equation and Hagen Poisille equation; friction factor; significance of Reynolds number; flow of incompressible fluid in conduits; energy loss in bands, fittings and valves; network of pipe lines; economic pipe diameter; flow through open channels; compressible fluid flow; transportation and metering of fluids; pumps, fans, blowers and compressors; flow measuring devices; agitation and mixing of fluids; power consumption; Rheology of fluids; Non-Newtonian fluids.

Immunology

BTL 3181 **(3-0-0=3)**

Immune system- an overview; cells and molecules of immune system; Primary and secondary lymphoid organ; Innate immunity; macrophages and dendritic cells; Humoral and cell mediated immunity; Antigen; B cells and antibody; Synthesis of antibody and secretion; Molecular basis of antibody diversity; Polyclonal and monoclonal antibodies, hybridoma technology; Antigen-antibody reactions; Immunological techniques, RIA/ELISA, Flow cytometry etc.
MHC structure and function; Antigen processing and presentation; T cells, T cell activation and differentiation; Complement; Hypersensitivity; Autoimmunity and immune tolerance; Regulation of immune response; Transplantation and rejection, Graft versus host reaction; Tumor immunology; Vaccines

Recommended Books:

1. Kuby Immunology, 6th edition by R.A. Goldsby Thomas J. Kindt, Barbara, A. Osbarne; W. H. Freeman.
2. M Immunology-A short course, 6th edition by Richard Coico and Geoffrey Sunshine (Wiley-Blackwell).
3. Fundamentals of Immunology, 7th edition (2013) by William E. Paul; Lippincott Williams and Wilkins.
4. Cell and Molecular Immunology, 7th Edition (2011), Abbas, Lichtman and Pillai (Elsevier).
5. Janeway's Immunobiology, 8th Edition (2011), Kenneth Murphy (Garland Science, Taylor and Francis).

Immunology Lab

BTP 3184 **(0-0-3=1.5)**

Separation of blood plasma and serum; Analysis of blood cells; isolation of lymphocytes; Precipitation reactions in gel: double diffusion, single radial diffusion, immunoelectrophoresis, rocket immunoelectrophoresis; purification of IgG; SDS-PAGE of IgG; immunoblot; ELISA.

Recombinant DNA Technology

BTL 3151 **(3-0-0=3)**

Introduction to r-DNA technology; vectors: definition and types; construction and properties of plasmid, phage, cosmid and phagmid vectors; restriction enzymes and other enzymes-properties and uses in cloning; gene cloning-genomic and c-DNA cloning, chromosome walking; expression of genes in recombinant cells; stability of recombinant cells in the production of biochemical's; restriction mapping, DNA sequencing; gene mapping; Polymerase chain reaction.

Recommended Books:

1. Principles of gene manipulation by Old and Primrose; 5th Edition; Blackwell Science Inc., 1994
2. Gene Cloning and DNA anlysis : An introduction by T.A. Brown; 5th Edition; Blackwell pub.,
3. Recombinant DNA: A short course by Watson. Tooze and Kurtz; Scientific American Books, '83
4. Recombinant DNA Technology and Applications. Alex Prokop, Rakesh K. Bajpai, and Chester S. Ho, Mcgraw-Hill (Tx), 1991

Recombinant DNA Technology Lab

BTP 3154 **(0-0-3=1.5)**

Isolation and purification of eukaryotic chromosomal DNA; demonstration of promoter activity; determination of plasmid copy number and stability; construction of genome library. PCR technique, nucleotide sequencing.

Recommended Books:

1. Maniatis, T., Fritch. E.F. and Sambrook, 1. (2001). Molecular cloning 3rd ed.: A laboratory manual, 1st edition. Cold Spring Harbour Laboratory, Cold Spring Harbour, New York.

Transport Process –II

BTL 2252 **(3-0-0=3)**

Heat transfer principles; boiling and condensation; heat exchangers; overall heat transfer coefficients; LMTD; analysis of heat exchangers; jacketed vessels; heat exchanger coils; condensers and evaporators; empirical correlation based on analogy between momentum, heat and mass transfer; humidification operations; design of cooling towers; drying of solids; design of batch and continuous dryers; oxygen mass transport.

Enzyme Engineering & Technology

BTL 3271 **(3-0-0=3)**

Introduction & scope; general distinctive features and industrial applications; enzyme kinetics: Single, substrate steady state kinetics; King-Altman's method; inhibitors and activators; Multi-substrate systems; effect of pH and temperature; allosteric enzymes; immobilization of enzymes: advantages; carriers; adsorption; covalent coupling; cross linking and entrapment methods; micro-environmental effects; enzyme reactors: Bio-operational strategies; A few case studies; Immobilized cells; challenges & Future trends.

Recommended Books:

1. Enzymes: Biochemistry, Biotechnology and clinical chemistry, Trevor Palmer & P L Bonner, East West Press Private Limited.
2. Fundamentals of Enzymology, Nicolas C Price & Lewis Stevens, Oxford University Press
3. Enzymes: A practical Introduction to structure, mechanism and data analysis, Robert A Copeland, A John Wiley& sons (Wiley-VCH)
4. Enzyme Kinetics: Behaviour and analysis of rapid equilibrium and steady-state equilibrium systems, Irwin H Segel, John Wiley & sons

Enzyme Engineering & Technology Lab

BTP 3274 **(0-0-3=1.5)**

Assay of enzymes; substrate specificity and efficiency of enzymatic catalysis; Kinetics of enzyme catalyzed reactions; Immobilization of enzymes; Mass transfer and biochemical reactions in continuous flow enzyme reactors; immobilized cells.

Chemical Engineering Thermodynamics

BTL 3261 **(3-0-0=3)**

Simplified mechanical structure of solids, liquids and gases; kinetic theory of gases; kinetic interpretation of gas pressure; intermolecular forces and non ideal behavior of gases; C_P, C_V and equations of state; Generalized properties; first law of energy balances applied to thermo chemistry and fluid flow; work in compression and expansion of fluids; second law; concept of irreversibility; Phase and chemical equilibria.

Recommended Books:

1. Introduction to Chemical Engineering Thermodynamics, J. M. Smith and H.C. Van Ness, Mc Graw Hill book company, Fifth Edition, 1999.
2. Fundamentals of Thermodynamics, J. Karl Johnson, University of Pittsburgh 2009.
3. Chemical Engineering Thermodynamics,Y V C Rao, University Press
4. A textbook of Chemical Engineering Thermodynamics,K V Narayanan, PHI

Cell Culture Technology

BTL 3021 **(4-0-0=3)**

Plant Tissue Culture- History, Laboratory Requirements and General Techniques, Tissue Culture Media, Cell Culture, Cellular Totipotency, Somatic Embryogenesis, Haploid Production, Zygotic Embryo Culture, Genetic Engineering and Production of Pathogen Free Plants, Production of Secondary Metabolites, Germplasm Storage. Animal Tissue culture-Introduction to cell culture; Biology of cultured cells; Aseptic Techniques; Cell culture media and supplements; Primary cell culture, Maintenance and subculturing of cells in culture; culture contamination and cryopreservation, scale up methods for animal cell cultures; micro & macro-carrier culture; Measurement of growth and viability of cells in culture; Organ and histotypic cultures; Cloning in animals; Transgenic animals and importance; Stem cells and their applications.

Recommended Books:

1. S.S. Bhojwani & M.K. Razdan:- Plant Tissue Culture : Theory & Practice – Revised Edition, Elsveir Science Publishers
2. John H. Dodds & L.W. Roberts:- Experiments in Plant Tissue Culture – 3rd Edition, Cambridge University Publishers
3. Kumar A.:-Methods in Plant Tissue Culture Agribios Publishers
4. I.K. Vasil & T.A. :-Thorpe Plant Cell & Tissue Culture ISBN -07923-2493-4
5. Culture of Animal cells, 6th Edition, R. Ian Freshney. Wiley-Blackwell publications.
6. Animal Cell Culture- Practical Approach, 3rd Edition, John R.W. Masters, Oxford University Press.
7. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
8. Animal Cell Biotechnology, Methods and protocols, Nigel Jenkins, Humana Press.

BTP3025: Cell Culture Technology Lab (3-0-0=3)

Sterilization and preparation of media, Development of Callus and cell suspension and culture; Anther and embryo culture, Agrobacterium mediated transformation, Tissue culture techniques for plant regeneration. Acquaintance to aseptic techniques and animal cell culture laboratory equipment; Preparation of cell culture media and reagents; Cell counting and cell viability testing; Cryopreservation and thawing; Propagate and maintenance of animal cell culture

BTL3261: Chemical Reaction Engineering (3-0-0=3)

Application of thermodynamics and chemical kinetics to analysis of chemical reactor systems; kinetics and equilibrium; elementary steps and transition state theory; ideal reactors; Batch plug flow and well mixed reactors; residence time distribution; heterogeneous reactors; diffusion with chemical reaction in catalyst particles; effectiveness factors; design of reactors for catalyzed and uncatalyzed reactions.

BTP3265: Chemical Engineering Lab (0-0-3=1.5)

Experiments in fluid mechanics; fluid particle mechanics and heat transfer experiments that will involve verification of the laws of governing fundamental concepts. Basic experiments on mass transfer, thermodynamics and reaction engineering.

BTL3241: Downstream Processing (3-0-0=3)

Characteristics of bioproducts; flocculation and conditioning of broth; mechanical separation; cell disruption; protein precipitation and its separation; aqueous two phase extraction; Adsorption-desorption processes; chromatographic methods of separation based on size; charge hydrophobic interactions, biological affinity methods etc.; membrane based separations; electrophoresis and electrodialysis; crystallization and case studies.

BTP3242: Downstream Processing Lab (0-0-3=1.5)

Convectional filtration; centrifugation; cell-disruption; protein precipitation and its recovery; aqueous two phase separation; ion exchange chromatography; gel filtration; membrane based filtration, i.e. micro filtration and ultra filtration in cross flow modules.

BTL3221: Introduction to Bioinformatics (2-0-0=2)

Database management systems, Biological databases - nucleotide sequence (Genbank EMBL, DDBJ), protein sequence (PIR, SwissProt), structural (Protein Data Bank), microarray (ArrayExpress, SMD), mutant (ATIDB), pathway (KEGG, BioCyc), literature (PubMed) and patent databases, Familiarization to online tools- BLAST, ORF finder, Primer 3, ClustalW, Protein motif and structural prediction tools, Introduction to genome sequence analysis and annotation, Introduction to in silico drug design and molecular modeling, Basics of Linux, Perl, Web designing.

Recommended Books:

1. Bioinformatics for Dummies, Claverie and Notredame, Wiley Publishing, Inc.
2. Introduction to Bioinformatics, Attwood TK and P Arry Smith DJ, Pearson Education (Singapore) Pvt. Ltd.
3. Bioinformatics Computing, Bryan Bergeron, Prentice Hall, Inc. Eastern Economy Edition
4. PERL for Dummies, Paul Hoffman, Wiley Publishing, Inc.

BTP3224: Bioinformatics Lab (0-0-2=1)

Practicals in accordance with theory subject.

BTL4262: Instrumentation & Process Control (3-0-0=3)

Instrumentation and control from the viewpoint of systems engineering; dynamics of chemical reactors and separation units; Open and closed loop systems; multivariable control.

BTL4263: Bioprocess Plant Design (3-1-0=4)

Introduction; general design information; mass and energy balance; flow sheeting; piping and instrumentation; materials for construction of bioprocess plants; mechanical design of process equipment; vessels for biotechnology application; design of fermenters; design considerations for maintaining sterility of process streams processing equipment; selection and specification of equipment for handling fluids and solids; selection, specification design of heat and mass transfer equipments used in bioprocess industries; design of facilities for cleaning of process equipment used in biochemical industries; utilities for biotechnology production plants; process economics; bioprocess validation; safety considerations; case studies.

BTL4301: Environmental Biotechnology (3-0-0=3)

Waste and its sources; physical, chemical and biological characteristics of waste water; BOD, COD and TOC and their estimation and correlation; BOD progression curve and kinetics; effect of reaction rate constant on short term BOD; determination of BOD rate constants; effect of temperature on BOD; activated sludge process (ASP); biological solid retention time; sludge volume index (SVI); relation between recycle ratio and biological solid retention time in ASP; minimum biological and solid retention time; Aeration systems in ASP; step-aeration; extended aeration; contact stabilization; loading criteria; excess sludge production; oxygen requirement in ASP; nutrient requirement in ASP; solid liquid separation in secondary clarifier; Evaluation of kinetic parameters in ASP; Nitrification and biological denitrification in ASP; Anaerobic treatment of wastes; Attached growth of biological treatment process; Trickling filter; Anaerobic digestion; Sludge characteristics and design consideration digestion kinetic relationship and design consideration. The scope of environmental biotechnology; Biodegradation of macromolecules; biodegradation of genobiotics; Vermicomposting. Heavy metal pollution; Bioremediation of metal contaminated soils, spilled oil and grease deposits and synthetic pesticides. Biosensors to detect environmental pollutants.

Recommended Books:

1. Manahan, S.E. 1997. Environmental Science and Technology. Lewis, New York.
2. Metcalf and Eddy (Eds). 2003, Wastewater Engineering: Treatment and Reuse, Tata McGraw-Hill, New Delhi.
3. Nelson, G.C. 2001. Genetically Modified Organisms in Agriculture: Economics and Politics. Academic Press.
4. Evans, G.M. and Furlong J.C. 2003. Environmental Biotechnology: Theory and Application. John Wiley and Sons.
5. Thomas, J.A. and Fuchs, R. 2002. Biotechnology and Safety Assessment Academic Press.
6. Wang L.K. Hung Y.T. and Shammas N.K.(Eds). 2006. Advanced, Physicochemical Treatment Processes. Springer-Verlag New York, LLC

BTP4301: Environmental Biotechnology Lab (0-0-3=1.5)

Characterization of waste; Design calculations for various types of wastes using various types of biological processes; Physical, Chemical and Biological characterization of water/waste water, sludge.

BTL4411: IPR and Biosafety (3-0-0=3)
Intellectual property, types of property rights, choice of intellectual property protection; patents, patent claims, legal decision making process, ownership of tangible and intellectual property; requirements of patentability, patentable subject matter, novelty and the public domain, non obviousness; patent litigation, procedural aspects of patent litigation, recent developments in patent system and patentability of biotechnological inventions; special issues in biotechnology patents, disclosure requirements, collaborative research, competitive research, plant variety protection act, plant breeders rights; international conventions, WTO, GATT, TRIPs; case studies Rice, Haldi, Neem, Basmati.
Biosafety concepts and issues: Rational vs subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biosafety levels, biosafety concerns at the level of individuals, institutions, society, region, country and the world; biosafety in the laboratory institution, laboratory associated infections and other hazards, prudent biosafety practices in the laboratory/institution; biosafety regulation in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad.

Recommended Books:

1. Subbaram N.R. "Handbook of Indian Patent Law and Practice ", S.Viswanathan (Printers and Publishers) Pvt. Ltd., 1998
2. Intellectual Property Rights: Critical Concepts in Law By D. Vaver Edition: illustrated Published by Taylor & Francis, 2006
3. Intellectual Property: A Reference Handbook By Aaron Schwabach Published by ABC-CLIO, 2007

BTC4311: Colloquium (1.5)

Fifty (50) working days or 400 hours of practical training in an industry at the end of three years of study. Besides presenting a report on the industry training, each student is required to present a seminar covering critical review of an area of biochemical engineering and biotechnology. The objective is to develop confidence in handling a topic with articulation and in time frame.

BTD4011: Investigational Project (0-6-12=12)

This involves carrying out a small R&D project in the last semester under the guidance of a faculty member of the department, covering literature, experimental and analytical work on an allotted project.

ELECTIVES (3-0-0=3)

Fluid-Solid System [BTEX254]

Flow of fluids past a stationary particle for low, medium and high Reynolds Number; Sedimentation theory; Solid liquid separation using centrifugation; 'S' concept in centrifugation for scale-up; Different types of centrifuges and their design; Applications for biological suspensions; Flow through packed beds; flow distribution; Packings and pressure drop calculations; filtration theory and its application in plate, frame and rotary vacuum filters; bubble velocity in a gas fluidized bed; application of multistage fluidization system inn wastewater treatment; size reduction; crushing and grinding; equipment for size reduction; screening; thickeners and classifiers; design procedure.

Food Science and Engineering [BTEX291]

Chemical constituents of food; their properties and functions; characteristic features of natural and processed foods; chemical/biochemical reactions in storage/handling of foods; unit operations in food processing size reduction, evaporation, filtration etc.; methods for food preservation; rheology of off products; flavour, aroma and other additives in processed foods; case studies of a few specific food processing sectors, cereals, protein foods, meat, fish and poultry, vegetable and fruits, milk products; legislation, safety and quality.

Thermodynamics of Biological Systems [BTEX253]

First and second laws of thermodynamics; activity coefficients and phase equilibrium; biological systems as open, non-equilibrium systems; failure of classical (closed, equilibrium) thermodynamics in describing biological processes; thermodynamics concepts for irreversible biological processes; concepts of thermodynamics flux and force; concept of entropy production; constitutive equations; Onsager reciprocal relations; Prigogine's principle concept of coupling in biological processes; thermodynamics of coupled biochemical reactions; cells as non-equilibrium states; non-equilibrium of thermodynamics of passive and active transport; Prigogine-curie law; thermodynamic analysis of oxidative phosphorylation; stability of non-equilibrium stationary states; ordering in time and biochemical engineering and biotechnology; space far from equilibrium; glycolytic oscillations; biological clocks; routes to chaos.

Modeling and Simulation of Bioprocesses [BTEX265]

Types of kinetic models; data smoothing and analysis; mathematical representation of bioprocesses; parameter estimation; numerical estimation techniques; parameter sensitivity analysis; statistical validity; discrimination between two models; physiological state markers and its uses in the formulation of a structured model; development of compartment and metabolic pathway models for intracellular state estimation; dynamic

simulation of batch, fed-batch study and transient culture and metabolism; numerical optimization of bioprocesses using mathematical models.

Biopharmaceutics and Pharmacokinetics [BTEX401]

Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development, Passage of drug across biological barrier, Pharmacokinetics of drug absorption (zero order, 1^{st} order), Factors influencing absorption of drugs, drug distribution in the body, Compartment and non-compartment model, plasma protein binding, Volume of distribution and distribution coefficient, Bioavailability and Bioequivalence, Measures of bioavailability, Pharmacokinetic parameters from plasma and urine data, C-max, and Area under curve (AUC), Calculation of LD50 & ED50, Therapeutic index, Dosage adjustment in patients with renal and hepatic failure.

Recommended Books:

1. Text book of Biopharmaceutics & Clinical Pharmacokinetics, Sarfaraz Niazi, Appleton-Century-Crofts (ACC), New York.
2. Pharmacokinetics and Metabolism in Drug Design, D. A. Smith, H. Van. de Waterbeemd, Don K.Walker, Wiley VCH.

Biochemistry II [BTEX042]

Catabolism of amino acids and nucleotides; allosteric transitions and regulation; biosynthesis of amino acids, lipids, nucleotides and their control ; integration of metabolism; protein degradation and turnover; protein targeting; signal transduction; receptors and hormones; antigen-antibody relationship.

Recommended Books:
1.Lehninger, Albert L.: Biochemistry - Ludhiana: Kalyani,1975. 574.192 N75LEH Acc.No. 40828
2.Biochemistry by Jeremy Berg,, John Tymocyzo and Lubert Stryer, WH Freeman and comp. 6^{th} edition.
3.Harper's Illustrated Biochemistry by Robert K. Murray ,Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell

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Biophysics [BTEX371]

The structure of biological macromolecules; methods of structural elucidation; conformation of biological system; polyelectrolytes, Deybe-Huckel theory; Photochemical and photobiological phenomena; Mechanism of photosynthesis; vision, absorption and florescence; biological energy conservation; concept of membrane potential and proton flux; Ion pumps; muscle contraction; the biophysics of locomotion; generation and propagation of the nerve impulse; biophysics of chemoreception; cybermetics and information theory; evolution of life.

Enzyme Catalyzed Organic Synthesis [BTEX462]

Enzyme as biocatalysis; associated techniques for enzyme applications; Co-immobilization of biocatalysts and cofactor cycling; enzyme stabilization and protein engineering; catalytic antibodies; enzymatic catalysis in bioseparations; biocatalytic applications in organic synthesis-hydrolytic reactions, oxidation reduction reactions, formation of C-C bond, addition & elimination reactions, glycosyl transfer reactions, isomerization, halogenation/dehalogenation reactions.

Analytical Methods in Biotechnology [BTEX172]

Nature and stability of biochemical metabolites; physical/chemical/biological techniques used in assay of biotechnology products; principles and applications of analytical instruments in biotechnology; on line bioprocess instrumentation and computer aided analysis.

Carbohydrates and Lipids in Biotechnology [BTEX061]

Introduction; molecular structure of polysaccharides; enzymes degrading polysaccharides; physical properties of polysaccharides; production of microbial polysaccharides; food usage of exopolysaccharides(EPS); industrial and medical applications of EPS; Molecular structure of lipids; physical properties of lipids; oleaginous microorganisms and their principle lipids; production of microbial lipids; modification of lipids for commercial application; extra cellular microbial lipids and biosurfacants; micelles and reserve micelles in biology; liposomes in drug delivery.

Protein Engineering [BTEX311]

Protein structure and folding; mechanism of folding; chaperonins and other proteins; shape, size and conformation; Motifs of protein structure; alpha domain; beta domain; alpha/beta domain; X ray analysis of proteins: mathematical principles, Bragg's law; NMR; strategies for protein engineering: random, site directed mutagenesis; catalytic effectivity: structure prediction and modeling of proteins; molecular graphics in protein engineering; Dynamics and mechanics; drug-protein interactions and design; protein engineering benefits in industry and medicine; engineering of antibodies.

Nanoscience and Nanotechnology [BTEX391]

Elements of nanoscience and nanotechnology, Applications of nanotechnology, Societal and economic impacts of Nanotechnology, Nanotechnology in health care, Drug delivery and its applications, Properties of

nanomaterials, Polymer and nanocomposites, Dendrimers, liposomes, Targeted nanoparticles, Synthesis of nanomaterials, Polymeric nanofibres, Colloids and micro emulsions in nanotechnology, nano-biotechnology, nanomedicines, Nanotechnology in diagnostic applications- Micro/Nano Devices and Sensors.

Recommended Books:

1. Nanobiotechnology: Concepts, applications, & perspectives, C.M. Niemeyer and C. A. Mirkin; Wiley- VCH, Weinheim.
2. Nano: The Essentials. Understanding Nanoscience and Nanotechnology, T. Pradeep. Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. Nanotechnology, Gnegory Timp. AIP Press. Springer International.

Stem Cell Technology [BTEX351]

Basic biology of stem cells; Types & sources of stem cell with characteristics; Stem cell isolation & characterizations; stem cells growth factor requirements and their maintenance in culture. Basis of pleuripotency and mechanisms of stem cell self-renewal, stem cell niche. Applications of stem cells in diseases, injury and gene therapy. Ethical and regulatory issues of stem cells.

Recommended Books:

1. R. Lanza and A. Atala, Handbook of Stem Cells, Two-Volume, 2012, Academic Press.
2. R. Lanza *et al. (Ed.)*, Essential of Stem Cell Biology, 2009, Elsevier Academic press.
3. J. J. Mao *et al.* (Ed): "Translational Approaches in Tissue Engineering & Regenerative Medicine" 2007, Artech
   House, INC Publications.
4. A. N. Habib, N.Y. Levicar, L.G. Jiao and N. Fisk: Stem Cell Repair and Regeneration. Volume-2, 2007, Imperial College Press.

Genetic Basis of Human Disease [BTEX121]

Advanced Concepts in Human Molecular Genetics explores modern genomic approaches to identifying disease genes and the analysis of genes and genetic variation. Introduction to the use of model organisms (eg yeast, *Drosophila*, *C.elegans* mouse). Single Gene Disorders: One gene - one protein, one disease. Recessive and Dominant Disorders. Examples Connective Tissue Disorders, Cytoskeletal disorders, Cystic Fibrosis and Ion Channel disorders, and the Muscula Dystrophies. Multifactorial Gene Disorders explores complex genetic interactions using neurological diseases such a Alzheimer's, depression, alcoholism and drug addiction as examples. Human Genetic Variation explores the role of geneti variation in disease and predisposition to disease, the rle of DNA mutations to both inherited and sporadic cancers Epigenetics explores the role of epigenetic mechanisms in human disease (eg. Imprinting).

Recommended Books:

1. Medical Genetics: With Student Consult Online Access, 4e (Medical Genetics (JORDE) By Lynn B. Jorde phd (Author), John C. Carey MD MPH (Author), (2)
2. Thompson & Thompson Genetics in Medicine: With Student Consult Online Access, 7e (Thompson and Thompson Genetics in Medicine) Paperback By Robert Nussbaum MD (Author), Roderick R. Mcinnes MD phd FRS(C) (3)
3. Chromosome Abnormalities and Genetic Counseling (Oxford Monographs on Medical Genetics) Hardcover By R.J.M Gardner (Author), Grant R Sutherland (Author), Lisa G. Shaffer (Author)

Principles in Research Methodology [BTEX425]

Research problem, Objectives and hypothesis, Review of published research work. Preparing a manuscript for publication, Copyright issues and Plagiarism, Protocol content for research project, Grant writing, Seminar and Scientific presentation. Sampling concepts, Questionnaire, Schedule, Advantage, Limitations and precautions of sampling, common methods of random sampling, Area sampling, Non-random methods of sampling. Hypothesis Testing —Null and alternative hypothesis, Level of significance.
Lab design and biosafety guidelines, Risk classification of laboratory, Design and safety guidelines for biosafety level, I, II, III, IV laboratories, Laboratory animal facility. Safe laboratory techniques for transport, storage. Handling and storage of hazardous chemicals, Chemical incompatibility, Lab equipments- Handling and maintenance. Safe work practices and procedures, Health hazards of chemicals. Emergency procedures for fire and chemical exposure, Safety checklist. Handling of Radioactive materials.

Recommended Books:

1. WHO (World Health Organization) (2003). Laboratory Biosafety Manual. WHO, Geneva.
2. Kothari, C.R.(2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi
3. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.

Radiation Biology [BTEX341]

This three credit hour course provides an introduction to principles and concepts underlying the biological effects of ionizing radiation at the molecular, cellular and whole-tissue level. Topics covered include selected aspects of microdosimetry, radiation damage to DNA, DNA repair mechanisms, cell-cycle kinetics (repopulation effects), cell death mechanisms and clonogenic survival, Linear Energy Transfer (LET) effects and relative biological effectiveness (RBE), oxygen effects, apoptosis, acute effects of whole body irradiation, radiation carcinogenesis, hereditary effects of radiation, the tumor control probability (TCP), clinical responses of normal tissues to radiation, cancer biology, and biological indicators of treatment effectiveness, such as biologically equivalent dose (BED) and equivalent uniform dose (EUD) concepts. Examples and discussion related to radiation therapy treatment planning and radiation protection are covered. The course emphasizes critical

thinking and problem solving skills.

Biomaterials [BTEX381]

Introduction to material science: Bulk and surface properties of materials; Polymeric materials; synthesis, characterization and fabrication methods – Inert, biodegradable, hydrogels, natural, genetically engineered and bioactive; Ceramics and glasses; Metals; Surface modification techniques. Biocompatibility of biomaterials; Protein structure, interaction of proteins with synthetic materials; Characterization of cell material interactions; inflammatory responses; acute and chronic inflammations, foreign body response, assessment of material performance.

Recent Advances in Biotechnology [BTEX177]

Recent advances in various areas of Biotechnology will be covered. The faculty offering the course shall specify the details of contents at the time of offering.

Course Structure of M. Sc. (Biotechnology)

Semester I

Course Code	Course Title	L-T-P	Credits
BTL6021	Cell & Molecular Biology-I	3-1-0	4
BTL6043	Fundamentals of Biochemistry	3-1-0	4
BTL6072	Fundamentals of Microbiology	3-1-0	4
BTL6412	IPR	2-0-0	2
BTL6161	Biostatistics	2-0-0	2
BTP6046	Fundamentals of Biochemistry lab	0-0-3	1.5
BTP6075	Fundamentals of Microbiology lab	0-0-3	1.5
CSL6011	Basics of Computers & IT	3-0-0	3
		16-3-6	**22**

Semester II

Course Code	Course Title	L-T-P	Credits
BTL6022	Cell & Molecular Biology -II	3-0-0	3
BTL6201	Plant Cell Culture	2-0-0	2
BTL6191	Animal Cell Culture	2-0-0	2
BTL6182	Principles of Immunology	3-0-0	3
BTL6173	Analytical Approaches in Biotechnology	3-0-0	3
BTL6272	Applied Enzyme Catalysis	3-0-0	3
BTL6091	Molecular Genetics	3-1-0	4
BTP6023	Cell & Molecular Biology -II lab	0-0-3	1.5
BTP6176	Cell Culture lab	0-0-3	1.5
BTP6185	Principles of Immunology Lab	0-0-3	1.5
BTP6275	Applied Enzyme Catalysis Lab	0-0-3	1.5
		19-1-12	**26**

Semester III

Course Code	Course Title	L-T-P	Credits
BTL7222	Computational Biology & Bioinformatics	3-0-0	3
BTL7152	Genetic Engineering and Applications	3-0-0	3
BTL7234	Bioprocess Engineering and Technology	3-1-0	4
BTE7SAY	School Elective-I	3-0-0	3
BTC7211	Colloquium		1.5
BTP7225	Computational Biology & Bioinformatics Lab	0-0-3	1.5
BTP7155	Genetic Engineering and Applications Lab	0-0-3	1.5
BTP7237	Bioprocess Engineering and Technology Lab	0-0-3	1.5
BTE7SAY	Open elective -II/School Elective-II	3-0-0	3
		15-1-9	**22**

Semester IV

Course Code	Course Title	L-T-P	Credits
BTL7012	Dissertation & Viva Voce	0-10-20	20
		0-10-20	**20**

Total Credits = 22 + 26 + 22 + 20 = 90 Credits

SEMESTER I

BTL602: Cell & Molecular Biology-I (3-1-0=4)

Plasma membrane: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
Structural organization and function of intracellular organelles**:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility; Historical development of molecular biology
Genetic material and genome replication-DNA and RNA as genetic materials, DNA&RNA -structure, forms and function ,Replication mechanism, enzymes in replication, regulation of genome replication. Topology of nucleic acids.
DNA damage and repair – Mutations, molecular mechanisms of mutagenesis, DNA Repair systems.
Genome organization in prokaryotes and eukaryotes- chromatin structure and function, genome packaging, kinetics of DNA reassociation, chloroplast and mitochondrial genome.
Protein synthesis-transcription and translation, ribosome structure and function. Genetic code –nature and deciphering; Regulation of prokaryotic gene expression.

Recommended Books:

1. Molecular Biology of the Cell by Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter; 4th Edition; New York and London: Garland Science; c2002
2. Cell Biology (by E.D.P. DeRobertis, Francisco A. Saez and E.M.F. DeRobertis); by Eduardo D P De Robertis; 6th
3. Edition; Published by Saunders, 1975
4. Molecular Biology of the Gene by James Watson, Richard Losick, Michael Levine, Alexander Gann, Tania Baker, Stephen Bell; 5th Edition; Published by Benjamin-Cummings Publishing Company, 2003
5. Molecular cell biology by Harvey F. Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Paul Matsudaira; 6th Edition; Published by W.H. Freeman, 2007
6. Gupta, P.K.: Cytology Genetics and Evolution - Meerut: Rastogi Publications, 2005. 574.87 P05GUP Acc.No. 40832

BTL6043: Fundamentals of Biochemistry (3-1-0=4)

Principles of Bioenergitics: Study of metabolite pathways such as glycolysis, citric acid cycle, oxidative phosphorylation, Photophosphorylation, pentose phosphate pathway and gluconeogenesis and their regulation. Carbohydrate biosynthesis, Lipid biosynthesis. Biosynthesis of aminoacids, nucleotides and related molecules.
Carbohydrates: Classification, structure of mono, di, oilgo and polysaccharides, methods for compositional analysis of polysaccharides.
Amino acids & peptides: classification, chemical reactions and physical properties; Proteins: Classification, criteria of homogeneity, end group analysis, primary, secondary, α-helix and β sheet structure, quaternary and domain structure, Disulphide bridges, Ramachandran plot; Protein folding, Protein stability.
Lipids: classification, structure and function of lipids & fatty acids
Chemistry of Biomolecules :Nucleic Acids –structures of purines, pyrimidines, nucleosides and nucleotides. Stability and formation of phosphodiester bonds., Denaturation and renaturation of DNA-Melting Curves. Calculation of Tm for oligonucleotides and DNA.
Enzymes and nucleic acids – Ligases, Nucleases, phosphotases and polynucleotide kinases, chemical and enzymatic susceptibility of Nucleic acids.

Recommended Books:

1. Voet, Donald: Biochemistry.- 3rd ed.- London: John Wiley & Sons, 2004. 574.192 P04VOE
2. Lehninger, Albert L.: Biochemistry - Ludhiana: Kalyani,1975. 574.192 N75LEH
3. Biochemistry by Jeremy Berg,, John Tymocyzo and Lubert Stryer, WH Freeman and comp. 6th edition.
4. Harper's Illustrated Biochemistry by Robert K. Murray ,Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell

BTL6072: Fundamentals of Microbiology (3-1-0=4)

General characters of microbes – Historical developments in microbial biotechnology, the concept of microbial origin of fermentation ,Microscopy Techniques; Structure and general characteristics of Bacteria, Archea, Fungi and Algae; Identification methods of bacteria and other microorganisms, Fundamentals of classification of bacteria, fungi and algae. Recent trends in microbial taxonomy.
Virology – Ultrastructure, classification and replication mechanism in viruses and phages.. Importance of viruses in biotechnology with reference to -Retroviruses, TMV, HIV,SV40, Prions-Kuru. Methods of cultivation of viruses.
Microbial techniques - Concept of sterilization, Methods of sterilization and their application in industry, Concept of pure culture and methods of pure culture development. Methods of preservations of microbial cultures of industrial applications ,methods of measurement of growth.
Microbial nutrition and growth - Nutrition in microorganisms and assimilation of nutrients , Nutritional groups of microorganisms and their importance in fermentation industry, Culturing of microorganisms in laboratory and industry, Long term preservation. Microbial media and their application, Microbial growth and growth curve, influence of environmental factors on growth. Growth measurement techniques.
Microbial Metabolism - Energy transduction in microbial systems. Aerobic and anaerobic pathways.Sulfate reduction, Nitrogen metabolism – nitrate reduction, nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer.

Role of microbial biota in natural environment .Microbial ecology; Microbial pathogenecity.

Recommended Books:

1. Pelczar, Michael J.: Microbiology. -5th ed. - New York: McGraw-Hill, 1986. 576 N86PEL
2. Lansing M Prescott, Microbiology 6th edition Mc Graw Hill.
3. Stanier, Ingram, Wheelis and Painter : The microbial world 1990 edition.
4. Stent and Calender , Molecular Genetics edition 2
5. Tartora, Gerard 1.: Microbiology: An Introduction. - 9th ed. 2007 - San Francisco: Peason Education.

BTL6412: IPR (2-0-0=2)

Intellectual property rights: Meaning,-Evolution - Classification and Forms. Rationale for protection of IPRs - Importance of IPRs in the fields of science and technology. Patents - Concepts and principles of patenting - Patentable subject matter. Procedure of obtaining patents - Rights of patents - Infringement of patent rights, traditional knowledge digital library, WIPO and other IPR related organization .Remedies for infringement of patent rights - Patentability and emerging issues.

Recommended Books:

1. Subbaram N.R. "Handbook of Indian Patent Law and Practice ", S.Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
2. Intellectual Property Rights: Critical Concepts in Law By D. Vaver Edition: illustrated Published by Taylor & Francis, 2006
3. Intellectual Property: A Reference Handbook By Aaron Schwabach Published by ABC-CLIO, 2007

SBTL111P: Biostatistics (2-0-0=2)

Basic terms, measures of central tendency and dispersion: Population, sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion: range, variance, standard deviation, coefficient of variation.
Probability and distributions: Sample space, events, equally likely events. Definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples bernoulli, binomial, poisson and normal distributions. Mean and variance of these distributions (without proof). Sketching of p.m.f. And p.d.f, use of these distributions to describe in biological models. Model sampling and simulation study.
Methods of sampling:Use of random numbers to generate simple random samples with replacement and without replacement. Sampling distribution and standard deviation of sample mean. Stratified sampling and its advantages.
Hypothesis testing:Hypothesis, critical region, and error probabilities. Tests for proportion, equality of proportions, equality of means of normal populations when variance known and when variances are unknown. Chi-square test for independence. P-value of the statistic. Confidence limits, introduction to one way and two-way analysis of variance.

Recommended Books:

1. Gupta S.P.: Statistical Methods Sultanchand & Co.
2. Mood M. Alexander, Graybill Frankline, Boes C. Duane: Introduction to the theory of statistics, McGraw Hill & Co.
3. Goon A.M. Gupta, M.K. Das Gupta: Fundamentals of Statistics Vol. I & II
4. Paul D. Leedy, Jeanne Ellis Ormrod, Jeanne E. Ormrod: Practical Research: Planning and Design
5. Oscar Krisen Buros: Research and Statistical Methodology: Books and Reviews.. 1933/38 Rutgers University School of Education, School of Education, Rutgers University, Rutgers University Press, 1938

BTP6046: Fundamentals of Biochemistry Lab (0-0-3=1.5)

Colorimetry and spectrophotometry

- Protein estimation by Lowry's method.
- Estimation of sugars by Anthrone method.
- Estimation of sugars by Bradford method.

Analysis of fats/oils

- Determination of acid value of a fat.
- Determination of saponification value of a fat.
- Determination of Iodine number of a fat.

Chromatographic Techniques

- Identification of sugars in milk by paper chromatography.
- Separation of lipids by thin layer chromatography.
- Separation of amino acids by ion-exchange chromatography.

Electrophoresis Techniques

- Native polyacrylamide Gel Electrophoresis.
- SDS polyacrylamide Gel Electrophoresis Enzyme characterization.

Enzyme Characterization

- Estimation of alkaline phosphatase enzyme activity.
- Effect of temperature and pH on enzyme activity.

BTP6075: Fundamentals of Microbiology Lab (0-0-3=1.5)

Light Microscopy – Principle, various parts, uses and care, Isolation and purification of microorganisms (bacteria) from soil/water/air by streak plate method and serial dilution; Size measurement of the purified bacterial strain, To perform the Gram staining of the purified bacterial culture, To perform the negative staining of the purified bacterial culture, To perform acid fast staining, To perform spore staining by the Schaeffer Fulton method, To perform capsule staining to distinguish between capsular material and the bacterial cell, To test for the antibiotic sensitivity of the bacterial sample.
To perform the MIC test for antibiotic sensitivity of a bacterial strain against a specific antibiotic, To perform IMVIC test for Coliform bacteria, To study the motility of bacterial strain using the hanging drop technique, To perform standard growth curve of purified bacterial strain, Preservation of microbial strain.

BTL6022: Cell and Molecular Biology –II (3-0-0=3)
Control of eukaryotic gene expression, post transcriptional gene regulation and nuclear transport.
Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.
Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cell division and cell cycle, Cell division and cell cycle: Regulation and mechanism.
Cancer**:** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

Recommended Books:
1. Molecular Biology of the Cell by Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter; 4th Edition; New York and London: Garland Science; c2002
2. Essentials of Molecular Biology by George Malacinski, David Freifelder; 3rd Edition; published by Jones & Bartlett Pub. ; January 1998
3. Molecular cell biology by Harvey F. Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Paul Matsudaira; 6th Edition; Published by W.H. Freeman, 2007

BTP6023: Cell and Molecular Biology –II Lab (0-0-3=1.5)

Isolation of genomic DNA from different plant tissues, Isolation of genomic DNA from *E coli* cells, Spectrophotometric analysis of DNA. –determination of base composition by UV spectroscopy, determination of base composition by thermal denaturation, Measurement of reassociation kinetics, Restriction digestion of DNA, Gel analysis of restricted and unrestricted samples, Isolation of total RNA, Isolation of plasmid, Ultrapurification of plasmid by CsCI density gradient centrifugation, Making competent cells of *Ecoli*, Transformation of competent *Ecoli* cells.

BTL6201: Plant Cell Culture (2-0-0=2)
Concepts & basic techniques in tissue culture. Conventional breeding vs tissue culture. Tissue culture media (composition & preparation), sterilization techniques, Initiation and maintenance of callus and suspension cultures, differentiation, organogenesis & somatic embryogenesis, Production and application of artificial seeds. Shoot tip culture for rapid clonal propagation & production of virus-free plants, stages of micropropagation.
Importance of variability, somaclonal and gametoclonal variations, practical application of somaclonal variations Protoplast isolation, fusion & culture, somatic hybridization, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids.
Haploid production and its significance, ovary, pollen culture, Embryo culture / embryo rescue, role of haploids in agriculture. Germplasm preservation & storage.
Plant secondary metabolites, synthesis & extraction, central mechanism and manipulation using plant cell and tissue cultures.

Recommended Books:
1. S.S. Bhojwani & M.K. Razdan:- Plant Tissue Culture : Theory & Practice – Revised Edition, Elsveir Science Publishers
2. John H. Dodds & L.W. Roberts:- Experiments in Plant Tissue Culture – 3rd Edition, Cambridge University Publishers
3. Kumar A.:-Methods in Plant Tissue Culture Agribios Publishers
4. I.K. Vasil & T.A. :-Thorpe Plant Cell & Tissue Culture ISBN -07923-2493-4

BTL6191: Animal Cell Culture (2-0-0=2)

Introduction: historical background, advantages and limitation of tissue culture. Biology of Cultured Cells, Different equipment used in cell culture laboratory, Aseptic Technique: objectives, elements of aseptic environment, sterile handling, standard procedures, apparatus and equipment; Culture vessels and substrates.
Cell culture media and supplements: physicochemical properties, balanced salt solutions, complete media; Importance of serum and serum-free media, adaptation to serum free media. Role of CO_2 in cell culture.
Primary and cell line cultures: Tissue disaggregation and primary culture establishment; Subculture and cell lines: difference between cell line and strain, cell line designations, Maintenance and subculturing cell culture. Cell cloning and separation methods, cells transformation, cell immobilization and cell synchronization.
Contamination types, detection and removal; Cryopreservation and transportation of cells; Measurement of growth and viability of cells in culture; Scale up methods for propagation of anchorage dependent and suspension cell culture.

Applications of animal cell culture; stem cell cultures, embryonic stem cells, i*nduced pluripotent stem cells* and their applications; cell micromanipulation, animal and human cloning. Organ and histotypic cultures.

Recommended Books:
Culture of Animal cells, 6th Edition, R. Ian Freshney. Wiley-Blackwell publications.
Animal Cell Culture- Practical Approach, 3rd Edition, John R.W. Masters, Oxford University Press.
Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
Animal Cell Biotechnology, Methods and protocols, Nigel Jenkins, Humana Press.

BTP6176: Cell Culture Lab (0-0-3=1.5)

Micropropagation, surface – sterilization of field grown tissues, callus induction, initiation of suspension cultures, role of hormones in plant morphogenesis, regeneration of shoots and roots from callus cultures.conditioning of tissue culture plants, transfer of plants to green house.
Isolation and purification of protoplasts, viability tests for protoplasts, protoplast cultures.
Acquaintance to aseptic technique and cell culture laboratory equipment; Preparation of cell culture media and reagents, apparatus and materials, sterilization of apparatus and liquids; Primary cell culture establishment; Cell counting and cell viability testing; Maintenance and Sub culturing of cultured cells; Cryopreservation and thawing; Measurement of cell growth; Detection of apoptosis in cultured cells; Cell cloning in microtitration plates.

BTL6182: Principles of Immunology (3-0-0=3)

Immune System - Innate Immune response and Adaptive Immune response, Humoral and cellular component of the Immune response., The lymphoid organs, their interaction Antigens, Epitopes and Immunogenicity.
Antibody- structure, function, diversity, engineering and MABs.
Major histocompatibility complex - - MHC molecules structure and function of gene products and organisation of their genes. Antigen presentation.
T Cell receptor- structure and interation with MHC I and MHC II. Organisation of TCR gene segments.
Activation of T cells and apoptosis. B Cell maturation. Complement. Cytokines-structure, function and receptors. Complement System Cell mediated effector responses. Hypersensitivity. Infectious diseases. Autoimmunity.
Organ Transplantation, graft vs host rejection, immunosuppression and immunomodulation, AIDS, Tumor immunology, Hybridoma technology and monoclonal antibodies production. Vaccine development, DNA vaccine, principle of diagnostic kits.

Recommended Books:
1. Kuby: Immunology by Thomas J. Kindt, Richard A. Goldsby, Janis Kuby, Barbara A. Osborne; 6th Edition; published by W H Freeman & Co., 2006.
2. Roitt, Ivan M.: Roitt's Essential Immunology - Massachusetts: Blackwell Science, 2001. 616.079 P01ROI Acc.No.40467

BTP6185: Principles of Immunology Lab (0-0-3=1.5)

Total leukocyte count, Differential leukocyte count, Precipitation tests (a) ring test (b) slide test in solution given an antigen and antibody, Precipitation reactions in gel by Ouchterlony Technique given an antigen and antibody (double immunodiffusion), Single radial immunodiffusion (Mancini's Technique) using an antigen and antibody, Immunoelectrophoresis given an antigen and antibody, Rocket immunoelectrophoresis on given antigen and antibody, ELISA, Polyacrylamide gel electrophoresis and western blotting, Separation and purification of antibodies from serum.

Recommended Books:
1. A Handbook of Practical Immunology - G.P. Talwar
2. Practical Immunology, 4th ed., Blackwell Sciences, U.K., Hay, F.C., Westwood, O.M.R. (2002).
3. Manual of Molecular and Clinical Laboratory Immunology, 7th Edition, ASM Press- Barbara Detrick, Robert G. Hamilton, and James D. Folds (2006).

BTL6173: Analytical Approaches in Biotechnology (3-0-0=3)
Spectroscopy Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lamberts law, Principles and applications of colorimetry; Chromatography Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC.

Centrifugation Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.
Electrophoretic techniques Principles of electrophoretic separation. Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, pulse field gel electrophoresis.
Viscosity Viscosity of macromolecules, relationship with conformational changes.
Electron microscopy Transmission and scanning, freeze fracture techniques, specific staining of biological materials.
ORD, CD, X-ray diffraction, X-ray absorption, NMR. Basics of radioactivity and autoradiography, Safety aspects of radiation,
Biosensors.

Recommended Books:
1. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by David M. Freifelder
2. Analytical Biotechnology (Methods and Tools in Biosciences and Medicine) by Thomas G.M. Schalkhammer
3. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker

BTL6272: Applied Enzyme Catalysis (3-0-0=3)

Introduction: Discovery, classification and nomenclature of enzymes, Enzyme isolation, Enzyme assay. Units of activity, cofactors, coenzymes, Prosthetic groups and enzyme specificity. Isoenzymes and nature of active sites identification of functional groups at active sites.
Kinetics of enzyme Catalysed reaction: Concept of Es complex, Michaelis-Menten equation for unisubstrate reactions. Haldane relationship king and Altman method of during steady state velocity equations. Different plots for determination of km & Vmax and their physiological significances. Importance of Kcat/km. Kinetics of zero and first order reactions. Significance and evaluation of energy of activation. Collision and transition state theory. Classification of mutisubstrate reactions with examples of each class. Derivation of the rate expression for ping pong random and order bi-bi mechanisms. Reversible and irreversible inhibition, competitive, non competitive. Uncompetitive, linear mixed type inhibition and their kinetics, determination of ki and numerical based on these suicide inhibitor. Effect of pH and temperature on enzyme catalysed reactions.
Mechanism enzyme catalysis: Factors responsible for catalytic efficiency of enzymes, i.e proximity aand orientation effects, covalent catalysis, nucleophilic and electrophilic catalysis, manifestation of enzyme specificity in maximum velocities, induced fit hypothesis, strain and distortion theory, mechanism of action of selected enzymes i.e chymotrypsion lysozyme, papain trypsin ribonuclease.
Enzyme regulation: General mechanisms of enzyme regulation, product inhibition enzyme induction and repression allosteric enzymes positive and cooperatively.
Enzyme immobilization: Immobilization techniques and methods influence of immobilization on enzyme activity. Production and application of free and immobilized enzymes in food and feed, detergents and textiles, pulp and paper pharmaceutical diagnostic, bios mass.

Recommended Books:
1. Dixon, M. and E.C. Webb. 1979. Enzymes, 3rd Ed. Academic Press, New York.
2. Segal, L.H. 1975. Enzyme Kinetics, Wiley Interscience, USA.
3. Trever, P. 1981. Understanding of Enzymes. Ellis Horwood Ltd, UK.
4. Biochemical Engineering Fundamentals, James Bailey and David Ollis

BTP6275: Applied Enzyme Catalysis Lab (0-0-3=1.5)

Assay of enzyme activity, Isolation and purification of Urease, Influence of substrate concentration on the rate of enzymatic reaction, Effect of pH and temperature on the rate of enzyme reaction, To find out km and Vmax of free enzyme, To calculate activation enzyme and Arrhenius constant of free enzyme, Inhibition of enzyme activity. Determination of ki values, Molecular weight determination of enzyme by gel filtration, Isozyme detection, Immobilization studies, Preparation of enzyme entrapped in alginate beads and determination of percent entrapment, Study of the kinetics of the rate of enzymatic reaction by enzyme entrapped alginate beads, Study of new ability and storage stability of enzyme entrapped alginate beads.

BTL6091: Molecular Genetics (3-1-0=4)

Mendelian Genetics: Principles, Mendelian experiments, Probability in mendelian inheritance, Patterns of single gene inheritance, autosomal recessive, autosomal dominant, sex-linked inheritance, pedigree analysis
Linkage, Crossing –Over, Molecular mechanism, Chromosome Mapping
Gene transfer in Bacteria: History, Transduction – generalized and specialized, Conjugation – F, F', Hfr, F transfer, Hfr-mediated chromosome transfer, Transformation – natural and artificial transformation, Merodiploid generation, Interrupted gene mapping, Genetic analysis using phage and plasmid
Concept of the gene: Evolution of the one gene – one polypeptide concept, Discovery of recombination within the gene, Complementation test, Colinearity of gene and polypeptide
Genomic variations – SNPs, RFLPs, Tandem repeat polymorphisms, Copy number polymorphisms
Genetic marker techniques – RFLP, RAPD, AFLP, SSR, ISSR, VNTRs, CAPS, SNP, SSCP, DNA microarrays, FISH, RNA interference, Applications of genetic markers, Genetic and physical genome mapping

Population and Evolutionary genetics: Allele frequencies, Hardy – Weinberg principle, Processes altering allele frequencies, Genetic equilibrium, Speciation, Patterns and modes of substitutions, Molecular clocks, Concepts of molecular phylogeny
Basic concepts of development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants & transgenics in analysis of development. Genes in early development, Maternal effect genes, Pattern formation genes, Homeotic genes

Recommended Books:
1. Principles of Genetics by Gardner ,Simmons and Snustad , 8th Edition; published by John Wiley & Sons Inc., 1991
2. Microbial Genetics ,David Freifelder ,Narosa publishing House ,1995
3. Principles of Developmental Genetics by Sally A. Moody.
4. Developmental Biology, Eighth Edition by Scott F. Gilbert.
5. Genetics – A molecular approach, P. Russell, Pearson Benjamin Cummings
6. Genetics – Analysis of genes and genomes, Hartl and Jones, Jones and Bartlett
7. Genetics, Strickberger, Pearson Education

8. Concepts of genetics, Klug and Cummings, Pearson Education

BTL7222: Computational Biology and Bioinformatics (3-0-0=3)

Experimental Methods for Molecular Structure Determination: Brief account of structure determination by X-ray crystallography and NMR spectroscopy. Validation of experimentally obtained NMR structures. Genomics and proteomics: Introduction to genomics, functional and structural genomics, sequencing strategies for whole genome analysis, sequence data analysis. Comparative genomics, genome annotation.
Strategies in proteomics. Structural/functional proteomics. Computational approach for studying protein–protein interactions. Proteomics methodologies. The Protein Data Bank (PDB) and the Nucleic Acid Data Bank (NDB) Proteomics applications: drug development, screening of diagnostic markers, identification and characterization of novel proteins. Global analysis of gene expression. Transcriptomics and microarray. Toxicogenomics. Pharmacogenomics.
Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, Needleman-Wusch & Smith-Waterman algorithms. Analysis of computational complexities and the relative merits and demerits of each method. Theory of scoring matrices and their use for sequence comparison Introduction to databases: Concepts, Sequence structure and Derived databases (Genebank, EMBL, Swiss prot and PDB). Database access and retrieval tools ENTREZ, SRS. Information system; NCBI, EBI, BTIs.

Recommended Books:
1. Bioinformatics and Functional Genomics, by Jonathan Pevsner. A readable introduction to the field. Aimed primarily at biologists, provides somewhat less detail than Mount, but is slightly more approachable.
2. An Introduction to Bioinformatics Algorithms, by N. Jones and P. Pevzner. A new algorithms text focusing on examples motivated by computational biology. Helpful if you've never taken an algorithms class; provides a more gentle introduction to selected topics than the following book.
3. Introduction to Algorithms, by T. Cormen, C. Leiserson, R. Rivest, and C. Stein. The cannonical algorithms textbook. Has nothing to do with biology, but should be on every computer scientist's bookshelf.
4. Introduction to Computational Molecular Biology, by J. Setubal and J. Meidanis. A detailed text focused on computational biology algorithms, aimed at computer scientists, from 1997.

BTP7225: Computational Biology And Bioinformatics Lab (0-0-3=1.5)

1. An introduction to the computing platforms
2. Molecular databases and how they are organized and accessed
3. Unknown DNA -- rational probe design and analysis
4. DNA fragment contig assembly and restriction enzyme mapping
5. Database similarity searching and the dynamic programming algorithm
6. Gene finding strategies. How are coding sequences recognized in genomic DNA
7. Multiple sequence alignment, expectation maximization, profiles, and Markov models Molecular evolutionary phylogenetic inference
8. Estimating protein secondary structure and physical attributes
9. Molecular modelling and visualization

BTL7152: Genetic Engineering and Applications (3-0-0=3)

Isolation and purification of nucleic acids.
Restriction enzymes- properties and uses in recombinant DNA technology
Gene cloning vectors: Plasmids, bacteriophages, phagemids, cosmids, binary vectors, artificial chromosomes: YAC, BAC, PAC, MAC, TAC and other commonly used vectors in microbes, plants and animals.
cDNA synthesis, Gene Libraries, construction of recombinant DNA with plasmids, cloning in plasmids, construction of DNA libraries with phages, construction of genomic libraries in cosmid vectors, screening of recombinants, use of selectable and scorable markers, characterization of recombinants.
Radiolabelling of DNA, Nucliec acid hybridization, DNase-I footprinting, functional analysis of promoters, Sequencing of nucleic acids.
Concept and applications of PCR, RT-PCR,Q-PCR.,RACE.
Genetic transformation of eukaryotes – genetic transformation of plants and animal cells.
Applications of genetic engineering: Transgenic animals, production of recombinant pharmaceuticals, gene therapy, disease diagnosis

Recommended Books:
1. Principles of gene manipulation by Old and Primrose; 5th Edition; published by Blackwell Science Inc., 1994
2. Gene Cloning and DNA anlysis : An introduction by T.A. Brown; 5th Edition; published by Blackwell pub., 2006
3. Gupta, P. K (1996). Elements of Biotechnology, Rastogi and Co., Meerut.
4. Gene VIII by Benjamin Lewin; published by Pearson Prentice Hall. 2004
5. Recombinant DNA : A short course by Watson ,Tooze and Kurtz; published by Scientific American Books, 1983
6. Recombinant DNA Technology and Applications by Alex Prokop, Rakesh K. Bajpai, and Chester S. Ho
7. The DNA Story: A Documentary History of Gene Cloning by James D. Watson and John Tooze

BTP7155: Genetic Engineering And Applications Lab (0-0-3=1.5)

Cloning of foreign DNA in plasmid. Southern blotting and hybridization, Northern blotting of RNA gel, PCR technique, Nucleotide sequencing, demonstration of promorter activity, *Agrobacterium tumefaciens* mediated plant

transformation, construction of genomic and cDNA library

Recommended Books:
1. Maniatis, T., Fritch. E.F. and Sambrook, 1. (2001). Molecular cloning 3rd ed.: A laboratory manual, 1st edition. Cold Spring Harbour Laboratory, Cold Spring Harbour, New York.

BTL7234: Bioprocess Engineering and Technology (3-1-0=4)

Screening and Improvement of industrially important microorganisms. Microbial Growth and Death Kinetics. Media for Industrial Fermentation. Air and Media Sterilization. Types of Fermentation Processes: Analysis of batch, fed-batch and continuous bioreactors, stability of microbial bioreactors, analysis of mixed populations, specialized bioreactors-pulsed, fluidized, photo bioreactors etc. Measurement and Control of bioprocess parameters. Downstream processing, Whole cell immobilization and their industrial applications. Industrial production of chemicals – Ethanol, Acids (citric, acetic and gluconic acid), solvents (glycerol, acetone, butanol), Antiobiotics (penicillin, streptomycin, tetracyclin), Semi-synthetic antibiotics, Amino acids (lysine, glutamic acid), single cell protein. Agitation and aeration: requirement in industrial processes, concept of volumetric oxygen transfer coefficient and its determination (K_{La}), Factors affecting $K_{La.}$ Uses of microbes in mineral beneficiation and oil recovery.
Introduction to food technology
. Elementary idea of canning and packaging
. Sterilization and pasteurization of food products

Recommended Books:
1. P.M. Doran; Bioprocess Engineering Principles, Academic Press
2. M. Shuler, F. Kargi; Bioprocess Engineering, Prentice Hall
3. J.E. Bailey and D. F. Ollis; Biochemical Engineering Fundamentals
4. D.G Rao; Introduction to Biochemical Engineering, McGraw Hill Companies
5. W. Creuger and A. Creuger; Biotechnology-A textbook of Industrial Microbiology, Sinaeur Associates
6. G. Reed; Prescott & Dunn's Industrial Microbiology, CBS Publishers
7. N.Glazer and H. Nikaido; Microbial Biotechnology Fundamentals of Applied Microbiology, Cambridge University Press
8. F.W.Richter; Biotechnology: Research, Technology and Applications, Nova Science Publishers

SBTP 213P: Bioprocess Engineering and Technology Lab (0-0-3=1.5)

Mutagenesis for strain development, Study different phases of microbial growth, Media sterilization in Bioreactor, Thermal deactivation kinetics, Monod kinetics in batch reactor, Production of organic acids in Submerged fermentation, Production of enzymes in Submerged fermentation, Study of production formation kinetics in a fermenter, K_{La} determination in the bioreactor.

BTC7211: Colloquium (1.5)

Fifty (50) working days or 400 hours of practical training in an industry at the end of one year of study. Besides presenting a report on the industry training, each student is required to present a seminar covering critical review of an area of Biotechnology. The objective is to develop confidence in handling a topic with articulation and in time frame.

ELECTIVE COURSES (3-0-0=3)

Microbial Biotechnology [BTE6081]
Microbes as bio control agents, Environmental applications of microbes , Microbial fuels , Algal biotechnology, Recombinant and synthetic vaccines, Plant microbe interactions, Microbial Polysaccharides and Polyesters, Bio catalysis in organic chemistry, Food and dairy microbiology.

Food Science and Technology [BTE6292]

Food Chemistry: Food quality characteristics; Composition and nutritive value of common foods, Structure, properties and metabolic function of food constituents.
Food Microbiology: Growth and inactivation kinetics; Harmful and beneficial effects of microbes, microbes in food industry; Food spoilage, poisoning and intoxication.
Food Process Principles: Basic principles of food preservation and processing; Preservation of food by removal or supply of heat, dehydration, irradiation, addition of chemicals and fermentation; CA/MA storage; Water activity and food stability.
Food Technology: Technological processes for industrial manufacture of selected foods of commercial importance from plants and animal sources. Laws and Standards: Food additives; Food packaging; Quality control in food industry.

Applications of Plant Biotechnology [BTE6211]

Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance –Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance.
Genetic Engineering for Plant Architecture and Metabolism – Seed storage proteins; Protein engineering; Vitamins and other value addition compounds; Introduction to post-harvest bioengineering

Plants as Biofactories – Concept of bio factories; production of industrial enzymes, vitamins and antibiotics and other biomolecules; Cell cultures for secondary metabolite production; Production of pharmaceutically important compounds; Bioenergy generation.

Plant Biochemistry [BTE6051]

Photosynthesis in higher plants and bacteria. Chemistry of light energy utilization; Plant pigments; Light and dark reactions, C3/C4 pathway and crassulacean acid metabolism.Regulation of Rubisco in crop plants. Photophosphorylation and photorespiration; Biosynthesis and degradation of nucleic acids. Plant hormones; Storage proteins.Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Stress physiology- Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.

Metabolic Engineering [BTE6312]

Basic concepts of Metabolic Engineering – Overview of cellular metabolism ,different models for cellular reactions. Synthesis of Primary Metabolites, Amino acid synthesis pathways and its regulation at enzyme level and whole cell level. Biosynthesis of Secondary Metabolites, regulation of secondary metabolite pathways and applications of secondary metabolites. Bioconversions- Applications of Bioconversions, Factors affecting bioconversions. Regulation of Enzyme Production, Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, optimization and control of metabolic activities. The modification of existing - or the introduction of entirely new - metabolic pathways . Metabolic flux, integration of anabolism and catabolism, metabolic flux distribution analysis, bioprocess, material balance, kinetic types, equilibrium reaction. Experimental determination method of flux distribution, Metabolic flux analysis and its applications. Applications of Metabolic Engineering-Application in pharmaceuticals, chemical bioprocess, food technology, agriculture, environmental bioremediation and biomass conversion.

Biocatalysis & Enzymes in Organic Reactions [BTE6463]

Introduction to biocatalysis, advantages/disadvantages of biocatalysis and concept of novel biocatalysis. Introduction to engineered enzymes, evolved enzymes, enzyme models and mimics, catalytic antibodies, immobilization, biocatalytic applications of enzyme and associated techniques, use of enzymes such as - Acyl transferases *i.e.* lipases, esterases, peptidases and amidases, acylases; Carbohydrate processing enzymes *i.e.* glycotransferases, glycosidases; Hydrolytic enzymes *i.e.* epoxidases, nitrilases and nitrile hydratases. Biocatalytic applications of enzymes in Reduction reactions *i.e.* reduction of C=C, C=O and C=N bonds; Oxidation reactions *i.e.* oxidation of alcohols and aldehydes, hydroxylation of alkenes, dihydroxylation, epoxidation of alkenes, Baeyer-Villiger oxidations; Carbon-carbon bond formation using aldolases, oxynitrilases; Addition and elimination reactions; halogenation and dehalogenation reactions.

Genome Stability Regulation and Drug development [BTE6332]

Model Organisms, Structure of DNA, Nucleotide Metabolism, Cell cycle regulation in Eukaryotes, Fundamentals of DNA Transaction, Mechanisms of Genome Stability regulation, Unit of replication, Enzymes involved, Replication Origin and Replication Fork, Fidelity of Replication, Extra-Chromosomal Replicons, DNA Damage and Repair Mechanisms, Homologous and Site-Specific Recombination, System Biology and Genetic Networks, Protein Degradation Mechanisms and Drug Targeting, Emerging Pathogen and Drug Targets.

Recommended Books:

1. Eukaryotic DNA Replication (2006) by M. De-Phamphilis CSHL press ISBN-10**:** 0879694599
2. Genes IX by Benjamin Lewin 2007
3. Biochemistry by A.L. Lehninger
4. Hartwell, L., Hood, L., Goldberg, M. and Reynolds, A. (2008). Genetics: From Genes to Genomes. McGraw-Hill Higher Education, 3rd Ed.

Environmental and Evolutionary Biology [BTE6302]

Principles of ecology and environment: physical, chemical and environmental factors and their relationship with living systems; ecological adaptations and dynamics of natural ecosystems. Materials and energy flow in natural ecosystems; physical and biological characteristics of ecosystems and their relationships; major ecosystems; environmental chemistry and microbiology: plant biomass (cellulose, starch, pectin, gum materials), animal biomass (chitin, milk whey, slaughter house waste), microbial biomass (algal blooms, fresh and sea waters, fungal-Mushrooms, yeasts and bacterial fermentation biomass wastes); bioremediation and bioleaching: types and sources of pollution - inorganic, organic and biotic, clinical examples of air, water and land pollutions; environmental impact of pollution and measurement methods; composting of organic wastes, microbial bioremediation of oil spills; concepts of bioremediation (in-situ, ex-situ), bioremediation of toxic metal ions-biosorption and bioaccumulation principles; water treatment technologies, sedimentation, coagulation and flocculation, primary, secondary and tertiary treatments; Biodiversity-major drivers of biodiversity change; biodiversity management approaches; Principles of conservation, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves); EVOLUTION AND BEHAVIOUR: Emergence of evolutionary thoughts, Origin of basic biological molecules, evolution of prokaryotes, origin of eukaryotic cells, The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale, Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny.

Principles in Human Genetic Disorders [BTE6122]

Human genomic sequence and annotations, Comparative homologies of human genomic sequence, evolutionary changes and SNPs, Genetic variations and molecular evolution, functional characterizations of mutant alleles, Genotype-phenotype correlations, Application and subdivisions of human population genetics, Hardy-Weinberg law and its application for autosomal locus, Non-recurrent and recurrent mutation, Mutation pressure, Genetic load, Heterozygous advantages, Equilibrium between mutation and selection, Genetic drift, Founder effect, Bottleneck effect, Consanguinity and inbreeding, Biological consequences of inbreeding, Admixture, Basic concepts of inheritance — Mendelian inheritance, Sex- linked inheritance, Multifactorial traits. Spectrum of genetic diseases (single gene, chromosomal, multifactorial, mitochondrial, somatic cell genetic diseases) and patterns of their inheritance. Human gene and mutation nomenclature, Mutations and their clinical consequences, Human genetic variations and use of polymorphisms in medical genetics. Twin studies, Linkage Studies, Candidate Gene Association Studies, Congenital anomalies and birth defects, Genetic Counseling, Impact of disease on the patient and family, Introduction to treatment and management of genetic diseases. The Human Genome Project, Human genetic variations, and human Evolution, Human Genographic project, Hapmap Project, 1000 genomes Project, ENOCDE project.

Recommended Books:

1. Hinde, A. (1998). Demographic Methods. Oxford University Press, Inc., New York.
2. Adkison, L. and Brown, M.D. (2007). Elsevier's Integrated Genetics (Elsevier's Integrated S.). Mosby (St. Louis).
3. Hartwell, L., Hood, L., Goldberg, M. and Reynolds, A. (2008). Genetics: From Genes to Genomes. McGraw-Hill Higher Education, 3rd ed.
4. Jorde, L.B., Carey, J.C. and Bamshad, M.J. (2010). Medical Genetics. Elsvier, Mosby, 4th ed.
5. Strachan, T. and Read, A. (2010). Human Molecular Genetics. Garland Publishers, London, 4th ed.
6. Brownstein, M.J., Khodursky and Arkady, B. (Eds.) (2003). Functional Genomics. Humana Press, New Jersey.
7. Jobling, MA, Hurles M and Tyler-Smith C (2004) Human Evolutionary Genetics: Origins, Peoples and Disease. Garland Science, Abingdon and New York

Radiation Biology [BTE6341]

Introduction to principles and concepts underlying the biological effects of ionizing radiation at the molecular, cellular and whole-tissue level. Selected aspects of microdosimetry, radiation damage to DNA, DNA repair mechanisms, cell-cycle kinetics (repopulation effects), cell death mechanisms and clonogenic survival, Linear Energy Transfer (LET) effects and relative biological effectiveness (RBE), oxygen effects, apoptosis, acute effects of whole body irradiation, radiation carcinogenesis, hereditary effects of radiation, the tumor control probability (TCP), clinical responses of normal tissues to radiation, cancer biology, and biological indicators of treatment effectiveness, such as biologically equivalent dose (BED) and equivalent uniform dose (EUD) concepts. Examples and discussion related to radiation therapy treatment planning and radiation protection are covered.

Stem Cells and Regenerative Medicine [BTE6352]

Basic biology of stem cells; types & sources of stem cell with characteristics: embryonic, adult, haematopoietic, mesenchymal stem cells, primordial germ cells, cancer stem cells, induced pleuripotent stem cells. Molecular basis of pleuripotency and stem cell niche.
Stem cell characterizations: isolation & characterizations, markers & their identification, growth factor requirements and their maintenance in culture. Feeder and feeder free cultures. Cell cycle regulators in stem cells. Mechanisms of stem cell self-renewal.
Applications of stem cells: neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopaedic applications, eye diseases, stem cells and gene therapy. Ethical and regulatory issues in the use of stem cells.

Recommended Books:

1. Handbook of Stem Cells, 2nd edition (2012) by Anthony Atala and Robert Lanza; Academic Press.
2. Essential of Stem Cell Biology, 2nd edition (2009) by R. Lanza *et al;* Elsevier Academic press.
3. Translational Approaches in Tissue Engineering & Regenerative Medicine (2007) by J. J. Mao *et al.;* Artech House.
4. Stem Cell Repair and Regeneration,Volume-2, (2007) by Nagy A. Habib, Nataša Y Levièar, Myrtle Gordon, Long Jiao and Nicholas Fisk; Imperial College Press.

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Mechanical Engineering

Introduction

Mechanical Engineers play key roles in the design of transportation systems including automobiles and space vehicles; environmental control systems, including air conditioners and furnaces; manufacturing machinery and processes including robots; energy conversion technology including engines and power plants; biomedical devices; and the list goes on. This tremendous breadth in the scope of the mechanical engineering profession gives the mechanical engineer access to employment in every major industry imaginable.

Recently, the scope of Mechanical Engineering has been enlarged. There has been steady progress from simple machines to more complicated and advanced ones. Today, machines with extremely intelligent functions are popular. Therefore, the present age demands mechanical engineering specialists who have the capacity of adaptability and creativity in the new technical areas and have knowledge not only in their own specialized fields but also in wide interdisciplinary fields as well.
To meet these demands, School of Mechanical Engineering is established in SMVD University from 2006-2007 academic session

Objectives
The educational objectives of Mechanical Engineering programme are designed to produce competent graduating engineers who are ready to contribute effectively to the advancement of mechanical engineering causes, and to accommodate the needs of local and global industries. These objectives are as follows:

- To prepare undergraduate students to become successful problem solvers, lifelong learners, innovators, and Professionals.
- To prepare students for working on mechanical systems including the design and realization of such systems.
- To provide service to the profession, to the country, and to the future development of engineering worldwide.
- To ensure that our students understand the necessities for professionalism, ethical responsibilities, and the need to function in multi-disciplinary teams.
- To prepare students to express themselves effectively in both oral and written communication.
- To prepare the students for engineering analysis and problem solving using appropriate mathematical and computational methodologies.
- To create an intellectually stimulating atmosphere within the School for advancing the art and science of mechanical engineering.
- To establish a mechanism for continuous observation of the demands and to devise Programs to meet these demands.

Categories of Courses to be undertaken by the Students

Category	Credits	%
Basic Sciences and Humanities (Physics, Mathematics, Communication Skills and Management)	32	18.82
Engineering Sciences (Introduction to Computers and Programming, Basic Electrical Engg., Basic Electronics Engg.)	9	5.29
Mechanical Engg. Core Subjects	100	58.82
Electives	15	8.82
Colloquium	02	1.18
Major Project	12	7.06
TOTAL	**170**	**100**

Practical Training will be arranged in the summer vacation following the sixth semester.

Laboratories

State-of the-art laboratories containing the latest equipment and machinery have been established, to ensure that the students get complete facilities to thoroughly understand and explore the concepts of Mechanical Engineering as learnt in the class room. The following laboratories provide the students with the best possible facilities for enhancing the value of the learning process:

- Central Workshop: Machine Shop, Carpentry Shop, Fitting Shop, Foundry Shop, Welding Shop, Smithy Shop, and Sheet Metal Shop.
- Thermal Engineering Lab
- Internal Combustion Engine Lab
- Heat and Mass Transfer Lab
- Refrigeration and Air Conditioning Lab
- Fluid Mechanics Lab
- Fluid Machinery Lab
- Strength Of Materials Lab
- Theory Of Machines Lab
- Automobile Lab
- Mechanical Vibrations Lab
- CAD Lab
- Production Engineering Lab
- Mechatronics Lab
- Metrology and Measurements Lab

Course Structure of
B. Tech Mechanical Engineering programme

Semester I **First Year**

Course Code	Course Title	L-T-P	Credits
PHL 1011	Fundamentals of Physics	3-0-0	3
MTL 1012	Calculus & Linear Algebra	3-0-0	3
MEL 1012	Engineering Mechanics	3-1-0	4
CSL 1021	Introduction to Programming with 'C'	3-0-0	3
LNL 1141	Communication Skills	3-0-0	3
CSP 1021	Programming Lab	0-0-2	1
PHP 1011	Physics Lab	0-0-2	1
MEP 1111	Workshop	0-0-3	1.5
MEL 1011	Engineering Graphics	1-0-3	2.5
	NSS (Non-Credit)	-	0
	Total Credits	**16-1-10**	22

Semester II **First Year**

Course Code	Course Title	L-T-P	Credit
MEL 1112	Materials Science and Engineering	3-0-0	3
MEL 1211	Thermodynamics	3-0-0	3
ECL 1021	Basic Electrical & Electronics Engineering	4-0-0	4
MEL 1013	Machine Drawing	1-0-3	2.5
MTL 1022	Differential Equations & Vector Calculus	3-0-0	3
BUL 1061	Engineering Economics and Management	3-0-0	3
MEP 1112	Materials Science & Engineering Lab.	0-0-2	1
ECP 1021	Electrical & Electronics Engineering Lab	0-0-2	1
LNP 1142	Language Lab-I	**0-0-2**	**1**
	Total Credits	**17-0-9**	**21.5**

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credits
MEL 2231	Fluid Mechanics	3-1-0	4
MEL 2015	Kinematics of Machines	3-1-0	4
MEL 2014	Strength of Materials	3-1-0	4
MEL 2132	Project Management	3-0-0	3
MTL 2023	Integral Transforms & Complex Analysis	3-0-0	3
MEL 2113	Manufacturing Processes	3-0-0	3
PCL 2042	Introduction to Logic	3-0-0	3
MEP 2231	Fluid Mechanics Lab	0-0-2	1
MEP 2014	Strength of Materials Lab	0-0-2	1
MEP 2113	Machine Tool Lab.	0-0-3	1.5
	Total Credits	**21-3-7**	**27.5**

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credits
MEL 2232	Fluid Machines	3-1-0	4
MEL 2212	Thermal Engineering	3-0-0	3
MEL 2016	Mechanics of Materials	3-1-0	4
MEL 2018	Dynamics of Machines	3-0-0	3
MEL 2017	Machine Design	3-0-0	3
MEL 2133	Operations Research	3-0-0	3
MEP 2232	Fluid Machines Lab	0-0-2	1
MEP 2212	Thermal Engineering Lab	0-0-2	1
MEP 2018	Theory of Machine Lab	0-0-2	1
	Total Credits	**18-2-6**	**23**

Semester V **Third Year**

Course Code	Course Title	L-T-P	Credits
MEL 3019	Design of Machine Elements	3-0-0	3
MEL 3221	Heat and Mass Transfer	3-0-0	3
MTL 2025	Engineering Computational Methods	3-0-0	3
MEL3131	Industrial Engineering	3-0-0	3
MEL3114	Machining Processes	3-0-0	3
	Open Elective –I	3-0-0	3
	School Elective – I	3-0-0	3
MEP 3221	Heat and Mass Transfer Lab	0-0-2	1
	Total Credits	**21-0-2**	**22**

Semester VI **Third Year**

Course Code	Course Title	L-T-P	Credits
MEL 3021	CAD/CAM	3-0-0	3
MEL 3121	Metrology and Measurements	3-0-0	3
MEL 3022	Mechanical Vibrations	3-0-0	3
	Open Elective – II	3-0-0	3
	Industrial Psychology	3-0-0	3
MEL 3222	Internal Combustion Engines	3-0-0	3
MEP 3021	CAD Lab	0-0-2	1
MEP 3121	Metrology and Measurements Lab	0-0-2	1
MEP 3022	Mechanical Vibration Lab	0-0-2	1
MEP 3222	I.C Engines Lab	0-0-2	**1**
	Total Credits	**18-0-8**	**22**

Note: *Practical Training* will be arranged in the summer vacation following the sixth semester

Semester VII **Fourth Year**

Course Code	Course Title	L-T-P	Credits
MEL 4031	Automobile Engineering	3-0-0	3
MEL 4223	Refrigeration and Air-conditioning	3-0-0	3
	School Elective – II	3-0-0	3
MEL 4023	Robotics and Mechatronics	3-0-0	3
	Open Elective-IV (HM)	3-0-0	3
MEP 4031	Automobile Engineering Lab	3-0-0	3
MEP 4223	Refrigeration and Air-conditioning Lab	0-0-2	1
MEC 4913	Colloquium	0-0-2	1
MED 4921	Minor Project	0-0-4	2
	Total Credits	**18-0-8**	**22**

Semester VIII **Fourth Year**

Course Code	Course Title	L-T-P	Credits
MED 4912	Major Project+Open Elective-III/Internship	0-0-20	10
	Total Credits	**0-0-20**	**10**

List of Electives:

School Elective-I

Course Code	Course Title	L-T-P	Credits
MEE 3224	Power Plant Engineering	3-0-0	3
MEE 3134	Work Study Ergonomics	3-0-0	3
MEE 3225	Fuel Combustion and Pollution	3-0-0	3
MEE 3122	Computer Integrated Manufacturing Systems	3-0-0	3
MEE 3226	Turbo Machinery	3-0-0	3
MEE 3024	Concurrent Engineering	3-0-0	3
MEE 3032	Industrial Automation	3-0-0	3
MEE 3233	Gas Dynamics and Jet Propulsion	3-0-0	3
MEE 3033	Control Systems	3-0-0	3

School Elective-II

Course Code	Course Title	L-T-P	Credits
MEE 4234	Computational Fluid Flow and Heat Transfer	3-0-0	3
MEE 4025	Design for Manufacturing and Assembly	3-0-0	3
MEE 4034	Environmental Science and Engineering	3-0-0	3
MEE 4141	Maintenance Engineering	3-0-0	3
MEE 4026	Mechanical System Design	3-0-0	3
MEE 4142	Injection Moulding and Mould Design	3-0-0	3
MEE 4027	Product Design & Developments	3-0-0	3
MEE 4035	Tool Design	3-0-0	3
MEE 4143	Total Quality Management	3-0-0	3
MEE 4235	Energy Management	3-0-0	3

Engineering Mechanics

MEL 1012 **3-1-0=4**

Unit I: Force and Force Systems: Coplanar, Concurrent and Non-Concurrent Force Systems, Resultant and Resolutions, Forces in Space, Vectors, Operations on Force using Vectors, Moment of Force, Varignon's Theorem, Couple and Its Properties, Resultant of a Spatial Force System.

Unit II: Equilibrium- Equilibrium of a Particle, External & Internal Forces, Equilibrium of a Rigid Body, Types of Supports, Structural Members and Beams, Reactions of Beams.
Properties of Lines, Areas and Solids: Centre of Gravity, Centroid of Lines (Basic and Composite Areas), Built-Up Sections, Product of Inertia, Mass Moment of Inertia.

Unit III: Trusses, Frames and Mechanisms: Connected Bodies, Two Force and Three Force Members, Trusses, Method of Joints, Method of Sections, Determinateness of Truss, Rigid and Non Rigid Frames, Simple Mechanisms, Space Frames.

Unit IV: Friction: Type of Friction, Characteristics of a Dry Friction, Equilibrium on Rough Inclined Place, The Wedge, The Screw Jack, Journal Bearing, Axle Friction, Thrust Bearing, Disc Friction, Clutches.

Unit V: Introduction to Dynamics, Kinematics and Kinematics of Particle in Rectilinear and Curvilinear Motions, Projectile, Kinematics and Kinematics of a Rigid Body.
Usage of D'Alembert's Principle, Work and Energy, Impulse and Momentum Principles.

Recommended Books:

1. Jurnarkar, S.B. and Shah, H.J. – Applied Mechanics, Charotar
2. Merium and Kraige – Engineering Mechanics, John Wiley & Sons.
3. Sharma, S.M. – Engineering Mechanics, Kirti Publications, Jammu.
4. Engineering Mechanics by Huges and Martin, E.L.B.S. and Macmillan.
5. Beer and E. R. Johnstons – Vector Mechanics, McGraw- Hill, New York

Workshop Practice

MEP 1111 **0-0-3=1.5**

Carpentry shop:Tools and Equipment, Making of Various Joints, Pattern Making.
Foundry Shop: Tools and Equipments, Preparation of Moulds of Simple Objects Using Single Piece, Two Piece and Match Plate Patterns.
Fitting Shop:Tools And Equipments, Practice in Chipping, Filing and Drilling, Making of V, Dovetail and Square Joints of M.S Flat.
Welding Shop: Tools and Equipments, Making of Various Joints Using Gas Welding and Arc Welding (MIG Welding) ,Bead Formation in Horizontal, Vertical and Overhead Positions, Brazing and Soldering Operations.
Sheet Metal Shop:Tools and Equipments, Making Tray, Cone, etc. with GI Sheet Metal
Machine Shop: Introduction to Various Lathe Operations and Practice on Milling, Drilling Machines, etc.
Smithy Shop:Tools and Equipments, Making of Simple Parts Like Hooks, Bolts, etc.

Recommended Books:

1. Raghuvanshi, B. S. - Workshop Technology–Vol 1, Dhanpat Rai & Sons, New Delhi.
2. Gupta, R. B. - Production Technology, Satyaprakashan, New Delhi.
3. Swarn Singh - Workshop Practice, Kataria & Sons, New Delhi.
4. Upadhyay, R. – Manufacturing Practice, Kataria & Sons, New Delhi.
5. Narayana, K L Kannaiah P. - Manual on Workshop Practice, Scitech Publishers, Chennai.

Engineering Graphics

MEL 1011 **1-0-3=2.5**

Section-A

Introduction of Engineering Graphics: Drawing instruments and their uses, Orthographic Projections: Planes of projection – Projection of points in different quadrants. Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane – Straight Line inclined to both the planes – True Length and inclination of lines with reference planes – Traces of line – Projection of Planes, Projection of Solids, Isometric Drawing: Types of Projection- Orthographic, Isometric, Oblique and Perspective Projections, exercises on Isometric drawings.
Section of Solids: Classification of Solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane.
Development of Surfaces: Principle, Engineering applications and Methods of development.

Section-B

Introduction: Introduction to Computer Aided Drafting (CAD), Reasons for implementing CAD, Applications of CAD, Benefits/limitations of CAD, Hardware of CAD system, Types of CAD software. Introduction to other drafting software such as Mechanical Desktop and Auto Cad Electrical

Introduction to AutoCAD: Starting AutoCAD, AutoCAD screen components, creating a drawing on AutoCAD, invoking different commands, Dialog boxes, Coordinate Systems, Exercises on Drawing of Line, Circle, Arc, Ellipse, Polygon, etc.

Drawing Aids and Editing Commands: Layers, Drafting Settings, Object Snaps, Function and Control keys, various Editing Commands, Editing the Objects with Grips, Grip Types.

Creating Text, Dimensions and Tolerances in AutoCAD: Creating Text, Editing Text, Styles of Dimensioning, Dimensioning System Variables, Editing/Updating Dimensions, Adding Tolerances.

Recommended Books:

1. Ellen Filkensten - AutoCAD 2006 & AutoCAD LT 2006 Bible,Wiley, New York.
2. Sham Tickoo - AutoCAD 2005 ,Tata McGraw Hill, New Delhi.
3. George Omura - AutoCAD, Sybex Inc.
4. Bhat, N.D. and Panchal, V. M. - Engineering Drawing, Charotar Publishers, Anand.
5. Narayana, K.L. and Kannaiah, P.- Engineering Graphics, Tata Mc Graw Hill, New Delhi.
6. Gill, P.S- Engineering Drawing, S.K Kataria & Sons, New Delhi.

Engineering Graphics With Cad

MEL 1014 **1-0-2=2**

Section-A

Introduction of Engineering Graphics: Drawing instruments and their uses, Orthographic Projections: Planes of projection – Projection of points in different quadrants. Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane – Straight Line inclined to both the planes – True Length and inclination of lines with reference planes – Traces of line – Projection of Planes, Projection of Solids.

Section of Solids: Classification of Solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane.

Development of Surfaces: Principle, Engineering applications and Methods of development.

Section-B

Introduction to AutoCAD: Starting AutoCAD, AutoCAD screen components, creating a drawing on AutoCAD, invoking different commands, Dialog boxes, Coordinate Systems, Exercises on Drawing of Line, Circle, Arc, Ellipse, Polygon, etc.

Drawing Aids and Editing Commands: Layers, Drafting Settings, Object Snaps, Function and Control keys, various Editing Commands, Editing the Objects with Grips, Grip Types.

Creating Text, Dimensions and Tolerances in AutoCAD: Creating Text, Editing Text, Styles of Dimensioning, Dimensioning System Variables, Editing/Updating Dimensions, Adding Tolerances.

Recommended Books:

7. Ellen Filkensten - AutoCAD 2006 & AutoCAD LT 2006 Bible,Wiley, New York.
8. Sham Tickoo - AutoCAD 2005 ,Tata McGraw Hill, New Delhi.
9. George Omura - AutoCAD, Sybex Inc.
10. Bhat, N.D. and Panchal, V. M. - Engineering Drawing, Charotar Publishers, Anand.
11. Narayana, K.L. and Kannaiah, P.- Engineering Graphics, Tata Mc Graw Hill, New Delhi.
12. Gill, P.S- Engineering Drawing, S.K Kataria & Sons, New Delhi.

Materials Science & Engineering

MEL 1112 **3-0-0=3**

Unit I Crystallography: Review of Crystal Structure, Space Lattice, Crystal Planes and Crystal Directions, Coordination Number, Number of Atoms Per Unit Cell, Atomic Packing Factor.

Unit II Imperfection & Deformation of Metal: Crystal Imperfections, Type of Defects and Effects on Metal Properties, Deformation of Metal. Mechanism, Yield Point Phenomena, Strain Ageing, Work Hardening, Bauschinger Effect, Season Cracking, Recovery, Re-Crystallization and Grain Growth.

Unit III Solid Solution and Phase Diagram: Introduction to Single and Multiphase Solid Solutions and Types of Solid Solution, Importance and Objective of Phase Diagram Systems, Phase and Structure Constituents, Cooling Curves, Unary & Binary Phase Diagrams, Gibbs's Phase Rule, Lever Rule, Eutectic, and Eutectoid Systems, Peritectic and Peritectoid Systems. Iron Carbon Equilibrium Diagram and TTT Diagram.

Unit IV Heat Treatment: Principles, Purpose, Classification of Heat Treatment Processes, Annealing, Normalizing, Stress Relieving, Hardening, Tempering, Carburing, Nitriding, Cyaniding, Flame and Induction Hardening, Allotropic Transformation of Iron and Steel, Properties of Austentic, Ferrite, Pearlite and Martensite.

Unit V Creep Concept, Creep Curve, Mechanism, Factors, Testing and Prevention. Corrosion-Type and Prevention of Corrosion. Fracture, Failures of Metals-Failure Analysis. Fatigue-Characteristics, Mechanism and Factors Affecting Fatigue.

Unit VI Plastic. Composite and Ceramics, Powder Metallurgy Techniques.

Recommended Books

1. Elements of Material Science and Engineering Van Vlack. Wesley Pub.
2. Material Science – Narula, Narula and Gupta, New Age Publishers.
3. Material Science and Engineering- V.Raghvan, Prentice Hall of India Pvt.
4. A test Book of Material Science & Metallurgy- O.P Khana, Dhanpat Rai

5. Material Science and Engineering- an Introduction – Callister; W.D., John Wiley & Sons, Delhi.
6. Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, and
7. Essentials of Materials Science & engineering – Donald R. Askeland, Pradeep P.Phale

Thermodynamics

EMEL 1211 **3-1-0=4**

Unit I: Introduction – Macroscopic and Microscopic Approaches; Thermodynamic Systems- Closed , Open and Isolated; Property, State, Path and Process; Quasi-Static Process; Temperature, Zeroth Law of Thermodynamics, Concept of Ideal Gas, Type of Thermometers, Work Transfer as a Path Function, P-dv Work in Various Quasi-Static Processes, Free Expansion, Heat Transfer as a Path Function.

First Law of Thermodynamics- Application to Closed System undergoing a Cycle, Closed System undergoing a Change of State, Different forms of Stored Energy, Enthalpy, PMM1.
First Law applied to Flow Processes, Mass and Energy Balance in a Simple Steady Flow Process, Some Examples.

Second Law of Thermodynamics –Statements of Kelvin-Planck and Clausius, Refrigerator and Heat Pump, Reversibility and Irreversibility, Causes of Irreversibility, Conditions of Reversibility, Carnot Cycle, Introduction to Entropy, Temperature-Entropy Plot.

Unit II: Elements of Heat Transfer: Basic Concepts, Conduction Heat Transfer, Convection Heat Transfer, Radiation Heat Transfer, Heat Exchangers.

Unit III: Properties of Pure Substance- PV-T, PT, TS Diagram, Mollier Diagram –Mixture of Gaseous and Vapours- Mixtures of Ideal Gases –Dalton's Law- Thermodynamic. Properties of Mixture – Mixtures of Ideal Gases and Vapours-Psychrometric Principles- Psychometrics Chart-Applications. Introduction to Refrigeration – Vapour Compression Refrigeration.
Unit IV: Vapour Power & Gas Power Cycles: Simple Steam Power Cycle, Rankine Cycle, Actual Vapour Cycle Processes, Comparison of Rankine and Carnot's Cycle, Reheat and Regenerative Cycles, Ericsson Cycle, Otto Cycle, Diesel Cycle and Dual Cycle.

Recommended Books:
1. Nag, P.K. - Engineering thermodynamics, Tata Mc Graw Hill Publishers,
2. Vasandani, V.P. and Kumar, D.S.-Heat Engineering, metropolitan book
3. Kumar, D.S.-thermal science and engineering, Kataria & Sons Publishers,
4. Gupta and Prakash –Engineering thermodynamics, S.Chand Publishers,
5. Kothandaraman, C.P, and Dornkundwar, S. - thermal Engineering, Dhanpat Rai & Sons, New Delhi.
6. Cengel and Boles Thermodynamics & Engineering Approach, Tata Mc Graw Hill Publishers, New Delhi.

Machine Drawing

MEL 1013 **1-0-3=2.5**

Introduction - Principles of Drawing, Requirements of Production Drawing, Sectioning and Conventional Representation, Dimensioning, Symbols of Standard Tolerances, Machining Symbols.
Fasteners - Various Types of Screw Threads, Types of Nuts and Bolts, Screwed Fasteners, Welding Joints and Riveted Joints.
Assembly And Dis-Assembly of the Following using a Computer Aided Drafting Package such as AutoCAD or Mechanical DeskTop.

A) Couplings: Solid or Rigid Coupling, Protected Type Flange Coupling, Pin Type Flexible Coupling, Muff Coupling, Oldham, Universal Coupling, Claw Coupling, Cone Friction Clutch, Free Hand Sketch of Single Plate Friction Clutch.
B) Knuckle and Cotter Joints
C) Pipe And Pipe Fittings: Flanged Joints, Spigot and Socket Joint, Union Joint, Hydraulic and Expansion Joint.
D) IC Engine Parts: Piston, Connecting Rod, Crankshaft
E) Boiler Mountings: Steam Stop Valve, Feed Check Valve, Safety Valve, Blow-off Cock.
F) Bearings: Swivel Bearing, Thrust Bearing, Plummer Block, Angular Plumber Block
G) Miscellaneous: Screw Jack, Drill Press Vice, Crane Hook.
H) Machine Tool Parts: Lathe Tail Stock, Tool Post

Note: Maximum number of above Drawing exercises may be carried out.
Recommended Books:
1. Bhatt, N. D. - Machine Drawing, Charotar Publications, Anand.
2. Gill, P. S. - Machine Drawing, Kataria & Sons, New Delhi.
3. Sidheshwar, N. - Machine Drawing, Tata McGraw Hill, New Delhi.
4. Ellen Filkensten - AutoCAD 2006 & AutoCAD LT 2006 Bible ,Wiley, New York.
5. Sham Tickoo - AutoCAD 2005 ,Tata McGraw Hill, N. Delhi

Materials Science And Engineering Lab

MEP 1112 **0-0-2=1**

The Following Practical Exercises are to be carried out:
1. To study Bravias Lattice crystal structure and crystal imperfection using ball models.
2. Study of Metallurgical Microscope
3. Preparation of specimen for microstructure studies
4. To study microstructures of metals/ alloys (ferrous and Non – ferrous) using metallurgical microscope

5. To study the effects of various heat treatments vi annealing, normalizing, quenching and tempering on low. Medium and high carbon steel samples.
6. Elemental analysis of Non – ferrous alloys (brass bronze and AL alloys)
7. Elemental analysis of steel and C.Is by spectrometer
8. Elemental analysis by atomic absorption spectrometer by inductively coupled plasma unit (ICP) for ferrous alloys, Non-ferrous alloys, ceramics, polymers
9. To determine the hardenability of a given steel by J.E.Q method
10. To study the effect of gas and are welding processes on hardness and microstructure of given steel sample.
11. To study the effects of TIG and MIG welding processes on microstructure and hardness of given metallic samples.
12. To study the effect of amount of determation by rolling on microstructure and hardness of given metallic sample

    To study the wire drawing on microstructure and hardness of given metallic sample.

Environmental Studies

3-0-0=Non Credit

(As per UGC Defined Syllabus)

The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness. Natural Resources, Renewable and non-renewable resources, Natural resources and associated problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem

Environmental Pollution: Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, Resettlement and rehabilitation of people; its problems and concerns.

Human Population and the Environment: Population growth, Environment and human health, Human Rights, Value Education, Women and Child Welfare, Role of information Technology in Environment and human health.

Field Work (Practical).

- Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

Fluid Mechanics

MEL 2231 **3-1-0=4**

Unit I: Introduction-Properties of Fluids-Pressure, Force, Density, Specific Weight, Compressibility, Capillarity, Surface Tension, Dynamic and Kinematic Viscosity-Pascal's Law, Newtonian and Non-Newtonian Fluids,Fluid Statics-Measurement of Pressure-Variation, Manometry-Hydrostatic Pressure on Plane and Curved Surfaces, Centre of Pressure, Buoyancy, Floation, Stability of Submerged and Floating Bodies, Metacentric Height, Period of Oscillation.

Unit II: Kinematics of Fluid Motion, Eulerian and Lagrangian Approach, Classification and Representation of Fluid Flow, Path Line, Stream Line and Streak Line. Basic Hydrodynamics, Equation for Acceleration, Continuity Equation, Rotational and Irrotational Flow, Velocity Potential and Stream Function, Circulation and Vorticity, Vortex Flow, Energy Variation Across Stream Lines, Basic Field Flow such as Uniform Flow, Spiral Flow, Source, Sink, Doublet, Vortex Pair, Flow Past a Cylinder with a Circulation.

Unit III: Euler's Momentum Equation-Bernoulli's Equation and Its Limitations, Momentum and Energy Correction Factors, Pressure Variation across uniform Conduit and uniform Bend-Pressure Distribution in Irrotational Flow and in Curved Boundaries, Flow Through Orifices and Mouthpieces, Notches and Weirs, Time of Emptying aTank, Application of Bernoulli's Theorem, Orifice Meter, Venturimeter and Pitot Tube.

Unit IV: Navier-Stoke's Equation, Body Force, Hagen-Poiseullie Equation, Boundary Layer Flow Theory, Velocity Variation, Methods of Controlling , Applications, Diffuser, Boundary Layer Separation, Wakes, Drag Force, Coefficient of Drag, Skin Friction, Pressure, Profile and Total Drag-Stream Lined Body, Bluff Body, Drag Force on a Rectangular Plate, Drag Coefficient for Flow around a Cylinder, Lift and Drag Force on an Aerofoil.

Unit V: Flow of a Real Fluid, Effect of Viscosity on Fluid Flow, Laminar and Turbulent Flow, Boundary Layer Thickness, Displacement, Momentum and Energy Thickness, Flow Through Pipes, Laminar and Turbulent Flow in Pipes, Critical Reynolds Number, Darcy-Weisback Equation, Hydraulic Radius, Moody;S Chart-Pipes in Series and Parallel, -Siphon Losses in Pipes, Power Transmission through Pipes, Water Hammer Equivalent Pipe, Open Channel Flow, Chezy's Equation, Most Economical Cross Section.

Recommended Books:

1. Som S.K. and Biswas, G - Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill, New Delhi.
2. Agrawal S. K.- Fluid Mechanics and Machinery, Tata McGraw-Hill, New
3. Kumar, D. S. - Fluid Mechanics and Fluid Power Engineering, Kataria & Sons Publishers, New Delhi.
4. Bansal R.K.- Fluid Mechanics and Hydraulic Machines, Laxmi Publications
5. Ramamrutham S., Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi.

Kinamatics Of Machines

MEL 2015 **3-1-0=4**

Unit I: Introduction - Links, Mechanisms, Kinematic Pair and Chains, Principles of Inversion, Inversion of a Four Bar Chain, Slider-Crank-Chain, Double Slider-Crank Chain and Their Inversions, Kinematic Pairs, Graphical (Relative Velocity Vector and Instantaneous Center Methods) , Analytical Methods for Dispmlacement, Velocity, and Acceleration of Mechanisms Including Corriolis Components.
Lower Pairs - Universal Joint, Calculation of Maximum Torque, Steering Mechanisms (Ackerman and Davis Approximate Steering Mechanism), Engine Indicator, Pantograph, Straight Line Mechanisms.
Unit II: Belts, Ropes and Chains - Material, Types of Drives, Idle Pulley, Intermediate or Counter Shaft Pulley, Angle and Right Angle Drive, Quarter Turn Drive, Velocity Ratio, Crowning Shaft Pulley, Loose and Fast Pulley, Stepped or Cone Pulleys, Ratio of Tension on Tight and Slack Sides of Belts, H.P Transmitted by Belts with consideration of Creep and Slip, Centrifugal Tensions and Its Effect on H.P Transmitted, Use of Gravity, Idle, Flat, V-Belts and Rope Materials, Length of Belt, Rope and Chain Drives.
Unit III: Cams-Types of Cams and Followers, Definitions of Connected Terms, Displacement Velocity and Acceleration Diagrams (Cam and Followers), Analytical and Graphical Design of Cam Profiles with Various Motions, Analysis of Follower Motion (Circular, Convex, Tangent Cam Profiles), Calculation of Pressure Angle.
Unit IV: Friction Devices - Concepts of Frictions and Wear Related to Bearings and Clutches, Types of Brakes, Principle of Function of Brakes ofVarious Types, Braking of Front and Rear Tyres of a Vehicle, Problems to Determine Braking Capacity, Types of Dynamometers.
Unit V: Flywheels - Turning Moment and Crank Effort Diagrams for Reciprocating Machines, Fluctuations of Speed, Coefficient of Fluctuation of Speed and Energy, Determination of Flywheel Mass and Dimensions for Engines and Punching Machines
Governors - Function, Types and Characteristics of Governors, Watt, Porter and Proell Governor. Hartnell and Willson-Hartnell, Spring Loaded Governors, Sensitivity, Stability, Isochronisms And Hunting of Governors, Governor Effort and Power.

Recommended Books:

1. Rao, J. S. and Dukkipati, R.V. - Mechanism and Machine Theory, Wiley-Eastern, New Delhi.
2. Ballaney, P.L. - Theory of Machines, Khanna Publishers, New Delhi.
3. Khurmi, R. S. and Gupta, J. K. - Theory of Machines, Eurasia Publishing House (P) Ltd, New Delhi.
4. Ghosh, A. and Mallick A.K.- Thoery of Mechanisms and Machines, Affiliated East-West Press Pvt.Ltd., New Delhi.
5. Rattan S.S. - Theory of Machines, Tata McGraw Hill, New Delhi.

Strength Of Materials

MEL 2014 **3-1-0=4**

Unit I: Simple Stresses and Strains - Concept of Stress and Strain, St. Vernants Principle, Stress and Strain Diagram, Hooke's Law, Young's Modulus, Poisson Ratio, Stress at a Point, Stress and Strains in Bars subjected to Axial Loading, Modulus of Elasticity, Stress Produced in Compound Bars subject to Axial Loading, Temperature Stresses and Strain Calculations Due To Application of Axial Loads and Variation of Temperature in Single and Compound Bars. Compound Stress and Strains, Two Dimensional System, Stress at a Point on a Plane, Principal Stresses and Principal Planes, Mohr's Circle of Stresses, Hook's Law, Principal Stresses Related to Principal Strains.
Unit II: Bending Moment and Shear Force Diagrams - S.F and B.M Definitions. BM and SF Diagrams for Cantilevers, Simply Supported Beams with or Without Overhangs and Calculation of Maximum BM and SF and the Point of Contraflexure Under A) Concentrated Loads, B) Uniformity Distributed Loads Over Whole Span or Part of Span, C) Combination of Concentrated Loads and Uniformly Distributed Loads, D) Uniformity Varying Loads, and E) Application of Moments.
Unit III: Slope and Deflection - Relationship between Moment, Slope and Deflection, Moment Area Method; Methods of Integration; Macaulay's Method: Use of these Methods to Calculate Slope and Deflection for A) Cantilevers, B) Simply Supported Beams With or Without Overhang, C) Under Concentrated Loads, Uniformly Distributed Loads or Combination of Concentrated and Uniformly Distributed Loads.
Unit IV: Theory of Bending Stresses in Beams Due to Bending - Assumptions in Simple Bending Theory, Derivation of Formula: Its Application to Beams of Rectangular, Circular and Channel, I & T-Sections, Combined Direct and Bending Stresses in aforementioned Sections, Composite Beams.
Torsion - Derivation of Torsion Equation and its Assumptions, Applications of the Equation to Hollow and Solid Circular Shafts, Torsional Rigidity, Combined Torsion and Bending of Circular Shafts Principal Stress and Maximum Shear Stresses Under Combined Loading of Bending and Torsion, Analysis and Close-Coiled-Helical Springs.
Unit V: Columns and Struts - Failure of Columns, Euler's Formulas, Rankine-Gordon's Formula, Johnson's Emperical Formula for Axially Loaded Columns and their Applications.

Recommended Books:

1. Singer, F. P. and Pytel, A. - Strength of Materials, Harper and Row H. Kogakusha Publishers, New York
2. Popov, E. P. - Mechanics of Materials, Prentice Hall India, New Delhi
3. Bedi, D. S. - Strength of Materials, Khanna Book Publishing Company, New Delhi.
4. Lehri, R.S. and Lehri, A.S.- Strength of Materials, Kataria & Sons Publishers, New Delhi
5. Khurmi, R. S. - Strength of Materials, Khanna Publishers, New Delhi

Project Management

MEL 2132 **3-0-0=3**

Unit I: Introduction - Project Definition, Criteria for Selection: Financial Aspects, Social Cost-Benefit Analysis, Selection of Site, Analysis of Present Situation, Evaluation of Improvements, Preparation of Recommendation Reports, Requirements of Public Projects.

Unit II: Organizational Aspects - Differences Between Project and Non-Project Organization, Project Organization Structure-Life, Staff Matrix, Task Oriented, Selecting a Project Manager, Characteristics of a Good Project Manager, Selection of other Personnel, Controlling, Directing, Coordinating and Delegation, Development of Performance Measures for Personnel, Selecting and Managing Contractors.

Unit III: Network Analysis - Determination of Activities and Events, Estimation of Duration Times Under Uncertainty, PERT (Program Evaluation and Review Technique) - Drawing Arrow Diagram, Calculating Total Project Time, Isolating Critical Path, Determination of Slack Times, Crashing, CPM Network, Critical Path Scheduling, Sequencing Models, Manpower Resource Allocation, Time-Cost Tradeoff, Computerized Project Management, Other Network Based Techniques-Line of Balance, Assembly Line Balancing
Note: A Number of Problems Related to PERT/CPM and other Network Based Techniques are Required to be Attempted in the Class Room

Unit IV: Project MIS and Cost Control - Information Requirements of Projects, Identification of Relevant Information, Channels of Communication, Preparation of Interim Reports. Understanding Cost Control, The Operating Cycle, Budgets and Variances.

Unit V: Real World Case Studies on Project Management.

Recommended Books:

1. Kerzner, H. - Project Management- A Systems Approach, CBS Publishers, New Delhi.
2. Wiest , J. D. and Levy, F. K. - A Management Guide to PERT/CPM, Prentice Hall, New Jersey.
3. Bhattacharya, S. -Management by Network, Institution of Engineers (India), Kolkata.
4. O'Brien -Network Based Management System, McGraw Hill, New York.
5. Srinath, L. S. - PERT and CPM, Principles and Applications, East-West Press, New Delhi.

Manufacturing Processes

MEL 2113 **3-0-0=3**

Unit I: Engineering Materials - Classification, Selection of Materials for Mechanical Design, Mechanical, Physical and Thermal Properties, Common Ferrous and Non-Ferrous Metals, Introduction to Ceramics & Composite Materials. Classification of Manufacturing Processes of Materials.

Unit II: Casting - Scope, Pattern, Pattern Allowances, Solidification, Gating and Risering, Sand Mould, Permanent Mould, Cold and Hot Chamber Die Casting, Shell Moulding, Investment Casting and Centrifugal Casting, Casting Defects and Remedies.
Unit III: Forming - Scope, Fundamentals of Forming, Hot & Cold Working Processes, Rolling, Extension, Wire Drawing, Forging, Fundamentals of Sheet Metal Operation, High Energy Rate Forming Processes.
Unit IV: Powder Metallurgy - Scope, Basic Steps, Production of Powders, Powder Characteristics, Advantages and Disadvantages.
Unit V: Welding - Scope, Classification, Fundamental of Welding, Heat Affected Zone, Welding Metallurgy and Its Effect on Performance of Weldments, Residual Stresses and Distortion of Weldments, SMAW, TIG, MIG, SAW, PAW and Gas Welding Process (Principles & Applications), Brazing and Soldering Operations.
Unit VI: Classification, Specifications, Operations and Machining Parameters of Lathe, Milling, Shaper, Drilling, Cylindrical Surface Grinder and Abrasive Wheels.

Recommended Books:

1. Kalpakjian, S. - Manufacturing Engineering and Technology, Pearson Education, Singapore
2. Hajra Choudhry, S. K. - Elements of Workshop Technology, Vol I, Media Promoters & Publishers Pvt., Ltd.
3. Jain, R. K. - A Text Book of Production Technology, Khanna Publishers, New Delhi.
4. Rao, P. N. – Manufacturing Technology (Casting, Forming and Welding), Tata McGraw Hill, New Delhi.
5. De Garmo, E. P. - Materials and Processes in Manufacturing, Prentice Hall of India, New Delhi.

Fluid Mechanics Lab

MEP 2231 **0-0-2=1**

1. To Study the Flow Through a Variable Area Duct and Verify Bernoulli's Energy Equation.
2. To Determine the Coefficient of Discharge for an Obstruction Flow Meter (Venture Meter/Orifice Meter)
3. To Determine the Discharge Coefficient for Notches And Weirs.
4. To Study the Transition from Laminar to Turbulent Flow and to ascertain Lower Critical Reynolds Number.
5. To Determine the Hydraulic Coefficient for Flow Through an Orifice.
6. To Determine the Friction Coefficient for Pipes of Different Diameters.
7. To Determine the Head Loss in a Pipe Line Due to Sudden Expansion/ Sudden Contraction/ Bend.
8. To Determine the Velocity Distribution for Pipeline Flow with a Pitot Static Probe.

Strength Of Materials Lab

MEP 2014 **0-0-2=1**

The Following Practical Exercises are to be carried out:
1. Tensile Tests on Ductile and Brittle Materials and to Draw Stress-Strain Curve and to Determine Various Mechanical Properties.
2. Compression Test on C.I. and to Determine Ultimate Compressive Strength.
3. Shear Tests on Different Materials and to Determine Ultimate Shear Strength.

4. Hardness Tests to Determine Hardness of Materials – Rockwell or Brinell or Vicker's Test
5. Impact Test to Determine Impact Strength.
6. Torsion Test and to Determine Torsional Strength.
7. Fatigue & Creep Tests
8. Tests on Close Coiled Helical Spring
9. Determination of Bucking Loads of Long Columns with Different End Conditions.

Machine Tools Lab

MEP 2113 **0-0-3=1.5**

The following practical exercises are to be carried out:
1. Practice of Lathe Operations
2. Shaping Rectangular Block or Cube
3. Milling Rectangular Block or Cube
4. T -Slot Milling
5. Spur Gear Cutting on Milling Machine
6. Practice on Cylindrical Grinding Machine
7. Surface Grinding practice
8. Grinding of a Single Point Cutting Tool
9. Tool wear and Cutting Force(s) Measurement in Turning, Drilling, Milling and Grinding Operations.

FLUID MACHINES

MEL2232 **3-1-0=4**

Unit I: Impact of Free Jets: Impulse – Momentum Principle, Jet Impingement - on a Stationary Flat Plate, Inclined Plate and a Hinged Plate, at the Center of a Stationary Vane, on a Moving Flat Plate, Inclined Plate, A Moving Vane and a Series of Vanes, Jet Striking Tangentially at the tip of a Stationary Vane and Moving Vane(s), Jet Propulsion of Ships. Problems.

Unit II: Impulse Turbines: Classification – Impulse and Reaction Turbines, Water Wheels, Component Parts, Construction, Operation and Governing Mechanism of a Pelton Wheel, Work Done, Effective Head, Available Head and Efficiency of a Pelton Wheel, Design Aspects, Speed Ratio, Flow Ratio, Jet Ratio, Number of Jets, Number of Buckets and Working Proportions, Performance Characteristics, Governing of Impulse Turbines. Problems

Unit III Francis Turbines: Component Parts, Construction and Operation of a Francis Turbine, Governing Mechanism, Work Done by the Turbine Runner, Working Proportions and Design Parameters, Slow, Medium and Fast Runners, Degree of Reaction, Inward/Outward Flow Reaction Turbines, Performance Characteristics, Problems.

Unit IV: Propeller and Kaplan Turbines: Component Parts, Construction and Operation of a Propeller, Kaplan Turbine, Differences Between the Francis and Kaplan Turbines, Draft Tube - Its Function and Different Forms, Performance Characteristics, Governing of Reaction Turbine, Introduction to New Types of Turbine, Deriaz (Diagonal), Bulb, Tubular Turbines, Problems.

Unit V: Dimensional Analysis and Model Similitude: Dimensional Homogeneity, Rayleigh's Method and Buckingham's Π-Theorem, Model Studies And Similitude, Dimensionless Numbers and their Significance. Unit Quantities, Specific Speed and Model Relationships for Turbines, Scale Effect, Cavitations – Its Causes, Harmful Effects and Prevention, Thomas Cavitation Factor, Permissible Installation Height, Problems.

Unit VI : Centrifugal Pumps: Classification, Velocity Vector Diagrams and Work Done, Manometric Efficiency, Vane Shape, Head Capacity Relationship and Pump Losses, Pressure Rise in Impeller, Minimum Starting Speed, Design Considerations, Multi-Stage Pumps. Similarity Relations and Specific Speed, Net Positive Suction Head, Cavitation and Maximum Suction Lift, Performance Characteristics. Brief Introduction to Axial Flow, Mixed Flow and Submersible Pumps, Problems.

Unit VII: Reciprocating Pumps: Construction and Operational Details, Discharge Coefficient, Volumetric Efficiency and Slip, Work and Power Input, Effect of Acceleration and Friction on Indicator Diagram (Pressure – Stroke Length Plot), Separation, Air Vessels and their Utility, Rate of Flow into or From the Air Vessel, Maximum Speed of the Rotating Crank, Characteristic Curves, Centrifugal Vs Reciprocating Pumps, Brief Introduction to Screw, Gear, Vane and Radial Piston Pumps, Problems.

Unit VIII: Hydraulic Systems: Function, Construction and Operation of Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic Crane, Hydraulic Lift and Hydraulic Press, Fluid Coupling and Torque Converter, Hydraulic Ram, Problems.

Recommended Books:

1. Som S.K. And Biswas, G - Introduction To Fluid Mechanics And Fluid Machines, Tata Mcgraw-Hill, New Delhi.
2. Agrawal S. K.- Fluid Mechanics And Machinery, Tata Mcgraw-Hill, New Delhi.
3. Kumar, D. S. - Fluid Mechanics And Fluid Power Engineering, Kataria & Sons Publishers, New Delhi.
4. Bansal R.K.- Fluid Mechanics And Hydraulic Machines, Laxmi Publications (P) Ltd., New Delhi.
5. Ramamrutham S., Fluid Mechanics, Hydraulics And Fluid Machines, Dhanpat Rai & Sons, Delhi.

Thermal Engineering

MEL 2212 **3-1-0=4**

Unit I: Steam Generators –Classification of Boilers with Details, Merits and Demerits of Fire Tube and Water Tube Boilers, High Pressure Boilers, Boiler Mountings and Accessories, Draught and Performance of Boilers.

Unit II: Steam Nozzles – Types of Nozzles, Steam Flow Through Nozzles, Condition for Maximum Discharge, Supersaturated Flow Through Nozzles.

Unit III: Fuels and Combustion –Types of Fuels, Calorific Value of Fuels, Combustion Equation for Hydrocarbon Fuel, Conversion of Volumetric Analysis to Mass Analysis, Determination of Excess Air Supplied. Determination of Percentage Carbon in Fuel Burning to CO And CO_2. Determination of Minimum Quantity of Air Supplied to Gaseous Fuels, Flue Gas Analysis, and Bomb Calorimeter Orsat Apparatus.

Unit IV: Compressors: Compression Processes, Work of Compression, Single-Stage Reciprocating Air Compressor, Volumetric Efficiency, Multi-Stage Compression, Rotary Compressors.

Unit V: Turbines: Impulse and Reaction Principles of Turbines, Compounding, Single and Multistage Turbines, Speed Regulations.

Unit VI: Steam Condenser: Types, Various Efficiencies, Air Leakage, Cooling Towers and Applications.

Recommended Books:

1. Nag, P.K. - Engineering Thermodynamics, Tata Mc Graw Hill Publishers, New Delhi.
2. Vasandani, V.P. and Kumar, D.S.-Heat Engineering, Metropolitan Book Co.
3. Kumar, D.S.-Thermal Science and Engineering, Kataria & Sons Publishers, New Delhi.
4. Gupta And Prakash –Engineering Thermodynamics, S.Chand Publishers, New Delhi.
5. Kothandaraman, C.P, and Dornkundwar, S. - Thermal Engineering, Dhanpat Rai & Sons, New Delhi.
6. Cengel and Boles Thermodynamics & Engineering Approach, Tata Mc Graw Hill Publishers, New Delhi.

Mechanics Of Materials

MEL 2016 **3-1-0=4**

Unit I: Strain Energy & Impact Loading: Definitions, Expressions for Strain Energy Stored in a Body when Load is applied (I) Gradually, (II) Suddenly and (III) with Impact, Strain Energy of Beams in Bending, Beam Deflections, Strain Energy of Shafts in Twisting, Energy Methods in Determining Spring Deflection, Castigliano's & Maxwell's Theorems.

Unit II: Theories of Elastic Failure: Various Theories of Elastic Failures with Derivations and Graphical Representations, Applications to Problems of 2- Dimensional Stress System with (I) Combined Direct Loading and Bending, and (II) Combined Torsional and Direct Loading.

Unit III Unsymmetrical Bending: Properties of Beam Cross Section, Product of Inertia, Ellipse of Inertia, Slope of Neutral Axis, Stresses & Deflections, Shear Center and Flexural Axis.

Unit IV: Thin Walled Vessels: Hoop & Longitudinal Stresses & Strains in Cylindrical & Spherical Vessels & their Derivations Under Internal Pressure, Wire Wounld Cylinders, Thick Cylinders & Spheres: Derivation of Lame's Equations, Radial & Hoop Stresses and Strains in Thick, and Compound Cylinders and Spherical Shells Subjected to Internal Fluid Pressure Only, Wire Wound Cylinders, Hub Shrunk on Solid Shaft.

Unit VI: Rotating Rims & Discs: Stresses in Uniform Rotating Rings & Discs, Rotating Discs of Uniform Strength, Stresses in (I) Rotating Rims, Neglecting the Effect of Spokes, (II) Rotating Cylinders, Hollow Cylinders & Solids Cylinders.

Unit VII; Bending of Curved Bars : Stresses in Bars of Initial Large Radius of Curvature, Bars of Initial Small Radius of Curvature, Stresses in Crane Hooks, Rings of Circular & Trapezoidal Sections, Deflection of Curved Bars & Rings, Deflection of Rings by Castigliano's Theorem, Stresses in Simple Chain Link, Deflection of Simple Chain Links, Problems.

Unit VIII: Springs: Stresses in Open Coiled Helical Spring subjected to Axial Loads and Twisting Couples, Leaf Springs, Flat Spiral Springs, Concentric Springs.

Recommended Books:

1. Popov, E. P. - Mechanics of Materials, Prentice Hall India, New Delhi
2. Singer,F.P.&Pytel,A.-Strength of Materials, Harper and Row H. Kogakusha Publishers, New York
3. Bedi, D. S. - Strength of Materials, Khanna Book Publishing Company, New Delhi.
4. Lehri, R.S. and Lehri, A.S.- Strength of Materials, Kataria & Sons Publishers, New Delhi
5. Khurmi, R. S. - Strength of Materials, Khanna Publishers, New Delhi

Dynamics Of Machines

MEL 2018 **3-1-0=4**

Unit I: Static Force Analysis - Static Equilibrium of Mechanism, Concept of Force and Couple, Free Body Diagram, Conditions of Equilibrium, Methods of Static Force Analysis of Simple Mechanisms and Power Transmission Elements, Consideration of Frictional Forces, Determination of Forces and Couples for a Crank, Inertia of Reciprocating Parts, Dynamically Equivalent System, Analytical and Graphical Method, Inertia Force Analysis of Basic Engine Mechanism, Torque Required to Overcome Inertia and Gravitational Force of a Four Bar Linkage.

Unit II: Balancing - Balancing of Rotating Masses in One Plane and in Several Planes, Unbalanced Forces in Reciprocating Engines, Balancing of In-Line Engines, Firing Order, Radial and V-Engines, Balancing of Machines, Balancing of Linkages, Fisher's Method of Principal Vectors, Method of Linearly Independent Vectors, Balancing of Shaking Moment.

Unit III: Gears - Toothed Gears and Spur Gears, Types of Toothed Gears, Definitions: Pressure Angle, Path of Contact, Arc of Contact, Conditions for Correct Gearing, Forms of Teeth, Involute and Its Variants, Interference and Methods of Removal, Calculation of Minimum No. of Teeth on Pinion/Wheel For Involute Rack, Helical/Spiral/Bevel/Worm Gears.

Gear Trains - Types of Gear Trains, Simple, Compound and Epicyclic Gear Trains, Problems and their Applications, Estimation of Velocity Ratio of Worm and Worm Wheel.

Unit IV: Single Degree Vibration - Natural Frequency of Free Oscillations, Equivalent System, Energy Method, Single Degree Damped Systems, Forced Vibrations, Support Isolation, Measurement of Vibrations, Critical Speed of Simple Shafts; Two and Multi Degree Vibration - Two Degree Freedom Systems, Generalized Coordinates, Principal Coordinates, Coordinate Coupling, Lagrange's Equation, Vibration Absorbers, Multi Degree Freedom Systems - Calculation of Natural Frequencies by Matrix Methods, Stodola , Ralyeigh and Holzer Methods.

Unit V: Kinematic Synthesis of Mechanisms – Freudenstien's Equation, Function Generation Errors in Synthesis, Two/Three Point Synthesis, Transmission Angles, Least Square Techniques.

Recommended Books:

1. Rao, J. S. and Dukkipati, R.V.-Mechanism and Machine Theory, Wiley-Eastern, New Delhi.
2. Ballaney, P.L. - Theory of Machines, Khanna Publishers, New Delhi.
3. Khurmi, R. S. and Gupta, J. K. - Theory of Machines, Eurasia Publishing House (P) Ltd, New Delhi.
4. Ghosh, A. and Mallick A.K.- Thoery of Mechanisms and Machines, Affiliated East-West Press Pvt.Ltd., New Delhi.
5. Rattan, S.S. - Theory of Machines, Tata McGraw Hill, New Delhi.

Machine Design

MEL 2017 **3-1-0=4**

Unit I Design For Production ; Erogonomic and Value Engineering Considerations in Design, Role of Processing in Design, Design Considerations for Casting, Forging and Machining. Variable Loading : Different Types of Fluctuating/ Variable Stresses, Fatigue Strength Considering Stress Concentration Factor, Surface Factor, Size Factor, Reliability Factor, etc., Fatigue Design for Finite and Infinite Life against Combined Variable Stresses using Goodman and Soderberg's Criterion, Fatigue Design using Miner's Equation, Design Problems on above.

Unit II Shafts: Detailed Design of Shafts for Static and Dynamic Loading, Rigidity and Deflection Consideration.

Unit III Springs: Types of Springs, Design for Helical Springs against Tension and their Uses, Compression and Fluctuating Loads, Design of Leaf Springs, Surging Phenomenon in Springs, Design Problems.

Unit IV Bearings: Design of Pivot and Collar Bearing , Selection of Ball and Roller Bearing Based on Static and Dynamic Load Carrying Capacity Using Load-Life Relationship, Selection of Bearings From Manufacturer's Catalogue, Types of Lubrication – Boundary, Mixed And Hydrodynamic Lubrication, Design of Journal Bearing using Raimondi and Boyd's Charts, Lubricants and their Properties, Selection of Suitable Lubricants, Design Problems.

Unit V: I.C. Engine Parts: Cylinder, Piston, Connecting Rod, Crank and Fly Wheel Etc.

Recommended Books:

1. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
2. Motts, R.L – Machine Elements in Mechanical Design, 3RD Ed., McMillan Publishing House.
3. Sharma, P. C. and Aggarwal, D. K. – Machine design, Kataria & Sons Publishers, New Delhi.
4. Sundarajamurthy, T. V. and Shanmugam, N. - Machine Design, Khanna Publishers, New Delhi.
5. Bhandari, V. B. -Design of Machine Elements, Tata McGraw Hill, New Delhi.
6. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
7. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.

FLUID MACHINES LAB

MEP 2232 **0-0-2=1**

The Following Practical Exercises are to be carried out:

1. Performance Characteristic Tests on Pelton Wheel (Load Test & Best Speed)
2. Performance Characteristic Tests on Francis Turbine (Load Test & Best Gate Opening).
3. Performance Characteristic Tests on Kaplan Turbine (Load Test & Best Gate, Vane Angle Opening).
4. Performance Characteristic Tests on Single Stage, Multi Stage Centrifugal Pumps at Constant Speed & at Variable Speed. Actual & Predicted Curves.
5. Performance Characteristic Tests on Self-Priming Pump, Jet Pump, Airlift Pump And Deep Well Pump.
6. Performance Characteristic Tests on Axial Flow Pump.
7. Performance Characteristic Tests on Hydraulic Ram.
8. Vibration Measurement and Computer Aided Fault Diagnosis of a Centrifugal/ Self-Priming /Gear/Reciprocating Pump.
9. Performance Characteristic Tests on Reciprocating Pump at Constant Speed and at Variable Speed.
10. Performance Characteristic Tests on Gear Pump.
11. Performance Characteristic Tests on Screw Pump.

Thermal Engineering Lab

MEP 2212 **0-0-2=1**

The Following Practical Exercises are to be carried out:

1. Determination of Flash Point and Fire Point
2. Determination of Dryness Fraction of Steam
3. Flue Gas Analysis
4. Bomb Calorimeter Experiment
5. Study of Various Types of Boilers, Boiler Mountings and Accessories

6. Performance and Energy Balance Test on a Fire Tube/ Water Tube Boiler.
7. Performance of Single Stage/ Multi Stage Reciprocating Compressor
8. Study of Various Types of Turbines
9. Study of Refrigeration System, Charging and Troubleshooting
10. Determination of COP of a Refrigeration System.
11. Study of Air Conditioning System, Charging and Trouble Shooting.

Theory Of Machines Lab

MEP 2018 **0-0-2=1**

The following practical exercises are to be carried out:
1. To Study Various Links and Mechanisms.
2. To Study and Plot Various Inversions of 4- Bar Chain and Single Slider Crank Chain.
3. To Draw Velocity Diagram of Engine Mechanism Using Graphical Method
4. To Conduct Experiments on Various Types of Governors and Plot Graphs Between Height and Equilibrium Speed of a Governor.
5. Determination of Gyroscopic Couple (Graphical Method).
6. Balancing of Rotating Masses (Graphical Method)
7. Determination of Vibration Characteristics of Free and Forced Spring Mass System with and without Damping.
8. Cam Profile Analysis (Graphical Method)
9. Determination of Gear- Train Value of Compound Gear Trains and Epicyclic Gear Trains.
10. To Study Pressure Distribution in a Full Journal Bearing.

Design Of Machine Elements

MEL 3019 **3-1-0=4**

Unit I: Product Development Principles – Mechanical Properties of Materials, Simple Stresses, Torsional Stresses, Bending Stresses, Variable Stresses in Machine Parts.
Theories of Failure: Maximum Normal Stress, Maximum Shear Stress, Maximum Principal Strain, Maximum Strain Energy, Maximum Distortion Energy Theories, Criteria of Failure, Stress Concentration Factor, Size Factor, Surface Factor, Load Factor, Factor of Safety, Design Stress.

Unit II: Design of Shafts and Springs: Design of Shafts Based on Bending Moment, Twisting Moment, Combined Bending & Twisting Moments, Axial Loads in Addition to Combined Torsional and Bending Loads,Rigidity and Stiffness.

Unit III: Couplings, Keys, Belts, Chains and Design of Rigid and Flexible Couplings, Design of Keys, Design of Belt and Chain Drives, Selection of Belt and Chain Drives, Design of Elements Subjected to Simple Loading, Screws Including Power Screws, Bolted Joints Including Eccentrically Loaded Joints, Clutches and Brakes.

Unit IV: Design of Welded And Riveted Joints: Types of Welded Joints, Weld Symbols and their Representation, Strength of Welded Joints Subjected to Various Types of Loads.
Riveted Joints: Types of Joints, Design of Riveted Joints for Pressure Vessels, Design of Riveted Joints for Structures.

Unit V: Design of Gears: Design of Spur, Helical, Bevel and Worm Gears, Design of Gear Box, Layout Diagram, Speed Diagram, Fixing Number of Teeth And Module Of Gears.

Recommended Books:

1. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
2. Khurmi,R. S. and Gupta, J. K.- A Text Book of Machine Design, Eurasia Publishing House (P) Ltd, New Delhi.
3. Sharma, P. C. and Aggarwal, D. K. – Machine design, Kataria & Sons Publishers, New Delhi.
4. Sundarajamurthy, T. V. and Shanmugam, N. - Machine Design, Khanna Publishers, New Delhi.
5. Bhandari, V. B. -Design of Machine Elements, Tata McGraw Hill, New Delhi.
6. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
7. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.

Heat And Mass Transfer

MEL 3221 **3-1-0=4**

Unit I: Modes of Heat Transfer, Conduction - Fourier's Law, Thermal Conductivity of Solids, Liquids and Gases, Factors influencing Thermal Conductivity, General Three Dimensional Heat Conduction Equation in Cartesian, Cylindrical and Spherical Co-ordinates, Heat Flow through Plane Walls, Cylinders and Spheres, Heat Source Systems, Plane Wall and Cylinder, Critical Thickness of Insulation, Different Types of Fins, Heat Transfer from Fins of Uniform Cross Section, Heat Flow in a Semi Infinite Solid with Sudden Change of Surface Temperature, Periodic Variation of Surface Temperature.

Unit II: Convection - Free and Forced Convection, Basic Concepts of Hydrodynamic and Thermal Boundary Layers, Similarity Conditions of Heat Transfer Processes, Equations of Motion and Energy, Application of Dimensional Analysis, Empirical Equation of Convective Heat Transfer -Reynolds Analogy, Fundamentals of Boiling Heat Transfer, Pool Boiling, Heat Transfer in Condensation, Drop Wise and Film Condensation, Emperical Equations.

Unit III: Radiation - Thermal Radiation, Monochromatic and Total Emissive Power Absorptivity, Reflectivity and Transmissivity, Black, Grey and Real Surfaces, Planck's Distribution- Law, Wien's Dispmlacement Law, Stefan -Boltzmann's Law, Kirchhoff's Law, Heat Transfer by Radiation between Black Surface and Grey

Surfaces, Heat Transfer in Presence of Re-Radiating Surface, Electrical Network Method of Solving Radiation Problems, Radiation Shields, Shape Factors.

Unit IV: Heat Exchangers - Basic Type of Heat Exchangers, Fouling Factor, Overall Heat Transfer Co-efficient, Logarithmic Mean Temperature Difference (LMTD), Effectiveness - NTO Methods of Design of Single and Multiple Pass Heat Exchangers.

Unit V: Mass Transfer - Rate Equations, Mass Diffusion in Binary Mixtures, Evaporation in a Column, Forced Convective Mass Transfer, Heat and Mass Transfer Analogies.

Recommended Books:

1. Yadav, R. -Heat and Mass Transfer, Central Publishing House, Allahabad.
2. Sachdeva, R. C. - Fundamentals of Engineering Heat and Mass Transfer, New Age International Publishers, New Delhi.
3. Holman J. P. - Heat and Mass Transfer, Tata McGraw Hill, New Delhi.
4. Ozisik, M. N. - Heat Transfer, McGraw Hill, New York.
5. Kothandaraman, C. P. - Fundamentals of Heat and Mass Transfer, New Age International Publishers, New Delhi.

Industrial Engineering

MEL 3131 **3-0-0=3**

Unit I: Introduction - Definition and Scope of Industrial Engineering, Role of an Industrial Engineer in Industry, Functions of Industrial Engineering Department and Its Organization, Qualities of an Industrial Engineer, Principles of Industrial Engineering, System and Review of Growth and Development of Industrial Engineering and Scientific Management.

Unit II: Plant Layout and Material Handling - Different Types of Layouts Viz. Product, Process and Combination Layouts, Introduction to Layouts Based on GT, JIT and Cellular Manufacturing Systems, Development of Plant Layout, Types of Material Handling Equipments, Relationship of Material Handling with Plant Layouts.

Unit III: Work Study - Use and Applications, Techniques, Human Factors in the Application of Work Study, Method Study Objectives, Basic Procedure, Various Charting Techniques, Use of Photographic Techniques, SIMO Charts, Principles of Motion Economy, Work Measurement Techniques, Time Study, Work Sampling, Predetermined Motion Time Standards (PMTS), Analytical Estimation.

Unit IV: Production Planning and Control – Functions, Forecasting Techniques, Product Design, Process Planning, Machine Loading and Scheduling, Dispatching, Progress Reporting, Corrective Action.

Inventory Control - Different Costs, Determining Economic Order Quantity, Quantity Discounts, Re-order Level, Re-order Cycle Systems, ABC, VED, FSN Models.

Unit V: Quality Control - Meaning of Quality and Quality Control, Quality of Design, Quality of Conformance and Quality of Performance, Functions of Quality Control, Introduction to Statistical Quality Control-Control Charts and Sampling Plans.

Recommended Books:

1. Khanna, O.P. - Industrial Engineering and Management, Khanna Publishers, New delhi.
2. Dalela, S. and Mansuor Ali - Industrial Engineering and Management systems, Standard Distributors and Publishers, New Delhi.
3. Ralph, M. B. - Motions and Time Standards, John Wiley, New York.
4. ILO - Introduction to Work Study, International Labor Office , Geneva.
5. Jain, K.C. and Agarwal, L. N. – Production Planning Control & Industrial Management, Khanna Publishers, New Delhi.

Machining Processes

MEL 3114 **3-0-0=3**

Unit I :Mechanism of Metal Cutting: Deformation of Metal During Machining, Nomenclature of Lathe, Milling Tools, Mechanics of Chip Formation, Built-Up Edges, Mechanics of Orthogonal and Oblique Cutting, Merchant Cutting Force Circle and Shear Angle Relationship in Orthogonal Cutting, Factors Affecting Tool Forces. Cutting Speed, Feed and Depth of Cut, Surface Finish. Temperature Distribution , Tool Chip Interface. Numericals on Cutting Forces and Merchant Circle.

Unit II: Cutting Tool Materials & Cutting Fluids: Characteristics of Tool Materials, Various Types of Cutting Tool Materials, Coated Tools, Cutting Tool Selection, Purpose and Types of Cutting Fluids, Basic Actions of Cutting Fluids, Effect of Cutting Fluid on Tool Life, Selection of a Cutting Fluid.

Unit III : Tool Wear and Machinability: Types of Tool Wear, Tool Life, Factors Governing Tool Life, Machinability: Definition and Evaluation. Economics of Machining. Numericals on Tool Life.

Unit IV: Gear Manufacturing: Introduction, Methods of Manufacture, Gear Generation and Forming: Gear Cutting by Milling, Single Point Form Tool, Gear Hobbing and Shaping. Gear Finishing Operations: Gear Shaving, Gear Burnishing, Gear Grinding, Lapping.

Unit V: Non-Conventional Machining Processes: Abrasive Jet Machining: Principles, Applications, Process Parameters. Ultrasonic Machining: Principles, Applications, Analysis of Process Parameters. Electro-Chemical Machining and Grinding: Principles, Classifications, Choice of Electrolytes, Applications. Electric Discharge Machining: Principles, Selection of Tools Materials and Dielectric Fluid. Electron Beam Machining: Generation of Electron Beam, Relative Merits and Demerits. Laser Beam Machining: Principles and Applications.

Unit VI: Jigs & Fixtures: Introduction, Location and Location Devices, Clamping and Clamping Devices, Drill Jigs, Milling Fixtures.

Recommended Books:

1. HMT - Production Technology, Tata Mcgraw Hill, New Delhi.
2. Kalpakjian, S. - Manufacturing Engineering and Technology, Pearson Education, Singapore
3. Hajra Choudhry, S. K. - Elements of Workshop Technology, Vol II, Media Promoters & Publishers Pvt., Ltd.
4. Jain, R. K. – A Text Book of Production Technology, Khanna Publishers, New Delhi.
5. Khanna, O.P. And Lal, M.- A Textbook of Production Technology, Vol II, Dhanpat Rai & Sons, New Delhi.

Heat & Mass Transfer Lab

MEP 3221 **0-0-2=1**

List of Experiments :

1. To Determine the Thermal Conductivity of a Metallic Rod.
2. To Determine the Thermal Conductivity of an Insulating Power.
3. To Determine the Thermal Conductivity of a Solid by Guarded Hot Plate Method.
4. To Find the Effectiveness of a Pin Fin in a Rectangular Duct Natural Convective Condition and to Plot Temperature Distribution along its Length.
5. To Find the Effectiveness of a Pin Fin in a Rectangular Duct Under Forced Convective and to Plot Temperature Distribution along its Length.
6. To Determine the Surface Heat Transfer Coefficient for a Heated Vertical Tube under Natural Convection and to Plot the Variation of Local Heat Transfer Coefficient along the Length of the Tube. Also Compare the Results with those of the Correlation.
7. To Determine Average Heat Transfer Coefficient for an Externally Heated Horizontal Pipe under Forced Convection & to Plot Reynolds and Nusselt Numbers along the Length of Pipe. Also Compare the Results with those of the Correlations.
8. To Measure the Emmisivity of the Gray Body (Plate) at Different Temperature and to Plot the Variation of Emmisivity with Surface Temperature.
9. To Find Overall Heat Transfer Coefficient and Effectiveness af a Heat Exchanger under Parallel and Counter Flow Conditions. Also Plot the Temperature Distribution in both the cases along the Length of Heat Exchanger.
10. To Verify the Stefen-Boltzmann Constant for Thermal Radiation.
11. To Demonstrate the Super Thermal Conducting Heat Pipe and Compare its working with that of the Best Conductor i.e., Copper Pipe. Also Plot Temperature Variation along the Length with Time or Three Pipes.
12. To Study the Two Phases Heat Transfer Unit.
13. To Study Cross Flow Type Heat Exchanger (Air To Air).

CAD/CAM

MEL 3021 **3-0-0=3**

Unit I: Fundamentals of CAD – Introduction, Design Process, Application of Computers in Design, Benefits of CAD, Computer Hardware, Graphic Input Devices, Display Devices, Graphics Output Devices, CAD Software and Database, Software Configuration of a Graphic System, Functions of a Graphic Package, Geometric Modeling, Database Structure and Control, Graphic Standards such as GKS and IGES.

Unit II: Geometric Transformations - Mathematics Preliminaries, Matrix Representation of 2 and 3 Dimensional Transformation, Concatenation of Transformation Matrices, Application of Geometric Transformations, Representation of Curves and Surfaces: Polygon, Meshed and Ruled Surfaces, Bezier Curves, B-Spline Curves.

Unit III: Geometric Modeling - Wireframe Modeling, Solid Modeling Representation, Volumetric Properties, Surface Modeling, Concept of Hidden-Line Removal and Shading, Kinematics Analysis and Simulation.

Unit IV: CNC Machine Tools - Development Of CNC Technology, Principles, Features, Advantages, Economic Benefits, Applications, CNC, DNC Concept, Classification of CNC Machines, Types of Control, CNC Controllers, Characteristics, Interpolators.

Unit V: Drives and Controls - Spindle Drives, Feed Drives, Open Loop and Closed Loop Control, Axis Measuring Systems. Tooling and Maintenance Of CNC Machine Tools.

Unit VI: CNC Programming - Coordinate System, Structure of a Part Program, G & M Codes, Manual Part Programming for Fanuc, Heidenhain, Numeric Control Systems, APT Part Programming, Programming Exercises. Computer Aided Process Planning – Retrieval, Generative and Hybrid Approaches, Advantages, Case Studies.

Recommended Books:

1. Groover, M. P. and Zimmers, E. W. - CAD/CAM, Prentice Hall of India, New Delhi.
2. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.
3. Rao, P. N. – CAD/CAM, Tata McGraw Hill, New Delhi.
4. Groover. M. P. - Automation, Production Systems and computer Integrated Manufacturing, Pearson Education Asia, New Delhi.
5. Reddy, J. N.-An Introduction to the Finite Element Method, McGraw Hill, New York.
6. Pham, D.T. and Dimov, S.S. - Rapid Manufacturing, Springer Verlag,
7. Ranky, P. G. -Computer Integrated Manufacture, Prentice-Hall

Metrology And Measurements

MEL 3121 **3-0-0=3**

Unit I: Linear Measurements- Vernier Scale and Micrometer, Vernier Height Gauge and Depth Guage; Comparators - Types, Relative Merits and Limitations; Angular Measurements-Sine Bar, Clinometer, Angle Guage; Concept and Measurement Of Straightness and Flatness by Interferometry; Surface Roughness - Specifications and Measurement by Talysurf, Measurements for Internal and External Threads; Measurements for Gears.

Unit II: Static and Dynamic Characteristics of Instruments, Zero, First and Second Order Systems and their Response to Step, Ramp and Sinusoidal Input Signals, Sources of Errors, Systematic and Random Errors; Statistical Analysis of Test-Data, Probable Error and Probability Tables, Ejection of Test Data; Curve Fitting, Error Propagation.

Unit III: Review of Electro-Mechanical Sensors and Transducers - Variable Resistance, Inductance and Capacitive Pick Ups, Photo Cells and Piezo-Electric Transducers, Resistance Strain Guages and Application of these Elements for Measurement of Position/Dispmlacement, Speed/Velocity/ Acceleration, Force and Liquid Level.

Unit IV: Pressure and Flow Measurement - Bourdon Tube, Diaphragm and Bellows, Vaccum Measurement - Mcleod Guage, Thermal Conductivity Guage and Ionisation Guage; Ultra-Sonic Flow Meters and Hot Wire Anemometer. Temperature Measurement - Thermal Expansion Methods, Thermo-Electric Sensors - Common Thermo Couples, Resistance Thermometers and Thermistors, Optical and Total Radiation Pyrometers. Speed, Force, Torque and Shaft Power Measurement - Mechanical Tachometers, Vibration Reed Tachometer and Stroboscope; Proving Ring, Hydraulic and Pneumatic Load Cells, Torque On Rotating Shafts; Absorption, Transmission and Driving Dynamometers.

Recommended Books:

1. Kumar, D. S. - Mechanical Measurement and Control, Metropolitan Book Co Pvt. Ltd., New Delhi.
2. Holman, J. P.- Experimental Methods for Engineers, McGraw Hill, New York.
3. Doebelin, E.O.-Measurement System: Application and Design, McGraw Hill, New York.
4. Jain, R. K. – Mechanical and Industrial Measurement, Khanna Publishers, New Delhi.
5. Jain, R. K. - Engineering Metrology, Khanna Publishers, New Delhi.

Mechanical Vibrations

MEL 3022 **3-1-0=4**

Unit I: Introduction - Periodic Motion, Harmonic Motion, Period, Frequency, Amplitude and Phase Angle of Vibratory Motion, Vector Representation, Dispmlacement, Velocity and Acceleration in Harmonic Motion, Superposition of Simple Harmonic Motions, Non- Harmonic Motions, Harmonic Analysis.

Unit II: Systems Having Single Degree of Freedom- Free Vibrations of Systems without Damping, Equilibrium and Energy Methods For Determining Natural Frequency, Rayleigh Method, Equivalent Systems; Free Vibrations of Systems with Viscous, Coulomb and Structural Damping. Forced Vibration of Systems with Viscous Damping, Simple Cases of Translent Excitation- Undamped Systems.

Unit III: Systems with Two Degrees of Freedom - Free Undamped Vibrations, Static and Dynamic Coupling, Principal Modes of Vibration, Undamped Dynamic Vibration Absorbers.
Multi Degree Freedom Systems - Calculation of Natural Frequencies by Matrix Methods, Stodola , Ralyeigh and Holzer Methods, Simple Geared Systems, Dunkerley's Method.

Unit IV: Vibration Measuring Instruments - Principle of Frequency, Dispmlacement, Velocity and Acceleration Measuring Instruments, Amplitude and Phase Shift Response.

Unit V: Whirling of Shafts - Whirling of Light Flexible Shaft with a Single Disc at the Centre of its Length with and without Damping, Critical Speeds of a Shaft Having Multiple Discs.

Recommended Books:

1. Dukkipati, R. V. and Srinivas, J. - Advanced Mechanical Vibrations, Narosa Publishing House, New Delhi.
2. Den Hartog, J.P. - Mechanical Vibrations, Dover Publications.
3. Thomson, W.T. - Theory of Vibrations with Applications, CBS Publishers,
4. Rao, S.S. - Mechanical Vibrations, Addison-Wesley, New York.
5. Rao, J. S. and Gupta, K. – Theory and Practice of Mechanical Vibrations, Tata McGraw Hill, New Delhi.

Internal Combustion Engines

MEL 3222 **3-1-0=4**

Unit I: Introduction - Classification & Nomenclature, Application of Internal Combustion (I.C.) Engines, Thermodynamic Analysis of Carnot, Sterling, Ericson, Otto, Diesel, and Dual Cycles. Working of 4 Stroke Petrol & Diesel Engines, Valve Timing Diagrams, Working of 2-Stroke Petrol & Diesel Engines (with Valve Timing Diagrams), Comparison of Two Stroke & Four Stroke Engines, Fuel Air Cycles and Analysis, Actual and Fuel-Air Cycles for S.I. and C.I. Engines.

Unit II: I.C. Engine Fuels- Types of Fuels, Solid, Liquid and Gaseous Fuels, Chemical Structure of Petroleum, Petroleum Refining Process, Important Qualities of S.I. & C.I. Engine Fuels and Their Rating, Combustion of Fuels, Calorific Valves of Fuels, Theoretical Determination of CV of Fuel, Combustion Equation for Hydrocarbon Fuels, Determination of Minimum Air Required for Combustion, Volumetric Analysis, Mass Analysis.

Fuel Supply System and Fuel Pumps, Properties of Air Fuel Mixture, A Simple Carburetor and Its Working, Approximate Analysis of Simple Carburetor, Actual Air Fuel Ratio of Single Jet Carburetor, Exact Analysis of Single Jet Carburetor, Ideal Requirements from a Carburetor, Different Modern Carburetors, Introduction to Fuel Injection Systems for C.I. Engines, Fuel Filters.

Unit III: Combustion in S.I. Engines - Stages of Combination in S.I. Engine, Flame Font Propagation, Flame Speed, Ignition Lag and Factors Affecting the Lag, Abnormal Combustion and Knocking, Control and Measurement of Knock, Rating of S.I. Engine Fuels and Anti Knock Agents, Combustion Chambers of S.I. Engines

Unit IV: Supercharging - Purpose of Supercharging, Type of Superchargers, Analysis of Superchargers, Performance of Superchargers, Arrangement of Supercharger and Its Installation, Turbo Charged Engines, Supercharging of S.I. & C.I. Engines, Limitations of Supercharging.

Unit V: Measurement and Testing - Measurement of Friction Horse Power, Brake Horse Power, Indicated Horse Power, Measurement of Speed, Air Consumption, Fuel Consumption, Heat Carried by Cooling Water, Heat Carried by the Exhaust Gases, Heat Balance Sheet, Governing of I.C. Engines, Performance Characteristics of I.C. Engines.

Recommended Books:

1. Ganesan, V. - Internal Combustion Engines, Prentice Hall of India, New Delhi.
2. Domkundwar - A Course in Internal Combustion Engines, Dhanpat Rai & Sons, New Delhi.
3. Kumar, D. S. - Thermal Science and Engineering, Kataria & Sons Publishers, New Delhi
4. Vasandani, V. P. and Kumar, D. S. - Heat Engineering, Metropolitan book Co.
   Kothandaraman, C.P. and Dornkundwar, S. – Thermal Engineering, Dhanpat Rai & Sons, New Delhi

CAD/CAM LAB

MEP 3021 **0-0-2=1**

SECTION - A

Exercises in Modeling and Analysis of various types of Mechanical Components and Assemblies using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA /ANSYS / NASTRAN, etc. At least 15 components and assemblies should be modeled and analyzed by the students using the above packages in the laboratory during the semester.

SECTION – B

The following practical exercises are to be carried out:

1. Study of the structure of a CNC turning centre
2. Study of the structure of a CNC machining centre
3. Part-Programming on the above CNC machines and execution of part programs for Machining given profiles (at least 10 different jobs).

(i) Manual Part Programming for CNC Machines using G and M codes, simulation of Tool Path
(ii) Computer Assisted Part Programming using APT language

4. Exposure to component modelling and CL data generation using CAD/CAM Software like Unigraphics, Pro/E, Smart CAM, etc.
5. NC code generation using CAD/CAM software - post processing for standard CNC controls like FANUC, SINUMERIC, etc.

Metrology And Measurements Lab

MEP 3121 **0-0-2=1**

The following practical exercises are to be carried out:

1. Measurement with the help of Vernier Caliper and Micrometer
2. Measurement of an angle with the help of SineBar
3. Measurement of Surface Roughness
4. Measurement of Gear Elements using Profile Projector
5. Three Wire Method to determine Effective Diameter of External Threads
6. Measurement of Thread Elements by Tool Makers Microscope
7. Calibration of a Pressure Guage with the help of a dead weight Guage Tester
8. Use of Stroboscope for Measurement of Speed of a Shaft
9. Use of Pitot type to plot velocity profile of a fluid through a circular duct
10. Preparation of a Thermocouple, its calibration and application for Temperature Measurement
11. Measurement of
    - Pressure.
    - Temperature.
    - Flow.
    - Strain.
    - Weight.
    - Cutting forces by piezoelectric Dynamometer.
    - Hardness by Micro Hardness Tester.

Mechanical Vibrations Lab

MEP 3022 **0-0-2=1**

1. To Study Undamped Free Vibrations of Equivalent Spring Mass System and to Determine the Natural Frequency of Vibrations
2. To Study the Free Vibration of System for Different Damper Settings. Draw Decay Curve and Determine the Log Decrement and Damping Factor. Also find the Natural Frequency
3. To Study the Torsional Vibration of a Single Rotor Shaft System and to Determine the Natural Frequency.
4. To Determine the Radius of Gyration of Given Bar Using Bifilar Suspension.
5. To Verify DunkerLey's Rule
6. To Study the Forced Vibration of System with Damping. Load Magnification Factor Vs. Frequency and Phase Angle Vs Frequency Curves. Also Determine the Damping Factor.
7. To Study the Pressure Distribution of A Journal Bearing Using A Journal Bearing Apparatus.
8. To Determine the Rate of Wear of A Metallic Pin from The Plot of Displacement Vs Time Curves Using Friction and Wear Monitor Apparatus.
9. To Determine Abrasion Index of a Material using Dry Abrasion Test Rig.
10. To Evaluate the Load Wear Index and yield Point of a Lubricant with the Help of a Four Ball Stream Pressure Tester.
11. To Determine the Two Frequencies of Tensional Spring Type Double Pendulum & Compare them with Theoretical Values.
12. To Determine the Radius of Gyration of A Compound Pendulum.
13. To Determine the Radius of Gyration of Disc using Trifilar Suspension.

I.C. Engines Lab

MEP 3222 **0-0-2=1**

The Following Practical Exercises are to be carried out:

1. Study of I.C. Engines, Components and Loading Devices
2. Study of Various Circuits of a Carburetor Fitted on Indian Make Vehicle
3. Valve Timing and Port Timing Diagrams
4. Performance Test on a 4-Stroke Diesel Engine.
5. Heat Balance Test on a 4-Stroke Diesel Engine.
6. Determination of Brake Power, Indicated Power, Friction Power and Mechanical Efficiency af a Multi-Cylinder Petrol Engine Running at Constant Speed (Morse Test).
7. Performance af a Diesel/ Semi Diesel Engine from No Load to Full Load (At Constant Speed) for a Single Cylinder/ Multi- Cylinder Engine in terms of Brake Power, Indicated Power, Mechanical Efficiency and SFC (Specific Fuel Consumption) and further obtain Power Consumption Curves and Draw the Heat Balance Sheet.

Automobile Engineering

MEL 4031 **3-0-0=3**

Unit I Introduction To Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety Considerations; Safety Features of Latest Vehicle; Future Trends in Automobiles.

Unit II Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi Plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

Unit III Power Transmission : Requirements of Transmission System; General Arrangement of Power Transmission System; Object of the Gear Box; Different Types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- Mesh Gear Boxes; Epi-Cyclic Gear Box, Freewheel Unit. Overdrive Unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer Cases.

Unit IV Drive Lines, Universal Joint, Differential and Drive Axles: Effect of Driving Thrust and Torque Reactions; Hotchkiss Drive, Torque Tube Drive and Radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of Load Coming on Rear Axles, Full Floating, Three Quarter Floating and Semi Floating Rear Axles.

Unit V Suspension Systems: Need of Suspension System, Types of Suspension; Factors Influencing Ride Comfort, Suspension Spring; Constructional Details and Characteristics of Leaf Springs.

Unit VI Steering System : Front Wheel Geometry & Wheel Alignment Viz. Caster, Camber, King Pin Inclination, Toe-In/Toe-Out; Conditions For True Rolling Motions of Wheels During Steering; Different Types of Steering Gear Boxes; Steering Linkages and Layout; Power Steering – Rack & Pinion Power Steering Gear, Electronics Steering.

Unit VII Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and Constructional Details of Drum Brakes, Disc Brakes; Brake Actuating Systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors Affecting Brake Performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & Their Constructional Details, Wheel Balancing, Tyre Rotation; Types of Tyre Wear & Their Causes.

Unit VIII Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the Automobiles, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC)

Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose Construction & Operation of Lead Acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Recommended Books:

1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
3. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
4. Automotive Technology – H.M. Sethi, TMH, New Delhi.
5. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
6. Automotive Mechanics – Joseph Heitner, EWP.
7. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
8. The Motor Vehicle – Newton steeds Garrett, Butter Worths.

Operations Research

MEL 4133 **3-1-0=4**

Unit I: Origin of Operations Research And its Role in solving Industrial Problems, Classification of Mathematical Models, Various Decision Making Environments.
Deterministic Models - Linear Programming - Graphical Method - Simplex Algorithm – Duality, Transportation Problems, Assignment Problems, Applications to Problems with Discrete Variables, Introduction to Goal Programming; Solution Techniques of Linear Goal Programming Problems.

Unit II: Probabilistic Models - Decision Making Under Uncertainty, Maximum and Minimum Models, Introduction to Decision Tree.
Game Theory - Solution of Simple Two Person Zero-Sum Games, Examples of Simple Competitive Situation.
Dynamic Programming - Introduction to Deterministic and Probabilistic Dynamic Programming, Solution of Simple Problems.

Unit III: Network Models - Shortest Route, Minimal Spanning Tree, Maximum Flow Models, Project Network - CPM and PERT Networks, Critical Path Scheduling, Sequencing Models.

Unit IV: Inventory Models - Economic Order Quantity Models, Quantity Discount Models, Stochastic Inventory Models, Multi Product Models.

Unit V: Queueing Models - Queueing Systems and Structures, Notation, Parameters, Single Server And Multi Server Models, Poisson Input, Exponential Service, Constant Rate Service, Infinite Population, Simulation.

Recommended Books:

1. Taha, H. A. - Operations Research, Prentice Hall of India, New Delhi.
2. Wagner, H. M. - Principles of Operations Research, Prentice Hall, New Jersey.
3. Gupta, P. K. and Hira, D. S. - Operations Research, S. Chand & Co., New Delhi.
4. Bazara, M. J. and Sherali,J. H. - Linear Programming and Network Flows, John Wiley, New York.
5. Srinath, L. S. - PERT and CPM, Principles and Applications, East-West Press, New Delhi.

Refrigeration & Air Conditioning

MEL 4223 **3-1-0=4**

Unit I: Introduction, Refrigeration Cycle, Departure of Actual Vapour Compression Cycle from Theoretical Cycle, Compressor Volumetric Efficiency, Analysis of Actual Cycle, Effect of Suction and Discharge Pressure, Subcooling and Super Heating on Performance, Compound Vapour Compression System With Intercooling for Single and Multiple Evaporators, Cascading, Manufacturing of Dry Ice, Leak Detection, Charging of Refrigerants.

Unit II: Aqua-Amonia Absorption Refrigeration System, Lithium Bromide-Water Absorption System, Electrolux System, Properties of Aqua-Ammonia Solution, Heat of Solution, Enthalpy Concentration Diagram.
Actual Air Refrigeration Cycle, Air Craft Cooling, Liquefaction of Gases, Minimum Work Cycle, Engineering Application of Cryogenics.

Unit III: Refrigerants - Introduction, Classification of Refrigerants, Required Properties of An Ideal Refrigerant, Important Refrigerants, Secondary Refrigerants, Antifreeze Solutions, Selection of Refrigerant.

Unit IV: Air Conditioning - Industrial and Comfort Air Conditioning, Physiologica1 Principle, Comfort Indices, Comfort Chart, Ventilation Requirements.
Psychrometry, Air Washer, Evaporative Cooling, Humidifier Efficiency, Cooling Tower,Performance Cooling and Dehumidification by Chilled Water Spray and Cooling Coils Equivalent by Pass Factor, Chemical Dehumidification, Sensible Heat Factor and Apparatus Dew Points

Unit V: Equipment - Description of Refrigeration and Air Conditioning Equipment, Compressors, Condensers, Evaporators, Air Washer and Expansion Devices. Central Air Conditioning Plants.
Applications - Manufacturing of Ice, Cold Storage and Food Freezing, Air Conditioning of Building.

Recommended Books:

1. Jordan Priester - Refrigeration and Air Conditioning, Prentice Hall of India,
2. Stoecker, W. F. and Jones, J. W. - Refrigeration And Air Conditioning, Tata McGraw Hill, New Delhi.
3. Arora, C. P. - Refrigeration and Air Conditioning, Tata McGraw Hill, New
4. Prasad, M. - Refrigeration and Air Conditioning, New Age International,
5. Arora, C. P. and Domkundwar - Refrigeration and Air Conditioning, Dhanpat Rai & Sons, New Delhi.

Robotics And Mechatronics

MEL 4023 **3-0-0=3**

Unit I: Introduction – Definition, Classification and Specification, Work Envelops and Other Basic Parameters of Robots, End Effectors – Sensors.

Unit II: Robot Drives and Control – Position and Velocity Sensing Devices, Hydraulic and Pneumatic Drives, Types of End Effectors – Vacuum, Magnetic And Air Operated Grippers.

Unit III: Robot Sensors - Transducers and Sensors, Sensors in Robot, Tactile Sensor, Proximity and Range Sensors, Sensing Joint Forces, Robotic Vision System, Image Segmentation, Pattern Recognition and Applications of Robots in Industries.

Unit IV: Introduction - Definition of Mechatronic Systems, Philosophy and Approach, Embedded Microprocessor Systems, Hardware Structure, Software, Programmable Logic Devices, Applications of Specific Integrated Chips, Automatic Control and Real Time Control Systems.

Unit V: Sensors, Transducers and Drives – Classification, Development in Transducer Technology, Semiconductors, Thick Film and Thin Film Elements, Sensors for Measuring Displacement, Position and Proximity, Velocity and Motion, Fluid Pressure, Temperature, and Light, Selection of Sensors. Programmable Logic Controllers (PLC), Electrical Actuators Such as Servo Motor And Stepper Motor, Drive Circuits, Open and Closed Loop Control,

Recommended Books:

1. Yoram Koren - Robotics for Engineers, Mc Graw Hill, New York.
2. Richard. D., Klafter, T. A. and Chmielewski, M. N/ - Robotics Engineering – An Integrated Approach, Prentice-Hall of India, New Delhi.
3. Deb, S.R.- Robotics Technology and Flexible Automation, Tata Mc Graw-Hill, New Delhi.
4. Groover, M. P., Weis, M. R., Nagel, N. and Odrey, N. G. - Industrial Robotics Technology, Programming and Applications, Mc Graw Hill, New York.
5. Jordanides, T. - Expert Systems and Robotics, Springer Verlag, New York.
6. HMT - Mechatronics, Tata McGraw Hill, New Delhi.
7. Dan Necsulescu - Mechatronics, Pearson Education Asia, New Delhi..
8. Michael B. Histand and David G.Alciatore - Introduction to Mechatronics and Measurement Systems, McGraw Hill, New York.

AUTOMOBILE ENGINEERING LAB

MEP 4031 **0-0-2=1**

1. To study and prepare report on the constructional details, working principles and operation of the automotive Engine Systems & Sub-System.
2. To study and prepare report on the constructional details, working principles and operation of the Fuels Supply systems.
3. To study and prepare report on the constructional details, working principles and operation of the automotive clutches.
4. To study and prepare report on the constructional details, working principles and operation of the automotive Transmission Systems.
5. To study and prepare report on the constructional details, working principles and operation of the automotive Drive Lines & Differentials.
6. To study and prepare report on the constructional details, working principles and operation of the automotive Suspension Systems.
7. To study and prepare report on the constructional details, working principles and operation of the automotive Steering Systems.
8. To study and prepare report on the constructional details, working principles and operation of the automotive Tyres & Wheels.
9. To study and prepare report on the constructional details, working principles and operation of the automotive Break System.
10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

Refrigeration & Air Conditioning Lab

MEP 4223 **0-0-2=1**

1. Study & Performance of basic Vapour Compression Refrigeration Cycle.
2. To find COP of water cooler.
3. To study the walk in cooler.
4. To study and perform experiment on Vapour Absorption Apparatus.
5. Perform the experiment & calculate various. Performance parameters on a blower apparatus.
6. To find the performance parameter of Cooling Tower.
7. To study various components in Room Air Conditioner.
8. To find RH of atmosphere air by using slings Psychometric and Psychometric.
9. To find performance of a Refrigeration Test Rig system by using different expansion devices.
10. To study different control devices of a Refrigeration System.
11. To study various Compressors.
12. To find the performance parameters of Ice Plant.

Colloquium

EMEC 4913 **0-0-2=1**

Introduction to Planning, Preparing and Making Presentation - Preparation of Slides, Time Management, Communication Aspects, etc. Making of a Presentation based on Practical Training with Response Sheet for Audience. Reading an Assigned Project Report, Making a Presentation with Audience Response Sheet and a Critique on Writing Style, Completeness and Editorial Get-Up. Performing Patent Searches on a Production or Industrial Engineering Process/ Product and Making a Presentation. Preparing Posters on Practical Training and Presenting Them during a Poster Session.

Major Project

EMED 4912 **0-0-20=10**

Team Formation For Designing, Manufacturing and Operating A Selected Product, Formulating Project Management Procedures. Need Identification, Assessment of Alternative Designs, Selection of Design for Development, Defining Design and Performance Specification and Testing Procedure. Detailed Mechanical, Thermal and Manufacturing- Related Design of Systems, Assemblies, Sub- Assemblies and Components Culminating in Engineering Drawings and Material Specifications; Preparing Bill of Materials and Identification of Standard Components and Bought-Out Parts using Engineering Drawings, The Process Sheets are Developed based on Available Materials, Machine Tools and other Fabrication Facilities. Materials and Standard Components are Procured and Manufacturing is carried out. After Inspection, Parts are Accepted. Assembly Procedure is Finalized and the Machine is Assembled. Acceptance Tests are carried out vis-a-vis Specifications From Phase-I. Functioning Product is Displayed at an Open House. Professional Quality Documentation of All Designs, Data, Drawings, and Results, Change History, Overall Assessment, etc. Is Mandatory along with a Final Presentation.

Power Plant Engineering

MEE 3224 **3-0-0=3**

Unit I: Basics of Steam Power Plant - Various Components of Steam Power Plant, Layout, Types of Firing, Stokers, Pulverized Coal Burners and Fluidized Bed Combustion. Coal Handling System - Trippers, Plough Feeders, Crushers, Gravimetric Feeders, Pulverizers, Ash Handling - Hydraulic & Pneumatic, Forced Draft and Induced Draft Fans, Primary Air Fans.

Unit II: Components of a Steam Power Plant - High Pressure and Superficial Boilers, Feed Pump, Economizer, Superheater, Desuperheater, Regenerator, Condensers, Deaerators, Cooling Towers.

Unit III: Nuclear and Gas Turbine Power Plant - Basic Nuclear Physics and Nuclear Reaction Related to Nuclear Reactors, Nuclear Materials, Radiation Shielding, Waste Disposal. Gas Turbine Power Plant - Application, Components and Layouts, Open and Closed Cycles Plants, Combined Gas Turbine and Steam Power Plants.

Unit IV: Hydro and Diesel Power Plant - Hydro Electric Power Plants, Layout, Selection of Water Turbine, Various Hydro Electric Power Plants and Their Applications, Diesel Engine Power Plant - Component and Layout .

Unit V: Power Plant Economics and Environmental Hazards - Load Curve, Fixed and Operating Costs, Economics of Different Types of Power Plants, Environmental Hazards of Various Power Plants, CO, SO_x, NO_x , Particulates, Trace Metals.

Recommended Books:

1. Vopat and Stortzki - Power Station Engineering and Economy, Tata McGraw Hill, New Delhi.
2. Arora and Domkundwar - Power Plant Engineering, Dhanpat Rai & Sons, New Delhi.
3. Nag, P. K. - Plant Engineering, Tata McGraw Hill, New Delhi.
4. Nagpal - Power Plant Engineering, Khanna Publishers, New Delhi.
5. Wakil, M.M.E.I. - Power Plant Technology, McGraw Hill, New York.

WORK Study & Ergonomics

MEE 3134 **3-0-0=3**

Unit I: Work Study - Areas of Application of Work Study in Industry; Method Study and Work Measurements and their Inter-Relationship, Reaction of Management and Labor to Work Study, Role of Work Study in Improving Plant Productivity and Safety.

Unit II: Method Study - Objectives and Procedure for Methods Analysis, Select, Record, Examine, Develop, Define, Install and Maintain; Recording Techniques, Micro Motion and Macro-Motion Study, Principles of Motion Economy, Normal Work Areas and Work Place Design.

Unit III: Work Measurement - Objectives, Work Measurement Techniques - Time Study, Work Sampling, Pre-Determined Motion Time Standards (PMTS), Etc., Determination of Time Standards, Observed Time, Basic Time, Normal Time, Rating Factors, Allowances, Standard Time.

Unit IV: Introduction to Ergonomics - Historical Development of Human Factors Engineering, Importance of Ergonomics Workplace Improvement and Preventing Workplace Injuries.

Unit V: Human-Machine Interface - The Man-Machine System, Machine as a System Component, Reaction Time, Muscular Performance, Static Work.

Types of Displays - Quantitative, Qualitative, Representative and Alpha-Numeric, Efficiency of Each Type, Pedal Design, Design of Tools and Controls, Stress in Human Body and its Consequences, Human Anthropometry - Measurement, Instrumentation, Adjustments in Measurement, Anthropometric Data for Indian Workers, Uses of Anthropometric Data, Computer-Aided Man-Machine System Design.

Recommended Books:
1. Shan, H. S. - Work Study and Ergonomics , Dhanpat Rai & Sons, New Delhi.
2. Dalela, S. and Saurabh -Work study and Ergonomics, Standard Publishers Distributors, New Delhi.
3. Bridger, R. S.- Introduction to Ergonomics ,Mcgraw Hill, New York.
4. Hicks - Industrial Engineering & Management, Tata McGraw Hill, New Delhi.
5. ILO - Introduction to Work Study, International Labor Office, Geneva.

Fuels, Combustion And Pollution

MEE 3225 **3-0-0=3**

Unit I: Fuels - Conventional and Non-Conventional Fuels (Solid, Liquid, and Gaseous Fuels), Definitions and Units, Wood, Peat, Coal, Classification of Coals, Combustion of Coals, Physical and Chemical Properties of Coals.

Unit II: Petroleum Oils - The Origin and Nature of Crude Petroleum, Petrol, Diesel, Kerosene, Properties and Specifications, Cetane Number, Octane Number, Natural Gas, CNG, LPG, LNG, Producer Gas, Coal Gas, Alternative Fuels (Biodiesel, Alcohol, Hydrogen)

Unit III: Combustion - Definitions, Basic Flame Types, Flame Structure, Thermodynamics of Combustion Processes, Combustion of Liquid and Solid Fuels, Combustion in Compression Ignition Engines, Types of Diesel Combustion Systems, Fuel Spray Behavior, Analysis of Cylinder Pressure Data, Ignition Delay

Unit IV: Combustion in Spark Ignition Engines, Flame Structure and Speed, Spark Ignition, Abnormal Combustion.

Unit V: Pollution: Pollutant Formation, Nitrogen Oxides, Kinetics of NO_x Formation, Carbon Monoxide, Unburned Hydrocarbon Emissions, Particulate Emissions, Soot Formation Fundamentals, Soot Oxidation, Pollution Control, Exhaust Gas Treatment, Catalytic Converters, Thermal Reactors, Particulate Traps, Adsorption and Condensation.

Recommended Books:
1. Heywood, J. B. - Internal Combustion Engine Fundamentals, McGraw-Hill, New York.
2. Warnatz J. and Mass, U. - Combustion, Physical and Chemical fundamentals, Modeling and Simulation, Experiments, Pollutant formation – Springer, UK.
3. Francis, W. and Peters, M. C. - Fuels and Fuel technology, A Summarized Manual, Pergamon Press.
4. Sharma and Mathur - Internal Combustion Engines, Dhanpat Rai & Sons, New Delhi..
5. Ganesan V.- Internal Combustion Engines, Tata McGraw-Hill, New Delhi.

Computer Integrated Manufacturing Systems

MEE 3122 **3-0-0=3**

Unit I: Introduction - Production Systems Facilities, Automation in Production Systems, Manual Labor in Production Systems, Automation Principles and Strategies; Manufacturing Operations, Production Concepts and Mathematical Models, Cost of Manufacturing Operations.

Unit II: Group Technology and Cellular Manufacturing, Parts Classification and Coding, Production Flow Analysis, Cellular Manufacturing.
Industrial Robotics: Robot Anatomy and Related Attributes, Robot Control Systems, Robot Applications.

Unit III: Definition and Broad Characteristics of Flexible Manufacturing Cells, Systems, Flexible Transfer Lines, Place of Flexible Manufacturing Systems in CIM, Economics and Technological Justification for FMS, Design and Planning, Role of Associated Technologies such as GT, JIT and Simulation, Operation and Evaluation, Scheduling Problems, FMS Hardware, Control Aspects of FMS, Flexible Machining Cells.

Unit IV: Introduction to Material Handling, Material Transport Systems, Storage Systems- Conventional / Automated Storage Systems, Automatic Identification Methods.

Unit V: Shop Floor Control – Functions, Order Release, Order Scheduling, Order Progress, Factory Data Collection Systems, Corrective Actions.

Recommended Books:
1. Groover, M. P.-Automation Production Systems and Computer Integrated Manufacturing, Pearson Education Asia, Delhi.
2. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.
3. Ranky, P. G. -Computer Integrated Manufacture, Prentice-Hall International, UK.
4. Rao, P. N. – CAD/CAM, Tata McGraw Hill, New Delhi.
5. Craig, J. J. - Introduction to Robotics: Mechanics and Control, Addison-Wesley, New York.

Turbomachinery

MEE 3226 **3-0-0=3**

Unit I: Introduction- Definition of Turbomachineries, Euler's Turbine Equation, Classification, Turbines (Reversed. Turbines) Axial, Radial and Mixed Flow Turbomachines, Method of Energy Transfer in Axial, Radial and Mixed Flow Machines.

Unit II: Cascade Theory- Blade Terminology, Cascade of Blades, Flow Angles, Flow Deviation, Lift and Drag, Losses in Cascades, Velocity Diagrams, Degree of Reaction.

Unit III: Three Dimensional Flow In Turbomachines:- Effect of Radial Pressure Gradient, Free Vortex Flow, Forced Vortex Flow, Effect of Vertex Flow on Design, Secondary Flow, Losses Due to Secondary Flow.

Theoretical Head Capacity Relations, Various Types of Turbomachines, Performance Characteristics of Different Types of Turbomachines, Head Capacity, Efficiency, Capacity, Power, Stall, Surge.

Unit IV: Centrifugal Pumps, Fans & Blowers- Inlet Section, Pre-Rotation, Inducing Section, Prewhirl, Limiting Inlet Velocity, Flow in Impeller Channel Modification of Euler's Theory, Vane and Channel Shape, Flow in the Discharge Casing, Volute Casing, Diffuser Performance Characteristics, Losses, Regulating Blowers, General Principles, Adjustable Inlet Guide Vane, Adjustable Blade Tip, Adjustable Disc, Adjustable Guide Devices, Control of Rotation, Self Adjustment by Characteristics, Mechanical and Hydraulic Speed Adjustment, Gears, etc.

Unit V: Hydraulic Turbines- Classification, Euler's Equation for Turbines, Velocity Triangle for Single Stage Axial and Radial Machines, Impulse and Reaction Turbines, Pelton, Francis & Kaplan Turbine, Power and Efficiency Calculations, Draft Tube, Cavitation, Water Turbine Governing.

Recommended Books:

1. Shephard, D. G. – Principles of Turbomachinery, McMillan, New york.
2. Yahya, S. M. -Turbines, Compressors & Fans, Tata McGraw Hill, New Delhi.
3. Jagdish Lal - Hydraulic Machines, Metropolitan Book Co., New Delhi.
4. Sayers, A.T. - Hydraulic and Compressible Flow Turbo Machines, McGraw Hill, New York.
5. Logan, E. and Roy, R. – Handbook of turbomachinery, Marcel Dekker, New York.

Concurrent Engineering

MEE 3024 **3-0-0=3**

Unit I: Historical Background of Concurrent Engineering (CE), Sequential and Concurrent Processes; Definition and Framework of CE; Decomposition of Product Development Stages, CE Team, Implementation of CE; Role of Information Technology in CE; Examples Of CE Applications.

Unit II: Concurrent Engineering Tools – Design For Manufacture and Assembly (DFMA), Design For Quality (DFQ), Design For Cost (DFC), Failure Modes Effects Analysis (FMEA), Fault Tree Analysis (FTA), Design of Experiments, Taguchi's Methods, Quality Function Deployment (QFD), Simulation, etc.

Unit III: Integration of Design and Manufacturing, Design Evaluation for Manufacturing Cost, Design Process Optimization for CE, Role of CAD/CAM and Automation in CE, Virtual Reality Tools and Techniques for Product Development and Interactive Modeling and Visualization, Rapid Prototyping. Design For Manufacturing (DFM) - Case Studies; Design For Reliability, Maintainability And Reparability and their implication on CE.

Unit IV: CE Application to Composite Structures - Structural Design using Composite Materials, Mechanical Properties and Design Parameters of Composite Materials, Composite Manufacturing Processes with emphasis on Manufacturing Time, Quality and Cost; Case Studie(s) on Design for Manufacturing of Composite Structural Elements.

Unit V: Submission of a Report: Real Industrial World Case Studies.

Recommended Books:

1. Biren Prasad - Concurrent Engineering Fundamentals, Vol. I & II, Prentice Hall, New Jersey.
2. Andrew Kusiak - Concurrent Engineering, Automation, Tools and Techniques, John Wiley & Sons, New York.
3. Backhouse, C.J. and Brookes - Concurrent Engineering, Gower Publishing House.
4. Karandikar, H. and Mistree, F. - Designing a Composite Material Pressure Vessel for Manufacturing: A Case Study in Concurrent Engineering, Engineering Optimization, Vol 18, pp. 235-262., 1992.
5. Moustapha, I. - Concurrent Engineering in Product Design and Development, New Age International, New Delhi.

Industrial Automation

MEE 3032 **3-0-0=3**

Unit I: Concept and Scope of Automation, Socio Economic Consideration, Low Cost Automation, Fluid Power Control - Fluid Power Control Elements and Standard Graphical Symbols. Construction and Performance of Fluid Power Generators, Hydraulic and Pneumatic Cylinders- Construction, Design and Mounting; Hydraulic and Pneumatic Valves for Pressure, Flow and Direction Control, Servo Valves and Simple Servo Systems with Mechanical Feedback, Governing Differential Equation and Its Solution for Step Position Input, Basic Hydraulic and Pneumatic Circuits.

Unit II: Pneumatic Logic Circuits - Design of Pneumatic Logic Circuits for a given Time Dispmlacement Diagram or Sequence of Operations.

Unit III: Fluidics - Boolean Algebra, Truth Tables, Conda Effect, Fluidic Elements – Their Construction Working and Performance Characteristics, Elementary Fluidic Circuits.

Unit IV: Transfer Devices and Feeders – Classification, Construction Details and Application of Transfer Devices and Feeders (Vibratory Bowl Feeder, Reciprocating Tube and Centrifugal Hopper Feeder).

Unit V: Electrical and Electronic Controls - Introduction to Electrical and Electronic Controls such as Electromagnetic Controllers - Transducers and Sensors, Microprocessors, Programmable Logic Controllers (PLC); Integration of Mechanical Systems with Electrical, Electronic and Computer Systems.

Recommended Books:

1. Anthony Esposito - Fluid Power with Applications, Prentice Hall of India, New Delhi.
2. Majumdar, S. R. - Pneumatic Control, Tata McGraw Hill, New Delhi.
3. Deb, S. R. - Robotics and Flexible Automation, Tata McGraw Hill, New Delhi.
4. Kumar, D. S. - Mechanical Measurement and Control, Metropolitan Book Co Pvt. Ltd., New Delhi.
5. Kuo, B.C. - Automatic Control Systems, Prentice Hall, New Jersey.

Gas Dynamics And Jet Propulsion

MEE 3233 **3-0-0=3**

Unit – I Gas Turbines - Introduction, Classification, Applications. Gas Turbine and Its Components, Gas Turbine Power Plants. Optimum Pressure Ratio for Maximum Specific and Thermal Efficiency in Actual Gas Turbine Cycle. Effect of Operating Variables on Thermal Efficiency, Air Rate and Work Ratio.

Unit – II Combustion Chamber- Types of Combustion Chamber, Factors Affecting Combustion Chamber Design, Combustion Processes, Combustion Chamber Performance, Fuel Injection Systems. Axial Flow Turbines & Combustion Chamber- Classification, Elementary Theory, Vortex Theory, Limiting Factors in Turbine Design, Overall Turbine Performance, Design Performance of Gas Turbine Plant, Matching of Turbine Components.

Unit – III Centrifugal Compressors- Prewhirling, Adiabatic Efficiency, Performance Characteristics, Pressure Coefficient and Slip Factor, Losses, Surging, Compressor Design Calculations, Mach Number.

Unit – IV Axial Flow Compressors- Principles of Operation, Simple Design Method, Blade Design, Calculation of Stage, Overall Performance, Compressor Characteristics, Mach Number, Reynolds Number.

Unit – V Jet Propulsion- Turbo Jet, Turbo Prop, Ram Jet, Rocket Engines Thrust Power, Propulsive Efficiency and Thermal Efficiency, Jet Propulsion Performance, Specifying Thrust and Specific Fuel Consumption in each case For Turbo Jet and Turbo Propulsion Units.

References:

- Gas Turbine Theory, Sarvanamatto, Cohen H, Rogers, Longmans Green.
- Turbines, Compressors and Fans, S M Yahya, Tata McGraw Hill book Co., New Delhi.
- Steam and Gas Turbines, R Yadav.

Computational Fluid Flow And Heat Transfer

MEE 4234 **3-0-0=3**

Unit I: Introduction - Mathematical Description of Fluid Flow and Heat Transfer; Conservation Equations for Mass, Momentum, Energy and Chemical Species, Finite Difference Method, Finite Volume Method, Finite Element Method, Governing Equations and Boundary Conditions, Derivation of Finite Difference Equations.

Unit II: Solution Methods of Elliptical Equations – Finite Difference Formulations, Interactive Solution Methods, Direct Method With Gaussian Elimination.Parabolic Equations-Explicit Schemes and Von Neumann Stability Analysis, Implicit Schemes, Alternating Direction Implicit Schemes, Approximate Factorization, Fractional Step Methods, Direct Method with Tridiagonal Matrix Algorithm.

Unit III: Hyperbolic Equations - Explicit Schemes and Von Neumann Stability Analysis, Implicit Schemes, Multi Step Methods, Nonlinear Problems, Second Order One-Dimensional Wave Equations.Burgers Equations - Explicit and Implicit Schemes, Runge-Kutta Method. Formulations of Incompressible Viscous Flows - Formulations of Incompressible Viscous Flows by Finite Difference Methods, Pressure Correction Methods, Vortex Methods.

Unit IV: Treatment of Compressible Flows - Potential Equation, Euler Equations, Navier-Stokes System of Equations, Flow Field-Dependent Variation Methods, Boundary Conditions, Example Problems.
Finite Volume Method - Finite Volume Method Via Finite Difference Method, Formulations For Two and Three-Dimensional Problems.
Unit V: Standard Variational Methods - Linear Fluid Flow Problems, Steady State Problems, Transient Problems.

Recommended Books:

1. Chung, T. J. - Computational Fluid Dynamics, Cambridge University Press.
2. Frank Chorlton - Text Book of Fluid Dynamics, CBS Publishers, New Delhi.
3. Patankar, S. V. - Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation.
4. Anderson, D. A., Tannehill J. C. and Pletcher, R. H. - Computational Fluid Mechanics and Heat Transfer, Hemisphere Publishing Corporation.
5. H. K. Versteeg and W. Malalasekara, An Introduction to Computational Fluid Dynamics, Longman Publishers.

Design For Manufacturing And Assembly

EMEE 4025 **3-0-0=3**

Unit I: Effect of Materials & Manufacturing Processes on Design - Major Phases in Design & Manufacture, Effect of Material Properties on Design, Effect of Manufacturing Process on Design, Material Selection Process, Cost Per Unit Property & Weighed Properties Methods.

Unit II: Tolerancing - Tolerance Specification & Representation of Various Tolerances, their Significance in Assembly, Material Tolerances for Assembly Line -True Position Tolerancing, Cumulative Effect of Tolerances in Assembly, Interchangeability and Selective Assembly in Manufacturing, Process Capability & Its Significance with Ref. to Tolerancing, Achieving Larger Machining Tolerances.
Datum Features - Functional Datum, Datum for Manufacturing, Changing the Datum, etc.

Unit III: Design Considerations - Design of Components with Casting Considerations, Pattern, Mould, and Parting Line, Cored Holes and Machine Holes, Identifying the Possible and Probable Parting Line, Castings Requiring Special Sand Cores, Designing of Obviate Sand Cores.
Component Design - Component Design with Machining Considerations(Design for Turning Components-Milling, Drilling and other Related Processes Including Finish-Machining Operations).

Unit IV: Design of Gauges - Design of Gauges for Checking Components In Assembly with emphasis on Various Types of Limit Gauges For Both Hole and Shaft.

Unit V: Case Studies - Related to Above Topics and (I) Redesign to Suit Manufacture of Typical Assemblies (II) Tolerance Design of a Typical Assembly (III) Design to Minimize Cost of A Product (IV) Computer Aided DFMA

Recommended Books:

1. Harry Peck, Design for Manufacture, Pitman Publications.
2. Boothroyd, G., Dewhurst, P. and Knight, W. - Product Design for Manufacture and Assembly, Mercel Dekker, New York.
3. Dieter -Machine Design, McGraw Hill, New York.
4. Groover. M. P. - Automation, Production Systems and computer Integrated Manufacturing, Pearson Education Asia, New Delhi.
5. Zeid, I. - CAD/CAM - Theory and Practice, Tata McGraw Hill, New Delhi.

Environmental Science And Engineering

EMEE 4034 **3-0-0=3**

Unit I: Components of Environment- Water, Air and Land, Inter-Relationship between Components, Subcomponents, Ecosystem Structure and Functional Components of Ecosystem, Development and Evolution of Ecosystem, Energy Flow and Material Cycling in an Ecosystem, Natural and Man Made Impact on Water, Air and Land, Environment and Development, Concept of Sustainable Development.

Unit II: Chemistry, Physics and Biology of Water, Air and Land; Stress on Chemistry, Physics and Biology of Water, Air and Land Owing to The Impact, Environmental Quality Objectives and Goals, Policies on Development Projects and Their Impacts.

Unit III: Current Environmental Issues at Country Level - Management of Municipal Sewage, Municipal Solid Waste, Hazardous Waste and Bio-Medical Waste, Air Pollution Due to Industries and Vehicles, Global Issues - Biodiversity, Climatic Change, Ozone Layer Depletion.

Unit IV: Minimization of Stress - Principles of Physics, Chemistry and Biology in Engineering Interventions such as Waste Treatment, Flow Sheets of Engineering Interventions Relevant to Engineering Discipline of the Student, Waste Minimization Techniques, Clean Technology Options, Standards of Performance of Interventions.

Unit V: Environmental Impact Assessment; Precautionary Principle and Polluter-Pays Principle, Constitutional Provisions, Legal and Economic Instruments in Environmental Management; Role of Non-Government Organizations, Community Participation Environmental Management Works, International Conventions and Protocols, Pollution Control Boards and Pollution Control Acts.

Recommended Books:

1. Masters, G. M. - Introduction to Environmental Engineering & Science, Prentice Hall of India, New Delhi.
2. Henry, J.G. and Heike, G.W.- Environmental Science s& Engineering, Prentice Hall, New Jersey
3. Dhameja S K, Environmental Engineering & Management, Kataria & Sons
4. State of India's Environment- A Citizen's report, Center for Science and Environment and others
5. Shyam Divan and Armin Rosancranz- Environmental Law and Policy in India, Oxford University Press

Maintenance Engineering

MEE 4141 **3-0-0=3**

Unit-I : Introduction

Fundamentals of Maintenance Engineering, Maintenance Engineering, Its Importance in Material & Energy Conservation, Inventory Control, Productivity, Safety, Pollution Control, etc. Safety Regulations, Pollution Problems, Human Reliability, Total Quality Management (TQM), Total Productivity Maintenance (TPM), Environmental Issues in Maintenance, ISO 9000.

Unit-II Maintenance Management

Types of Maintenance Strategies, Planned and Unplanned Maintenance, Breakdown, Preventive & Predictive Maintenance, Comparison, Advantages & Disadvantages, Computer Aided Maintenance, Maintenance Scheduling, Spare Part Management, Inventory Control, Organization of Maintenance Department.

Unit-III Tribology In Maintenance

Friction Wear and Lubrication, Friction & Wear Mechanisms, Prevention of Wear, Types of Lubrication Mechanisms, Lubrication Processes. Lubricants- Types, General and Special Purpose, Additives, Testing of Lubricants, Degradation of Lubricants, Seal & Packing.

Unit-IV Machine Health Monitoring

Condition Based Maintenance, Signature Analysis, Oil Analysis, Vibration, Noise and Thermal Signatures, OnLine & Off Line Techniques, Instrumentation & Equipment Used in Machine Health Monitoring,Instrumentation In Maintenance, Signal Processing, Data Acquisition and Analysis, Application of Intelligent Systems, Data Base Design.

Unit-V Reliability, Availability & Maintainability (RAM) Analysis

Introduction to RAM Failure Mechanism, Failure Data Analysis, Failure Distribution, Reliability of Repairable and Non-Repairable Systems, Improvement in Reliability, Reliability Testing, Reliability Prediction, Utilization Factor, System Reliability by Monte Carlo Simulation Technique.

References :

1 Gopal Krishnan and Banerji, Maintenance & Spare parts Management,

2 Mishra and Pathak, Maintenance Engineering and

Management, PHI
3 S.K. Shrivastava, Industrial Maintenance Management.
4 CNR Rao, Handbook of Condition Monitoring,.
5 Higgins, Maintenance Engineering Hand Book.

Mechanical System Design

MEE 4026 **3-0-0=3**

Unit-I : Introduction to Mechanical Systematic Design Approach, Need, Need Analysis. Conceptual Design,Phases of a Design Process at Conceptual Design Stage. Problem Identification in a Design Approach,Concept Hunt, etc.

Unit–II Functional Tree, Function Structure, Physical Reliability, Economical and Social Criteria, Possible Solutions, Concept of Embodiment Design , Preliminary Design Layouts, Selecting Best Preliminary Layouts, Design Optimization.

Unit-III Design Modeling, Reliability, Maintainability, Safety, Meterial Selection, Value Engineering, Experimental Design, Design and Patent. Detailed Design, Final Design, Complete Detail Drawing Check All Documents, Documentation Solution, etc.

Unit-IV Role of Artificial Intelligence in Mechanical Engineering: Introduction to Artificial Intelligence, Computer Programming and Development of Algorithms, Programming of Various Algorithms, Expert Systems, Expert System Packages,Concept of Knowledge Base, Artificial Neutral Network (ANN) and Varoius Optimization Techniques, Solution of Mechanical Design Problems using Artificial Intelligence Techniques to Shafts, Bearings, Gears, Clutches, Brakes, Hydraulic System. Pneumatic System, etc.

References :

1. Pahl, G. and Beitz, W- Engineering Design, Springer Verlag, London, 1984.
2. Shigley,J.E. and Mischke - Mechanical Engineering Design, McGraw Hill, New York.
3. Motts, R.L – Machine Elements in Mechanical Design, 3RD Ed., McMillan Publishing House.
4. Ullman, D.G. - The Mechanical Design Process, Mc-Graw Hill, International Edition, Singapore, 1997.
5. Some **Research Papers** relevant to the Subject area may also be referred.

Injection Moulding And Mould Design

MEE 4142 **3-0-0=3**

Unit I: Introduction to Moulding Process - Injection Moulding Process, Compression/Transfer Moulding Process, Blow/Rotational Moulding Process, Thermoforming Process, Examples of Products.

Unit II: Moulding Machines - Injection and Compression Moulding Machines- Classification, Specifications, Parts and Their Functions, Hand Machines.

Unit III: Injection Moulds - Main Parts and Their Function, Feeding Systems, Runners, Gates, Parting Line, Ejection Systems, Ejector Return Mechanism, Under Cuts, Sliders, Spmlit Moulds, Multicavity Moulds, Moulds for Threaded Components, Draft Angle Placement of Cavities, Three Plate Moulds, Mould Cooling, Location and Guide System, Shrinkage Allowances, Clamping Force, Mould Ventilation, Moulding Defects, Moulding Cycle.

Unit IV: Compression/Transfer Moulds - Main Parts of Compression Moulds and Their Function, Ejection System, Ejector Return, Mould Heating, Moulding Pressure, Tool Location. Hand Mould, Multicavity Mould, Semi Positive Mould, Flash Mould, Encapsulation, Work Cycle, Draft Angle, Transfer Moulds. Main Parts and Their Functions, Runners and Gates, Location of Gate Ventilation, Moulding Materials, Powder, Pre-Heating.

Unit V: Material for Mould Parts - Materials Used for Various Mould Parts, Their Treatment Like Hardening, Tempering, Electroplating.
Mould Maintenance - Maintenance, Storage and Safety of Moulds, Transportation/Handling.
Making Drawings of Relevant Topics Learned, Design & Drawing of Multicavity, Mould for Simple Components, Injection & Compression.

Recommended Books:

1. Glanvill, A. B. and Denton, E. N. - Injection Mould Design Fundamentals, Industrial Press Inc.
2. Athalye, A. S. - Plastic Material Handbook, Vol. I & II, Multitech Publishers Co., Mumbai.
3. Athalye, A. S. - Injection Moulding, Multitech Publishers Co., Mumbai.
4. Chandra & Mishra - Rubber & Plastic Technology, CBS Publishers, New Delhi.
5. Harry, D. B. and Waynel, P. - Plastics Mould Engineering Handbook, Van Nostrand Rehnhold Company.

Product Design And Development

MEE 4027 **3-0-0=3**

Unit-I: Product Design – Traditional and Modern Design Processes, Innovation, Creation and Diffusion Techniques, and Functional, Technological, Ecological, Ligiale Evaluation of New Product Ideas.
Unit-II: Product Modeling and Reverse Engineering-Wireframe, Surface, and Solid Modeling Techniques, Reverse Engineering

Unit- III: Product Data Exchange-Neutral File Format such as DXF, IGES, STEP, Concurrent Engineering-Concept Design for X, DFM, DFA, DFR, DFQ
Unit-IV: Rapid Protyping Methods-Liquid Based RP Methods such as SLA, SGC, And SCS, Solid Based RP Methods Such As FDM, And LOM, Powder Based RP Methods such as SLS, 3DP, And BPM

References Books
1. Product Design & Manufacturing - A.K.Chitab &R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P.Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce &Co., New York
4 Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.

Tool Design

MEE 4035 **3-0-0=3**

Unit I: Principles of Jigs and Fixtures Design, Locating Principles, Locating Elements, Standard Parts, Clamping Devices, Mechanical Actuation, Pneumatic & Hydraulic Actuation, Analysis Of Clamping Forces, Tolerance and Error Analysis.

Unit II: Design of Jigs - Drill Bushes, Different Types of Jigs, Plate Latch, Channel, Box, Post, Angle Plate, Angular Post, Turnover, Pot Jigs, Automatic Drill Jigs, Rack & Pinion Operated, Air Operated Jigs Components.

Unit III: Design of Fixtures - General Principles of Boring, Lathe, Milling and Broaching Fixtures, Grinding, Planing and Shaping Fixtures, Assembly, Inspection and Welding Fixtures, Modular Fixtures, Design and Development of Jigs and Fixtures for Given Components.

Unit IV: Design of Press Tools - Press Working Terminology, Presses and Press Accessories, Computation of Capacities and Tonnage Requirements, Strip Layout, Design and Development of Various Types of Cutting, Forming and Drawing Dies, Blank Development for Cylindrical and Non Cylindrical Shells, Compound, Progressive, and Combination Dies.

Unit V: Submission of an Industrial Report: On Training In Jigs, Fixture and Press Tools.

Recommended Books:
1. ASTME - Handbook of Fixture Design, McGraw Hill, New York.
2. ASTME - Fundamentals of Tool Design, McGraw Hill, New York.
3. Sharma, P. C. - A Textbook of Production Engineering, S. Chand Publishers, New Delhi.
4. Goroshkin, A. K. - Jigs and Fixtures Handbook, MIR Publishers, Moscow.
5. Die Design Handbook, McGraw Hill, New York.
6. Rao, J. S. and Gupta, K. – Theory and Practice of Mechanical Vibrations, Tata McGraw Hill, New Delhi.

Total Quality Management

MEE 4143 **3-0- 0=3**

Unit I: Evolution of Philosophy of Quality Management: Attributes of Quality, Various Approaches of Quality Definitions, Contributions of Deming, Juran, Taguchi, Crosby, Ishikawa, Shewhart, And Feigenbaum In Quality Revolution.

Unit II: Total Quality Management: Concept of TQM, Salient Feature of TQC And TQM, Quality Assurance, 7-Basic Tools of Quality Control, and Concept Of Six-Sigma.

Unit III: Customer Focus: Customer Satisfaction, Total Employee Involvement, Employee Empowerment, Education and Training, Quality Circle and Processes of Brainstorming.

Unit IV
Just-In-Time (JIT), Zero Defect, Waste Management, MRP (Material Requirement Planning), MRP Vs JIT, Kanban Systems.

Unit V
Concept Of Quality Standards, Benchmarking, Origin and Clauses of ISO 9000, International Quality Awards, Quality Awards In India.

References
1. The Management and Control of Quality, J R Evans and W M Lindsay, Thomson south western.
2. Total Quality Management: A cross functional perspective, Ashok Rao, john Wiley & Sons.
3. Total Quality Management, Besterfield, et al, PHI.

Control Systems

EMEE 3033 **3-0-0=3**

Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems

Mathematical Models of Physical Systems: Linear and non-linear systems, Transfer function, Mathematical modeling of electrical, Mechanical, Thermal, Hydraulic and pneumatic systems, Analogies, Block diagrams and signal flow graphs.

Components: AC and DC servomotors and tachogenerators, Potentiometers, Synchros, Stepper motors.

Analysis: Time and frequency domain analysis, Transient and frequency response of first and second order systems, Correlationship between time and frequency domain specifications, Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins, M and N circles, Nichols charts

Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.

Components: D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors, Introduction to PLCs, their hardware and ladder diagram programme.

State Space Analysis: Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

Energy Management

MEE 4235 **3- 0- 0=3**

Unit 1:- Importance of energy management. Energy auditing :(methodology, analysis of past trends plant data),laws of thermodynamics, measurements, portable and on line measurements.
Unit 2:- Energy economics – Discount rate, pay back period, internal rate of return, life cycle costing.Steam systems:Boiler – efficiency testing, steam distribution and use steam traps, condensate recovery, flash steam utilisation.Thermal insulation.
Unit 3:- Electrical systems: Demand control, power factor correction, Motor drives- motor efficiency testing, energy efficient motors, motor speed control.Varaible speed drives. Lighting-lighting levels, fixtures, daylighting, timers, energy efficient windows.
Unit 4:- Energy conservation in pumps, Fans (flow control), compressed air systems, Refrigeration and air conditioning systems.Waste heat recovery: recuprators, heat wheels, heat pipes, heta pumps.
Unit 5:- Cogeneration – concept, options (steam/ gas turbines/diesel engine based), selection criteria, control strategy.

Texts/Recommended Books:

1. Hand book on Energy Audit and Management, Amit kumar Tyagi, TERI Press.
2. L.C.Witte, P.S.Schimdt, D.R.Brown, Industrial Energy Management and Utilisation, Hemisphere Publ,Washington, 1988.
3. Practical hand book on Energy Conservation in Buildings, Indian Building Congress, Nabhi Publication.
4. The Efficient use of Energy, Ed: I.G.C.Dryden, Butterworths, London, 1982.
5. Energy Management Handbook, Ed: WQ.C.Turner, Wiley, New York, 1982.

M. Tech.(Manufacturing And Automation)

Objective of the Programme

Manufacturing is the core area in the development of the country and Automation helps in reducing the cost of manufacturing and increase the level of quality of the products.

Thus Management and Automation are major components in faster and systematic growth and overall development. They also help in creating global competition and make the industry efficient and competitive. To achieve this we require well trained and highly educated professional engineers. With this objective in mind the School of Mechanical Engineering of SMVDU is offering a 2 years full time Post-graduate program leading to Master of Technology Degree in Manufacturing and Automation.

The programme will focus on latest subjects and recent developments in areas like Welding, Metal Forming, Machining, CAD/CAM, FMS, Robotics, Mechatronics, Metrology and Industrial Inspection.

The School is well equipped with following Labs for the above courses:

1. CAD/CAM Lab
2. Metrology & Industrial Inspection Lab
3. Mechatronics Lab
4. Non-conventional Machining Lab (EDM)
5. Production Engineering Lab
6. CIMS Lab (Under Establishment)

Course Structure of
M. Tech. (Manufacturing And Automation)

First Year **First Semester**

Course Code	Course Title	L-T-P	Credits
MEL 6123	Foundry Technology	3-0-0	3
MEL 6028	Optimization Techniques	3-0-0	3
MEL 6124	Metal Forming Technology	3-0-0	3
MEL 6125	Metrology & Industrial Inspections	3-0-0	3
MEL 6021	CAD / CAM	3-0-0	3
MEP 6125	Metrology Lab	0-0-4	2
MEP 6021	CAD / CAM Lab	0-0-4	2
	Total	**15-0-8**	**19**

First Year **Second Semester**

Course Code	Course Title	L-T-P	Credits
MEL 6122	Computer Integrated Manufacturing Systems	3-0-0	3
MEL 6032	Industrial Automation	3-0-0	3
MEL 6027	Product Design and Development	3-0-0	3
MEL 6126	Advanced Machining Processes	3-0-0	3
	Elective –I	3-0-0	3
MEP 6122	CIM Lab	0-0-4	2
MEP 6027	Production Engineering Lab	0-0-4	2
	Total	**15-0-8**	**19**

Second Year **Third Semester**

Course Code	Course Title	L-T-P	Credits
MEL 7029	Simulation & Modelling	3-0-0	3
MEL 7036	Mechatronics	3-0-0	3
	Elective-II	3-0-0	3
	Elective-III	3-0-0	3
MEP 7036	Mechatronics Lab	0-0-4	2
MEV 7914	Contemporary Lecture	3-0-0	3
MED 7911	Minor Project	0-6-0	6
	Total	**15-6-4**	**23**

Second Year **Fourth Semester**

Course Code	Course Title	L-T-P	Credits
MEC 7913	Student Seminar	0-3-0	3
MED 7912	Major Project	0-18-0	18
	Total	**21**	**21**

Grand Total Credits: 82

List Of Electives

Elective I

1. MEE 6037 Computer Aided Process Planning
2. MEE 6144 Supply Chain Management
3. MEE 6143 Total Quality Management

Elective II

1. MEE 7133 Operational Research
2. MEE 7141 Maintenance Engineering
3. MEE 7033 Control Systems

Elective III

1. MEE 7135 Methods Engineering and Ergonomics
2. MEE 7127 Welding & Allied Processes
3. MEE 7038 Industrial Robotics

M.Tech. degree will be awarded on the basis of **82** earned credits. Successful completion of dissertation is essential for award of degree.

Foundry Technology

MEL 6123 **3-0-0=3**

Unit I: Design for casting: Design Consideration for Casting, Design of Pattern Riser, Gate, Design of Mould and Core Boxes, Sand Testing, Solidification of metal, Solidification Time, Directional Solidification, Automation in Foundries

Unit II: Special Casting Methods: Principle, Procedure, Advantages and Limitations of various processes: Investment Casting, Continuous Casting, Centrifuged Casting, Gravity and Pressure Die Casting, Vacuum Casting, Slush Casting

Unit III: Melting of Metals Cast Iron: Casting of Steel, CI, Aluminum, Magnesium and Copper and their Alloys, Selection, Construction and Operation of Cupola, Crucibles & Electrical Furnaces

Unit IV: Plastics: Classification and Properties of Plastics, Principle, Selection Operation, Advantages and Limitations of various Moulding Processes, Design Considerations for plastic moulded parts

Unit V: Inspection and Defects: Fettling and Finishing of Casting, Inspection and testing of Casting by Destructive and Non-Destructive Techniques, Types of defects- Causes and remedies

Recommended Books:

1. Manufacturing Technology – P.N.Rao, Tata McGraw Hill Pub. Company Ltd. New Delhi.
2. Principles of Metal Casting – Rosenthal.
3. Manufacturing Engineering and Technology – Kalpakjian, Pearson Education.
4. Principles of Manufacturing Materials and Processes – J.S.Cambell, Tata McGraw Hill New Delhi.
5. Manufacturing Process and System – Phillip F. Oswald & Jain Munoz.

Optimization Techniques

MEL 6028 **3-0-0=3**

Unit I: Intoduction to Optimization Techniques, Linear Programming, Dynamic Programming.
Unit II: Design of Experiments, Analysis of Results, Response Surface Design and Analysis, Response Surface Design and Analysis , Response Surface Optimization, Numerical Optimization, Graphical Optimization, Mixture Designand Analysis,Mixture Optimization ,Crossed Mixture – Process, Advanced Design Features.
Unit III: Statistical Details: Design Selection, Factorial Design Selection, Response Surface Design Selection, Mixture Design Selection, Crossed Design Options, Design Editing, Power Calculations. Case Studies Using Design Expert, Minitab and MATLAB.

Recommended Books:

1. Design and analysis of experiments, By Douglas C Montgomery, *John. Wiley,*
2. Optimal Design of Experiments, By, Pukelsheim, F., *John. Wiley*

Metal Forming Technology

MEL 6124 **3-0-0=3**

Unit I: Stress-Strain Relations in Plastic Deformations, Yield Criteria for Ductile Material, Work Hardening and Anisotropy in Yielding, Technology and Analysis of Various Metal Forming Processes.

Unit II: Theory of Plasticity: Formulation of Plastic Deformation Problems, Application of Theory of Plasticity for Solving Metal Forming Problems Using Slab Method, Upper and Lower Bound Methods, Slip Line Field Theory, Extremum Principle.
Unit III: Design of Roll Pass and Rolling Schedules, Description of Typical Cold Rolling Mill Plants, Die Design For Forging, Extrusion, and Wire Drawing.

Unit IV: Automation in Metal Forming Processes, Recent Development in Forming Equipments, Technological Advances in Sheet Metal Forming, Forging, Rolling, Extrusion, and Wiredrawing.
Unit V: Unconventional Metal Forming: Hydrostatic Extrusion, High-Energy Rate Forming, Hydroforming of Sheet and Tubes, Explosive Forming, High Velocity Forming.

Recommended Books:

1. Metal Forming Technology, B L Juneja, New Age International (Pvt), New Delhi
2. Metal Forming Technology, Sadhu Singh, Khanna Publication, Delhi.
3. Machining Science, Ghosh & Malik, Affiliated East West Press

Metrology And Industrial Inspection

MEL 6125 **3-0-0=3**

Unit I: Limits, Tolerance & Gauges - Types of Measurement, Errors in Measurements, Limits, Tolerance-Dimensional & Geometrical, Allowance, Types of Fites, Hole and Shaft Basis Measurements, Gauges, Different Types of Limit Gauges, Snap Gauges, Taper Gauges, Ring Gauges. Methods & Measuring Equipments for Testing of Limit Gauges.

Unit II: Linear, Angular And Circular Measurements-Gauges for the Linear Measurements, Determination of Taper of Ring Gauge By Precision Balls and Rollers, Sign Bar, Clinometers, AutoCollimators, Roundness Measurement of Shaft by Dial Indicator Method, Optical Dividing Head.

Unit III: Thread And Gear Measurement-Measurement of Major and Minor Diameter of External and Internal Threads, Pitch Measurement, Angle and Forms of Thread Measurement, Screw Head Gauges-Plug and Ring Gauge, Thread Caliper Gauge.
Measurements of Forms and Pitch of Gear Teeth by Parson's Gear Rolling Tester, Tooth Thickness Measurements- Constant Chord Method and Basic Tangent Method; Testing of Involutes and Cycloidal Form of Gear Teeth, Depth Measurement.

Unit IV: Measurement Of Surface Texture- Waviness, Straightness and Roughness Measurement- Ra, RMS, Rz, CLA Value; Flatness Measurement, Use of Optical Flats, Surface Plates, Straight Edge, Comparators-Optical, Mechanical, Pneumatic and Electronic.

Unit V: Industrial Inspection- Visual Inspection, Online and Offline Inspection, Inspection by Variables and by Attributes, Automatic Gauging, Coordinate Measuring Machine, Non Contact Inspection Methods, Post Process Metrology, Computer Aided Inspection Using Robot. Industrial Inspection Instruments and Their Calibrations.

Recommended Books:

1. Mechanical and Industrial Measurement, R. K. Jain, Khanna Publishers.
2. Measurement Systems- Application and Design, Deobelin, E.O, Mc Graw Hill, NewYork.
3. Handbook of Dimensional Measurement, Industrial Press, New York
4. Engineering Metrology, R. K. Jain, Khanna Publishers.

CAD/CAM

MEL 6021 **3-0-0=3**

Unit I :Introduction - CAD/CAM Hardware, Software, Image on Screen, Scan Conversion, Graphic Mode, Graphic Function, Pixel, Drawings, Line , Curve (Circle, Ellipse, Arc), Filling of Objects; With C++ Programming, Features of GKS, Other Graphics Standards, PHIGS, IGES, PDES.

Unit II : Geometric Transformation 2D-3D - Two Dimensional Transformation, Matrix Representation, Representation of Transformations, In Uniform & Composite Transformation, Mirror Image, Shearing, Homogeneous Matrix, Three Dimensional Representation of Matrix, Translation, Scaling, Rotation, Mirror, Shearing , Composite Matrix.

Unit III: Geometry Modeling - Types & Mathematical Representation of Curves, Wire Frame Models, Entities, Representations, Parametric Representations, Review of Vector Algebra, Lines, Circle, Ellipse, Parabolas, Parametric Representation of Synthetic Curves, Cubic Curves, β - Spline, Bezier Spline, Sweep Curves, Surfaces & Solids – Model, Entities, Representations, Fundamentals of Solid Modeling, β-Rep, Constructive Solid Geometry (CSG), Analytical Modeling, Sweep.

Unit IV: NC/CNC - Introduction, Components, NC Procedure, Coordinate and Motion Control, Manual Programming, Programming Formats, Tool Offset, Coding And Format, Voice NC Programming, APT Language. Introduction to CNC, DNC, Adaptive Control, Mapping Systems.CNC Hardware Basics.

Unit V: Part Programming In CNC -Axis Movements and Interpolation with other Axis. Application of Rotary Axis. Manual Programming-Offline. Programming Formats, Tool Offsets, Type of Compensations And Cutting Parameters. G-Codes And M-Codes, Part Programming of Components on CNC Lathe & Milling Machines, CAPP.

Recommended Books:

1. CAD/CAM Theory & Practice-Ibrahim Zeid , Tata Mc Graw Hill
2. CAD/CAM, P. N. Rao, Tata Mc Graw Hill.
3. Computer Aided Design, Dr. S.S. Khandare, Charotar publishing house

Metrology Lab

MEP 6125 **0-0-4=2**

1. Measurement of Angle using SineBar and Slip Gauges
2. Measurement of Angles by Auto Collimeters
3. Roundness measurement of Shaft by Dial Indicator Method
4. Measurements by using Coordinate Measuring Machine.
5. Prepartion of specimen of different materials for Microscopic Examination
6. Study of microstructures of different materials by Metallurgical Microscope
7. Measurement of Surface Roughness
8. Measurement of Cutting Force by Piezoelectric Dynamometer
9. Measurement of Vibrations.
10. Speed measurement using Stroboscope
11. Study of OnLine Inspection Systems
12. Study of OffLine Inspection Systems

CAD /CAM LAB

MEP 6021 **0- 0-4=2**

A. CAD Experiments-

1. Line drawing or Circle drawing algorithm experiment: writing the program and running it on computer.
2. Transformations algorithm experiment for translation/rotation/scaling: writing program and running it on computer.
3. Design problem experiment: writing the program for design of machine element or other system and running it on computer.
4. Optimisation problem experiment: writing a program for optimising a function and runing it on computer.
5. Auto CAD experiment: understanding and use of AutoCAD commands.
6. Writing a small program for FEM for 2 spring system and running it. Or using a FEM package.
7. Use of Graphic software standards packages e.g. GKS/PHICS/GL etc.
8. Use of pro-Engineer/Ideas etc.

B. CAM Experiments-

1. Writing a part-programming (in word address format or in APT) for a job for drilling operation (point-to-point) and running on NC machine.
2. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and running on NC machine
3. Experiment on Robots and it programs
4. Experiment on Transfer line/Material handling.
5. Experiment on difference between ordinary machine and NC machine, study or retrofitting.
6. Experiment on study of system devices such as motors and feed back devices.

Experiment on Mechatronics & controls.

Computer Integrated Manufacturing Systems

MEL 6122 **3-0-0=3**

Unit I:

Computer Integrated Manufacturing System

Definition, CIM Wheel Concept, Evolution of CIM and System View of Manufacturing, CIM , IT & Concurrent Engineering, Elements of CIM System, CIM Hardware and Software.

Unit II:

Wire Frame, Surface and Solid Modelling - Solid Modeling Packages - Finite Element Analysis (FEA) - Introduction and Procedures - Solution Techniques - Introduction to Software Packages.

Unit III:

Manufacturing Planning and Control – CAD/CAM Integration - Principles of Computer Integrated Manufacturing - Hierarchical Network of Computers - Local Area Network –Process Planning: Computer Aided Process Planning - Retrieval and Generative Approaches.

Unit IV:

CNC Machine Tool and Programming

Development of CNC Technology, Principles, Features of NC, CNC and DNC System, Classification of CNC Machine Tools, CNC Controller, CNC Programming for Various Controllers, Fanuc Program, G&M Codes, Part Programming of Prismatic and Revolved Components, APT Part Programming Using CAD, CAM S/W.

Recommended Books:

I. Groover, Production System & CIM: PHI
2. Zeid, CAD/CAM Theory & Practice: Mc Graw Hills

Industrial Automation

MEL 6032 **3-0-0=3**

Unit I Fluid Power

Hydraulic and Pneumatic Power: Advantages, Disadvantages and Applications, Desirable Properties and Types of Power Transmitting Fluids. Pumps, Compressors, Hydraulic & Air Motors, Linear & Rotational Actuators, Accumulators and Pressure Intensifiers, Flow Direction, Non-Return and Pressure Control Valves, Filters, Piping, Servo and Cartridge Valves, Hydraulic Fuses, Pressure and Temperature Switches – Characteristics and Symbols of the Components, Hydraulic, Pneumatic, Hydro-Pneumatic, Electro-Hydraulic and Electro-Pneumatic Circuits and Servomechanisms.

Unit II Transfer Devices and Feeder

Vibratory & Non Vibratory Feeding And Orienting Devices, Classification and Constructional Details and Application of Transfer Devices and Feeders, Parts Transfer, Parts Design for Automated Assembly.

Unit III Industrial Switching Element

Electronic Logic Gates, Relays, Plds, I/O Module, Timers, Pulse Shapers, Trigger Flip Flops, Binary Counters, Shift Registers, Schmitt Triggers, Integration of Mechanical Systems with Electrical, Electronics and Computer System

Unit IV Microprocessor *and* Micro Controller

8085 Microprocessor Architecture And Its Operation-Memory-Input, OutPut Devices, Microprocessor Systems, Application in Temperature Control & Traffic Control. Micro Controller Intel-8051, Basic Features, Application in Domestic Washing Machine.

Unit V Programmable Logic Controller

Introduction, Basic Structure, Input/Output Processing, PLC Operating Cycle, Additional Capabilities, Selection of PLC, Nomenclature, Programming, Mnemonics, Timers, Internal Relays and Counters, Data Handling, Analog Input/Output, Shift Registers, Master and Jump Controls.

Recommended Books:

1. Fluid power , Anthony Esposito, Prentice Hall.
2. Hydraulics & Pneumatics, Andrew parr, Jaico publications .
3. Oil Hydraulics: Principles & Maintenance, Majumdar S.R..
4. Pneumatic and Hydraulic system, W. Boltan B. H Butterworth, Heinemam
5. Pneumatic systems : Principles and maintenance, Majumdar S.R., Mc
6. Industrial Automation Circuit Design and Components, David W. Pessan
7. Microprocessor Architecture Programming & Applications with 8085, Ramesh S. Goankar, Third Edition, Tenram International Publications

Product Design And Development

MEL 6027 **3-0- 0=3**

Unit-I: Product Design – Traditional and Modern Design Processes, Innovation, Creation and Diffusion Techniques, and Functional, Technological, Ecological, Ligiale Evaluation of New Product Ideas.

Unit-II: Product Modeling and Reverse Engineering-Wireframe, Surface, and Solid Modeling Techniques, Reverse Engineering

Unit- III: Product Data Exchange-Neutral File Format such as DXF, IGES, STEP, Concurrent Engineering-Concept Design For X, DFM, DFA, DFR, DFQ

Unit-IV: Rapid Protyping Methods-Liquid Based RP Methods Such As SLA, SGC, and SCS, Solid Based RP Methods such as FDM, And LOM, Powder Based RP Methods such as SLS, 3DP, And BPM

Recommended Books:

1. Product Design & Manufacturing - A.K.Chitab &R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P.Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce &Co., New York
4 Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.

Advanced Machining Processes

MEL 6126 **3-0-0=3**

Unit I

Mechanical Processes**:** Ultrasonic Machining- Mechanics of USM, USM Unit and Feed Mechanism, Process Parameters. Abrasive Jet Machining- Mechanics of AJM, Variables in AJM, Process Details. Water Jet Machining-Jet Cutting Equipments, Process Details, Advantages, Disadvantages and Applications of USM, AJM, WJM.

Unit II

Electrochemical and Chemical Metal Removal Processes: Electrochemical Machining- Elements of ECM Process, Tool Work Gap, Chemistry of the Process, Design for Electrolyte Flow, Metal Removal Rate, Accuracy, Surface Finish and Other Work Material Characteristics, Advantages, Applications, Limitations. Electrochemical Grinding - Material Removal, Surface Finish, Accuracy, Advantages, Applications.

Unit III

Thermal Metal Removal Processes: Electric Discharge Machining (EDM) or Spark Erosion Machining Processes, Mechanism of Metal Removal, Spark Erosion Generators, Electrode Feed Control, Dielectric Fluids, Flushing, Electrodes for Spark Erosion, Selection of Electrode Material, Surface Finish, Machining Accuracy, Applications.Wire Cut EDM. Laser Beam Machining (LBM)- Apparatus, Material Removal, Cutting Speed and Accuracy of Cut, Metallurgical Effects, Advantages and Limitations.

Unit IV

Plasma Arc Machining (PAM): Mechanism of Metal Removal, PAM Parameters, Equipments for D.C. Plasma Torch Unit, Safety Precautions, Other Applications of Plasma Jets. Electron Beam Machining (EBM) - Generation and Control of Electron Beam, Theory of Electron Beam Machining, Process Capabilities and Limitations.

Recommended Books:

1. Modern Machining Processes – P.C.Pandey, H.S.Shan, Tata McGraw Hill
2. Machining Science- Ghosh and Malik, Affiliated East-West Press
3. Non Traditional Manufacturing Processes- Benedict G.F, Marcel Dekker
4. Advanced Methods of Machining- Mc Geongh J.A, Chapman and Hall

CIM Lab

MEP 6122 **0- 0-4=2**

List Of Experiments

1. Programming And Manufacturing on CNC Lathe
2. Programming And Manufacturing on CNC Milling
3. Experiment on Automated Guided Vehicle.
4. Programming of Robot
5. Integration of Conveyors System of Robots and CNC Machines

Production Engineering Lab

MEP 6027 **0-0-4=2**

List Of Experiments

1. Shear-Angle determination (using formula) with tube cutting (for orthogonal) on Lathe Machine.
2. Bolt (thread) making on Lathe Machine
3. Tool Grinding (to provide tool angles) on Tool-Grinder Machine.
4. Gear cutting on Milling Machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Measurement of cutting forces on lathe, grinding, drilling and mlling
11. Experiments on:
    - EDM
    - USM
    - AJM
    - ECM and WJM

Simulation And Modelling

MEL 7029 **3- 0- 0=3**

Introduction to Modeling: Concept of System, Continious and Discrete System, Types of Models, Steps in Simulation Study; Statistical Models in Simulation: Discrete, Continuous, Poisson and Empirical Distributions, OutPut Data Analysis for a Single System, Comparing Alternative System Configuration Statistical Procedures for Comparing Real World Observations with Simulation OutPut Data, Generations of Arriving Processes, Verification and Validation of Simulation Models; MotnteCarlo Simulation and Its Applications in Queing Models and Inventory Models; Simulation of Manufacturing and Material Handling Systems; Case Studies on Simulation Packages.

Recommended Books:

1. Averill, M. Law - Simulation Modelling and Analysis, Mc-Graw Hill.
2. Banks, Jerry – Discrete Event System Simulation, Pearson Education.
3. G. Govdan – Simulation and Modeling - PHI

Mechatronics

MEL 7036 **3-0- 0=3**

Unit I Basic Electronics & Computation

Binary System, Boolean Algebra, Logic Gates, Digital Circuit Technologies, Rtl/Dtl/Dctl/Ttl/Mos/Cmos/Ecl, Analysis of Basic Circuits in these Families, Internal Architecture of Programmable Logic Devices, Combinational Design, Sequential Circuits, Flip-Flops, Counters, Shift Registers, Memory System - RAM ,ROM, EPROM. EEPROM, PAL, PLDS, PGAS. Hard Disk Drive Assembly, IC and their Characteristics.

Unit II. **Components of a Mechatronic System**

Sensors:-Electric Position Sensors, Pneumatic Position Sensors, Comparison Between Different Position Sensors, Level Switches, Pressure Switches, Temperature Switches. Actuators:-Hydraulic, Pneumatic and Electric Actuators. Controllers:- Micro Controller and Microprocessor, PLC Mechanical Component:- Kinematic Chains, Cams, Gears Trains, Ratchet and Pawl, Belt And Chain Drives, Bearings, Ball Screws.

Unit III Signal Conditioning & Data Presentation System

D-A and A-D Converters, Operational Amplifier; Protection, Filtering, Digital Signals, Multiplexers, Pulse Modulation, Data Acquisition, Digital Signal Processing; Pulse Modulation; Data Presentation Systems – Displays; Data Presentation Elements; Magnetic Recording; Data Acquisition Systems; Testing & Calibration, Interfacing D-A and A-D Converters.

Unit IV Mechatronics Product Design

Mechantronics Design Approach, Possible Mechatronics Design Solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, Pick & Place Robot, Automatic Camera, Engine Management System & Bar Code Recorder. Software and Hardware Principles and Tools to Build Mechatronics System.

Unit V Introduction to MEMS, NEMS and Nanotechnology. Introduction To Distribution Control System.

Recommended Books:

1. Mechatronics by W. Bolton, Published by Addition Wesley.
2. Mechatronics System Design – Devdas Shetty and Richard A. Kolx Brooks/ Cole 1997.
3. Introduction to Mechatronics and Measuring System : david G. Alciation and Michael B. Hist and Tata McGraw Hill

Mechtronics – Sensing to Implementation - C.R.Venkataraman, Sapna

Mechatronics Lab

MEP 7036 **0-0-4=2**

List of experiments

1. Application of PLC's, Motors (Stepper, Servo etc.),
2. Pneumatic Drives.
3. Hydraulic Drives to create systems that resemble current industrial systems and applications.

Computer Aided Process Planning

(ELECTIVE-I)

MEE 6037 **3- 0- 0=3**

Unit I Introduction: The Place of Process Planning in the Manufacturing, C Process Planning and Production Planning - Process Planning and Concurrent Engineering, CAPP, Group Technology.

Unit II Part Design Representation: Design Drafting - Dimensioning –Conventional Tolerancing - Geometric Tolerancing - CAD - Input/Output Devices – Topology - Geomctric Transformation - Perspective Transformation - Data Structure -Geometric Modelling for Process Planning - GT Coding - The Optiz System – The MICLASS System.

Unit III Process Engineering And Process Planning: Experienced, Based Planning - Decision Table and Decision Trees - Process Capability Analysis – Process Planning – Variant Process Planning - Generative Approach - Forward and Backward Planning, Input Format, Al.

Unit IV Computer Aided Process Planning Systems:
Logical Design of a Process Planning - Implementation Considerations –Manufacturing System Components, Production Volume, No. of Production Families - CAM-I, CAPP, MI-PLAN, APPAS, AUTOPLAN and PRO, CPPP.
Unit V An Intergarted Process Planning System: Totally Integrated Process Planning Systems - An Overview - Modulus Structure - Data Structure, Operation– Report Generation, Expert Process Planning.

Recommended Books:
1. Gideon Halevi and Roland D. Weill, "Principles of Process Planning", A logical approach, Chapman & Hall, 1995.
2. Tien-Chien Chang, Richard A. Wysk, "An Introduction to automated process planning systems ",Prentice Hall, 1985.
3. Chang, T.C., " An Expert Process Planning System ", Prentice Hall, 1985.
4. Rao, "Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2000.
5. Roy. A. Lindberg, "Processes and Material of Manufacture", Prentice Hall.

Supply Chain Managemant
(ELECTIVE-I)

MEE 6144 **3-0-0=3**

Unit I Introduction: Logistics - Concepts, Definitions. Approaches, Factors Affecting Logistics. Supply Chain - Basic Tasks of Supply Chain - The New Corporate Model.

Unit II Supply Chain Management: The New Paradigm, The Modular Company, The Network Relations. Supply Process, Procurement Process - Distribution Management.

Unit III Evolution of Supply Chain Models: Strategy And Structure - Factors of Supply Chain - Manufacturing Strategy Stages, Supply Chain Progress - Model For Competing Through Supply Chain Management - PLC Grid, Supply Chain Redesign - Linking Supply Chain With Customer.

Unit IV Supply Chain Activity Systems: Structuring The SC, SC and New Product, Functional Roles in SC, SC Design Frame-Work, Collaborative Product Commerce (CPC).

Unit V SCM Organisation and Information System: The Management Task, Logistics Organisation, The Logistics Information Systems -Topology Of SC Application -MRP, ERP, Warehouse Management System, Product Data Management - Cases.

Recommended Books:
1. Scharj, P.B., Lasen, TS., Managing the global supply chain , Viva books, New Delhi
2. Ayers, J:B., "Hand book of supply chain management ", The St. Lencie press, 2000.
3. Nicolas, J:N., "Competitive manufacturing management-continuous improvement ",Lean production, customer focused quality, McGraw-Hill,
4. Steudel, N and Desruelle, P., "Manufacturing in the ninetees-How to become a mean, lean and world class competitor ",

Total Quality Management
(ELECTIVE – I)

MEE 6143 **3-0-0=3**

Unit I
Evolution of Philosophy of Quality Management: Attributes of Quality, Various Approaches of Quality Definitions, Contributions of Deming, Juran, Taguchi, Crosby, Ishikawa, Shewhart, and Feigenbaum in Quality Revolution.
Unit II
Total Quality Management: Concept of TQM, Sailent Features of TQC and TQM, Quality Assurance, 7- Basic Tools of Quality Control, and Concept of Six-Sigma.
Unit III
Customer Focus: Customer Satisfaction, Total Employee Involvement, Employee Empowerment, Education and Training, Quality Circle and Processes of Brainstorming.
Unit IV
Just-In-Time (JIT), Zero Defect, Waste Management, MRP (Material Requirement Planning), MRP Vs JIT, Kanban Systems.
Unit V
Concept of Quality Standards, Benchmarking, Origin and Clauses Of ISO 9000, International Quality Awards, Quality Awards in India.

Recommended Books:

1. The Management and Control of Quality, J R Evans and W M Lindsay, Thomson south western.
2. Total Quality Management: A cross functional perspective, Ashok Rao, john Wiley & Sons.

Operational Research
(ELECTIVE-II)

MEE 7133 **3-0-0=3**

Unit I Introduction to Operations Research and Historical Development, Introduction to Various Mathematical Programming Models-LP, IP, DP, and GP And Computational Techniques.

Unit II Discrete Event Simulation, Random Number Generation, Various Mathematical Distributions- Normal, Binomial, Poisson, and Exponential, Simulation using Monte Carlo Method.

Unit III Waiting Models, Single and Multiple Channels Models, Application of Waiting Line Theory in Industrial and Service Sectors.

Unit IV Multiple Objective Decision Making Process: Analytic Hierarchy Process, Analytic Network Process, Linear Structural Modeling, and Application of Fuzzy Sets in Decision-Making Process.

Unit V Data Envelopment Analysis: Efficiency Analysis of Decision Making Units in Case of Multiple Input and Multiple Output, Application Of DEA in Performance Rating in Industry.

Recommended Books:

1. Operations research: An Introduction, H A Taha, Tata McGraw Hill, New
2. The analytic hierarchy process, Saaty, T.L., McGrow-Hill Book Company,
3. Data Envelopment Analysis: A competitive Text with Models, Cooper, Seiford and Tone, Kluwer Academic Publishers, Boston.

Maintenance Engineering
(ELECTIVE- II)

MEE 7141 **3- 0-0=3**

Unit 1 Introduction

Maintenance Types/ Systems: Breakdown, Corrective, Opportunistic, Routine and Other Types of Maintenance, Condition Based Maintenance Systems (CBMS), Various Condition Monitoring Techniques. Total Productive Maintenance, Basic Systems of TPM, Reliability Based Maintenance, Creative Maintenance.

Unit II Defect/ Failure Analysis

Need, Classification, Causes and Types of Defects, Processing and Fabrication Defects, Techniques of Failure Analysis, Equipment Downtime Analysis, Breakdown Analysis (FTA, FMEA,FMECA

Unit III Maintenance Planning And Control

Maintenance Planning and Scheduling, Controlling and Documentation, Planning of Spares, Inventory Planning, Maintenance Costing. Repair Decision- Repair, Replacement and Overhauling. Computer Applications in Maintenance (Computerised Maintenance Management System)

Unit IV Reliability, Availability And Maintenance (RAM)

Fundamentals of Reliability, Failure Distributions, Statistical Analysis of Failure Data, Weibull Analysis. Availability and Assessment. Maintainability and Its Assessment.

Unit V Tribology

Factors Influencing Tribological Phenomenon, Various Laws and Theory of Friction, Wear-Types, Mechanism, Controlling Techniques. Lubrication- Requirements, Types and Testing. Introduction to Micro and Nano Tribology.

Recommended Books:

1. Maintenance Engineering and Management R. C. Mishra & K. Pathak,
2. Maintenance Planning & control, Anthony Kelly, East-West Pvt. Ltd.
3. Reliability Engineering, L. S. Srinath, East West Publisher
4. Engineering Tribology, Gwidon W. Stachourale, Andrew W. Batchelor, Elsevier Butterworth Heinemann.

Control Systems
(ELECTIVE- II)

MEE 7033 **3- 0- 0=3**

Unit I Introduction

Control System Model, Concept of Feedback, Advantages and Disadvantages of Both Types of Systems, Block Diagram Fundamentals, Basic Rules For Block Diagram Reduction, Introduction to Signal Flow Graph Algebra, Node Elimination in Signal Flow Graph, Mason's Gain Formula, Laplace Transform Properties, Application in Solution of Differential Equations, Transfer Function, Numericals.

Unit II System Models

Mathematical Models, Building Blocks of Mechanical, Electrical, Fluid and Thermal System. Engineering Systems, Rotational-Translation Systems, Electromechanical Systems, Hydraulic-Mechanical Systems, Modeling Dynamic Systems, First Order Systems, Second Order Systems, Performance Measures For Second Order System, Stability, Numericals.

Unit III Controllers

Potentiometers, Error Detector, Synchro Transmitter and Synchro Receiver, Block Diagram Representation, Transfer Function of Field Controlled DC Servomotor, Speed - Torque Characteristics of Two Phase AC Servomotor, Transfer Function of Two Phase AC Servomotor, Stepper Motor, AC and DC Potential Control Systems. Different Types of Control Actions. On – Off, Proportional, Derivative, Integral, PI, PD, PID, Pneumatic And Hydraulic Controller, Controller Tuning, Adaptive Control.

Unit IV Stability Of Control Systems

Characteristics Equation of a Control System, Location of Roots of Characteristics Equation on S-Plane and its Effects on the Response Of The System, Routh-Hurwitz Stability Criterion, Special Cases In RH Tabulation, Determination of The Range of **K** For Stable Operation.

Unit V Frequency Domain Analysis

Sinusoidal Inputs, Phasors, Phasors Equations, Frequency Response of First And Second Order System, Bode Plots, System Identification, Stability and Stability Measures, Phase Lead and Phase Lag Compensation, Polar Plot, Nyquist Plot and Stability Criterion, Relative Stability, Numericals.

References

1. Modern Control Engineering , KATSUHIKO OGATA, Prentice Hall of India
2. Control Systems - Principles and Design, M. Gopal, Prentice Hall of India
3. Automatic Control Systems - seventh Edition, Benjamin C Kao, Tata-Mc- Graw Hill

Methods Engineering And Ergonomics
(ELECTIVE-III)

MEE 7135 **3-0-0=3**

Unit I Methods Study

Methods Study Design Cycle, Motion Study, Memo Motions, Micro Motion Study and Use of Therbeligs and Basic Elementary Motions, Principles of Motion Economy.

Unit II Work Measurement

Introduction to Work Measurement, Methods of Work Measurement: Time Study, Performance Rating and Allowances, Work Sampling, Synthesis Data System, Predetermine Motion Time Study, Work Factor System and MTM. Productivity and Methods to Improve Productivity.

Unit III Job Evaluation And Merit Rating

Introduction, Methods of Job Evaluation, Ranking Method, Grade Description Method, Point System, Factors Comparison Method, Difference Between Merits Rating and Performance Rating, Methods of Merit Rating, Incentives System and Incentive Plans.

Unit IV Ergonomics

Introduction to Basic Ergonomics, Study of Man-Machine System, Psychological and Physiological, Aspects in Ergonomics, Design of Facilities,. Machines, Components, Displays and Controls. Concept of Anthropometry and Applications. Plant Layout and Material Handling.

Unit V Environment

Study of Physical Environment: Temperature, Noise, Vibration. Study of Psychological Environment: Leadership, Social Environment, Motivation and Boredom.

References

1. Method Engineering, Krich , E.V., John Wiley & Sons.
2. Motion & Time Study , Mundel M. E.;PHI, New Delhi.
3. Introduction to Work study, ILO Geneva
4. Ergonomics, Murwell K F H, Chapman & Hall.
5. Human Factors Engineering Pub, Mc Cormich J. E; Mc Graw Hill
6. Psychology, Mumm N. L.; Honhghton Muffin, Sydney

Welding And Allied Processes
(ELECTIVE-III)

MEE 7127 **3-0-0=3**

Unit I Introduction

Classification of Welding Processes, Safety Recommendations, Weldability of Ferrous, Non-Ferrous Materials and Plastics, Weldability Test, Metallurgical Aspects of Welded Joints, Methods to Relieve Welding Stresses.

Unit II Welding Processes

Gas Welding, Arc Welding, Flux Shielded Metal Arc Welding, Electrode- Classification & Specification, Submerged Arc Welding, Tig, Mig, Electroslag Welding, Plasma Arc Welding, Atomic Hydrogen Welding, Resistance Welding- Spot, Seam, Projection & Flash Butt Welding

Unit III Special Welding Processes

Thermit Welding, Electron Beam Welding, Laser Beam Welding, Ultrasonic Welding, Friction Welding, Explosion Welding, Diffusion Welding

Unit IV Allied Processes

Brazing And Soldering- Selection Principles & Operation, Thermal Cutting of Metals, Joining of Plastics.

Unit V Inspection And Testing

Defects- Causes and Remedies, Inspection and Testing of Welded Joint by Destructive and Non-Destructive Methods.

References

1. Welding Process and Technology – Dr R.S.Parmar, Khanna Publications.
2. Welding and Welding Technology – Richard L. Little, Tata McGraw Hill Publishing Company Ltd.
3. Modern Arc Welding Technology – S.V.Nadkarni, Advani Oerlikon Ltd.
4. Manufacturing Engineering and Technology – S.Kalpakjian, Pearson Education.

Industrial Robotics
(ELECTIVE – III)

MEE 7038 **3-0-0=3**

Unit I Introduction

Brief History, Robot Terminology, Robot Components & Classification, Characteristic, Physical Configuration, Structure of Industrial Robot, Robot Joints, Robot Coordinates, Robot Workspace Design, Robot Application, Advantages and Disadvantages. Justification-Considerations in Applying Industrial Robots.

Unit II Robot Drives, Control and End Effectors

Robot Drives & Control- Controlling The Robot Motion, Position & Velocity Sensing Devices, Design of Drive Systems, Hydraulic and Pneumatic Drives, Linear and Rotary Actuators and Control Valves, Electro Hydraulic Servo Valves, Electric Drives, Motors, Magnetostrictive Actuators Design Consideration of End Effectors-Mechanical, Vacuum, Magnetic and Air Operated Grippers, Tools as End Effectors, Robot/End Effectors Interface.

Unit III Sensors & Machine Vision

Transducers and Sensors, Sensor Characteristics, Sensors in Robotics- Tactile, Touch, Position, Velocity, Acceleration, Force, Pressure, Torque Sensors, Proximity and Range Finders, Sniff Sensors, Light & Infra Red Sensor, RCC Devices& Micro Switches. Robotic Vision System, Sensing and Digitizing Function In Machine Vision, Image Gripping, Image Processing and Analysis, Image Segmentation & Pattern Recognization, Vision System Robotic Applications.

Unit IV Robot Programming

Robot Programming: Types of Programming, Lead Through Programming, Motion Programming, Interlocks, Advantages and Disadvantages. Robot Languages: Motion Programming, Simulation and Off-Line Programming, Work Cell Control Elements of Artificial Intelligence in Robots.

Unit V Robot Cell Design &Applications

Robot Work Cell Design and Control, Safety in Robots, Robot Cell Layouts, Multiple Robots and Machine Interference. Application -Welding, Electro-Plating, Painting, Spraying, Assembling, Material Handling, Inspection, Future Applications.

Recommended Books:

1. Industrial Robotics (Technology, Programming and applications),Mc Graw
2. Robotics – An introduction, Douglas R. Malcolm. Jr, Delmar Publisher Inc
3. Robot technology fundamentals , Saures G. Keramas, Delmar publishers
4. Fundamentals of robotics–analysis & control, Robert J. Schilling, PHI
5. Robotics-Control, sensing, vision and Intelligence, K.S. Fy.,R.C. gonzaler, C.S.G.Lee, Tata Mc Graw Hill editions
6. Robotics Technology and flexible Automation , S.R. Deb, Tata Mc. Graw
7. Robotic Engineering and Integrated Approach, Richard D. Klatter, Negin, Chmielewski, Prentice Hall Of India
8. Fundamentals Of Robotics–Analysis And Control, Tsuneo Yoshikawa, PHI

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Energy Management

Objectives of the Program:

Energy is the basic infrastructural need for a modern civilized society. Industrial development all over the world, especially in the developed countries, has overstrained the existing energy sources and resulted in environmental problems. The growing economies like India, china and other countries face the twin problem of supplying growing energy needs of their countries and at the same time ensure a check on the resulting environmental emissions. This calls for an organized educational program in Energy Management. The school of Energy Management plans to offers a 3 years part-time post graduate program leading to **Master of Technology degree in Energy Management.**

The objectives of this post graduate program are:

- To provide interdisciplinary necessary input to students, in energy resources, planning, technology and economics of energy usage in various sectors after their basic graduate degree.
- To provide energy and environmental correlation and detailed information on environmental friendly energy conversion technologies.
- To provide details of energy and environmental economics
- To provide details of non- conventional renewable energy sources
- To provide information on energy related management practices
- To provide detailed practice on energy related software's.

The school is in the process of establishing :

- Energy Laboratory including
    1. Non-conventional Energy Sources
    2. Engine Performance & Exhaust Emission Testing
    3. Energy Instruments

Eligibility:

The applicant must have a Bachelor's degree in Engineering/Technology / or a Masters degree in Sciences /Applied Sciences and/or any appropriate discipline related to energy and environment with CGPI of 6.75 on 10 point scale or equivalent or 60% marks in aggregate wherever marks are awarded. The candidates with valid GATE score will be given preference.

Program Structure of M.Tech(Energy Management) – Part Time

Semester I **First Year**

Course Code	Course Title	L-T-P	Credit
EEML 101P	Fuel Technology	3-0-0	3
EEML 102P	Heat Transfer	3-0-0	3
EEML 103P	Principles of Energy Conversion	3-0-0	3
EEML 104P	Technology Forecasting and Assessment	3-0-0	3
	Total Credits	12-0-0	12

Semester II **First Year**

Course Code	Course Title	L-T-P	Credit
EEML 105P	Non Conventional Energy Sources	3-0-0	3
EEML 106P	Industrial Energy Management	3-0-0	3
EEML 107P	Project Evaluation and Management	3-0-0	3
EEMP 108P	Energy Lab.	0-0-4	2
	Total Credits	9-0-2	11

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credit
EEML 201P	Solar Energy Utilization	3-0-0	3
EEML 202P	Energy Economics and Planning	3-0-0	3
EEME 2XXP	Program Elective-I	3-0-0	3
	Total Credits	9-0-0	9

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credit
EEML 203P	Solar Photovoltaic Power Plants: Planning, Design and Balance of Systems	3-0-0	3
EEML 204P	Power Plant Engineering	3-0-0	3
EEME 2XXP	Program Elective-II	3-0-0	3
	Total Credits	9-0-0	9

Semester V **Third Year**

Course Code	Course Title	L-T-P	Credit
EEMT 301P	Industrial/Field Training (To be conducted in summer vacations and the cost to be borne by the students)	0-0-30	15
EEMD 302P	Major Project Part –I	0-0-12	6
	Total Credits	0-0-42	21

Semester VI **Third Year**

Course Code	Course Title	L-T-P	Credit
EEMD303P	Major Project	0-0-40	20
	Total Credits	**0-0-40**	**20**

Program Electives I

Course Code	Course Title	L-T-P	Credits
EEME 201P	Wind and Small Hydro Systems	3-0-0	3
EEME 202P	Energy Efficiency in Buildings	3-0-0	3
EEME203P	Solar Passive Architecture	3-0-0	3
EEME204P	Decentralized Generation Systems	3-0-0	3
EEME 205P	Pollution control in power plants	3-0-0	3
EEME 206P	Cogeneration and Energy Efficiency	3-0-0	3

Program Electives II

Course Code	Course Title	L-T-P	Credits
EEME 207P	Instrumentation and Control in Energy Systems	3-0-0	3
EEME 208P	Fuel Cell and Hydrogen Energy	3-0-0	3
EEME 209P	Energy Storage	3-0-0	3
EEME 210P	Demand Side Management of Energy	3-0-0	3
EEME 211P	Solar Refrigeration & Air Conditioning	3-0-0	3

Fuel Technology

EEML 101P **3-0-0=3**

Principles of combustion , Solid , Liquid and Gaseous fuels, Coal as source of energy and chemicals, Coal preparation, Carbonization, Gasification and Liquefaction of coal and lignite , Petroleum and its derived products, Inter conversion of fuels, Natural gases and derivatives, Sources and Potential, combustion equipment for solid , Liquid and gaseous fuels, Nuclear fuel and technology.

Text Books :

[1] Sarkar Samir, (1990); *Fuels & Combustion*, 2nd Edition, Orient Longman,
[2] Sharma, B. K, (1998); *Fuels and Petroleum Processing , 1st ed*. Goel publishing, Meerut

Recommended Books:

[1] Gupta O.P, (1996); *Elements of Fuels, Furnaces & Refractories*, 3rd edition, Khanna Publishers.
[2] Civil Davies, (1966); *Calculations in Furnace Technology*, Pergamon Press, Oxford,
[3] Khartchenko Nikolai V. ed(1998), *Advanced Energy Systems*, Taylor Francis Washington D.C.

Heat Transfer

EEML 102P **3-0-0=3**

Theory of heat conduction, Mathematical and numerical analysis of two dimensional heat conduction with and without internal heat generation, Mathematical and numerical analysis of transient and periodic state heat conduction, Theory of convective heat transfer, Boundary layer theory, Heat transfer in duct flow, laminar and turbulent, Heat exchangers, Radiation heat transfer, between black and grey bodies, Laws of radiation heat transfer, Numerical solution of radiation network analysis

Text Books:

[1] Sukhatme S. P. (1996); A Text book on Heat Transfer, University Press
[2] Holman J. P. (1992); Heat Transfer, 7th ed. Mc Graw-Hill, London.
[3] Incropera F.P. and Dewitt D. P. (2006); Fundamentals of Heat and Mass Transfer, 5th ed. John Wiley

Recommended Books:

[1] Prasuhn A. L., (1980); Fundamentals of Fluid Mechanics, Prentice Hall
[2] Gupta V (1995); Elements of Heat and Mass Transfer, New Age International Publishers, NewDelhi

Principles of Energy Conversion

EEML 103P **3-0-0=3**

Energy classification, sources, utilization, economics and terminology
Principal fuels for energy conversion
Production of thermal energy
Fossil fuel systems
Nuclear reactor design and operation
Production of mechanical and electrical energy

Text Books:

[1] Goswami D. Y., Kreith F. (2006); Energy Conversion, CRC Press, Taylor and Francis Group.

Technology Forecasting and Assessment

EEML 104P **3-0-0=0**

Module 1:
Forecasting as an input to technology planning, future research , Elements of forecasting, Process, Types of forecasting methods, Quantitative methods of forecasting ,Time series models, Growth curves, Precursor, Envelope curves, Experience curves, Technical assessment.

Module 2:
Quantitative methods, Morphological analysis, Relevance trees, Delphi, technological gap analysis, Analogy method, Organizing for technology forecasting.

Module 3:
Technology assessment, Components, Problem definition, Social description, Measure impact assessment ,Strategies for assessment, Economic impact analysis, Assessment of risk and uncertainty ,Safety and environmental considerations.

Non Conventional Energy Sources

EEML 105P **3-0-0=3**

Renewable energy sources, Potential, solar radiation, Atmospheric phenomena, calculation of solar radiation on horizontal and inclined surfaces , Measurement of solar radiation, Low temperature applications, Solar distillation ,Heat pump, Solar refrigerator ,Passive space conditioning, Solar thermal power generation

,Photovoltaic, wind energy ,Physical and thermo chemical methods of bioconversion, Biological methods, Renewable energy economics.

Text Books:

[1] Bansal N.K., Kleemann M. and Meliss M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill Publishing Company, New Delhi, 1990

[2] Goswami D Y, Kreith Frank and Kreider J F, Taylor & Francis (1999) ; Principles of Solar Engineering, Taylor & Francis, USA

[3] Tiwari, G.N (2002); Solar Energy, Fundamentals design, modeling and Apllications, Narosa, New Delhi

[4] Duffie J. A. and W. A. Beckman, (2006); Solar Engineering of Thermal Processes, Johnn Wiley

Recommended Books:

[1] Alexiades, V & A.D. Solomon, (1993) ; Mathematical Modeling of Melting and Freezing process, Hemisphere publishing corporation, Washington

[2] Narayan R., B. Viswanathan, (1998) ; Chemical and Electrochemical Energy System, Universities Press

[3] Ter-Gazarian A., (1994) ; Energy Storage for Power Systems, Peter Peregrinus Ltd. London

Industrial Energy Management

EEML 106P **3-0-0=3**

Energy analysis and mass balance , Economic analysis, Instrumentation and control, combustion analysis, Industrial insulation, Heat exchangers , Energy efficiency in buildings, Condensating steam, Cogeneration, Compressors, Power factor, Transmission and distribution, Principles of management.

Text Books:

[1] Petrecca G (1993). Industrial Energy Management: Principles and Applications; Springer Science+ Business Media, LLC, New York.

[2] Schmidt P., Brown D. (1987); Industrial Energy Management and Utilization, Taylor and Francis.

Project Evaluation and Management

EEML107P **3-0-0=3**

Module 1:

Project system management: A life cycle approach , Project characteristics, Project life cycle phases, Conception , Definition, Planning and organizing, implementation and project cleanup, Project feasibility analysis, Role and responsibilities of project manager, team building , Tools and techniques of project management, Environmental impact analysis of a project .

Module 2:

Network technique for project management- PERT, CPM and GERT, Accounting for risk , Uncertainty and fuzziness, Time cost trade off and crashing procedures, multi project planning and scheduling with limited resources, Multi objective fuzzy and stochastic based formulations in project environment.

Text Books:

[1]. Prasanna Chandra, Projects planning, analysis, selection, financing, implementation and review- 6th edition Tata McGraw Hill publications.

[2]. Bhavesh M Patel Project management, strategic financial planning, evaluation and control, Vikas publishing house pvt. Limited.

Energy Laboratory

EEML 108P **0-0-4=2**

The experiments to be carried out by the M.Tech students in Semester-II will be identified from the following broad areas. However, based on the latest Research, Development and Testing requirements of the Energy Industry, new areas will be identified and experiments will be designed and introduced for the students as and when required so that the Students develop expertise as per the current needs of Industry and R&D institutions

1. Solar Radiation Data Monitoring and Analysis:
Sunshine hour duration, Direct Solar Radiation, Global Solar Radiation, Diffuse Solar Radiation, Net radiation [W/m2], Outgoing radiation [W/m2] , Infra red radiation, Diffuse radiation from global and direct radiation at a given zenith angle

2. Solar Photovoltaic:
Current-voltage characteristics of Solar Cell, Efficiency Variation of solar cell, Performance variation of solar photo cell at different light intensities,; Determination of power produced by a solar photo voltaic system, Performance Evaluation of a Solar Photo voltaic lighting system and its components: inverter, charge controller and battery, Performance evaluation of a solar photovoltaic water pump.

3. Solar thermal measurements and analysis:
Experimental study of thermal performance of Solar water heater, Evacuated tube solar collector, Solar still, Thermal performance of solar drying system , Thermal testing of a box type Solar Cooker, Concentrator type and community solar cookers, Designing and testing of Innovative solar thermal systems

4. Energy performance of buildings: solar passive buildings:
Testing & performance evaluation of Solar air heating systems: Solar Trombe wall, Thermosyphon heating panels, Attached green houses; Lighting measurements & analysis, Measurement and analysis of heat gain and air-conditioning load in a building, day lighting in a building: sky luminance, daylight from illumination from window and skylight

5. Energy audit:
Thermal energy audit: Measurement of variables such as, temperature, pressure, air flow, etc of selected energy equipments and analysis; Electric energy audit: Measurement of basic parameters in electric power systems i.e. current, voltage, resistance, power factor, power and energy

List of Experiments

A. General

1. Calculation of Sun's position and Solar Radiation

Objective: Calculation of Solar Radiation on various facades of a building and comparison with the energy demand of the house.

Requirements:

Basic principles: extraterrestrial Solar Radiation (Solar Constant), Solar radiation transmission through the atmosphere, turbidity factor of the atmosphere, Air-mass, Terrestrial Solar Radiation, Angle dependence (solar and incident angle), Declination, Hour angle, Direct and Diffuse Radiation, Reflected Radiation, Global Radiation Definition of a Test Reference year,
Practical and Exercise, Calculation of solar radiation on various facades of a house.

2. Measurement of Direct, Diffuse, Reflected and Global Radiation: comparison with calculated values.

Objective: Knowledge about various types of pyrano-meters- and pyr- heliometers, Error analysis and effect of micro – climate.

Requirements: Pyranometer, pyr-heliometer, Data - logger
Experiment, observations, Analysis, Comparison with calculated values

B. Solar Thermal Systems

3. Characterization of a solar flat plate collector and evaluation of U and (τȧ) values from Hotel – Whillier – Bliss equations.

Objective: to set up an experiment for solar collector characterization and to evaluate the effect of parameters on its thermal performance

Requirements: Solar flat plate collector, water storage tank, pump, regulator, pressure gauge, temperature sensor, solarimeter, Date logger, thermostatic bath, flow rate meter
Setting up of Hotel-Whillier- Bliss equation and evaluation of U and (τ ȧ) values, Influence of Fin factor, selection of collectors for different uses.

4. Characterization of Evaluated tube collectors

Objective: Setting up an experiment for characterization of an evaluated tube collector and analyze the difference in performance of a flat plate and an evaluated tube collector.

Requirements: Evaluated tube collector, water storage tank, thermostatic bath, heat exchanger, radiation meter, pressure and temperature sensors, pump, water flow rate meter, date logger.
Conduction of detailed experimentation, evaluation of heat transfer factors and thermal- optical parameters, Estimation of achievable temperatures.

5. Evaluation of solar concentrator and comparison with theoretically calculated values.

Objective: calculation of geometry of a solar concentrator, ideally achievable temperatures, experimentally achievable temperatures, optical errors and evaluation.

Requirements: Solar concentrator, pyrano and pyrheliometer, temperature sensor, data logger.

6. Design and layout of a Solar Hot Water System

Basics: energy balance over collector, storage, auxiliary heating, use of collector parameters in layout, head profile, technical evaluation and economic analysis.

Requirements: Solar flat plate/ET collector, storage tank, heat exchanger, pump, flow rate meter, radiation meter, temperature and pressure sensors.
Set up the experiment, experiment conduction, data logging and analysis, techno-economic evaluation.

Solar Photo –Voltaic

7. I-V curve of a solar cell at different solar radiations and temperatures.

Objective: Practical understanding of solar cell and characterization and cell parameters like I_{sc}, v_r, efficiency.

Requirements: Solar cell mounted on an optical table, water circulation system, radiation source, constant temperature bath, milli-ammeter and milli-voltmeter, plotter.

8. Characterization of Solar Photo- Voltaic Module at different solar radiation and temperatures.

Objective: Understanding of series and parallel connection of solar cells in a module, Understanding of crystalline and thin film modules, evaluation of module efficiency and power.

Requirements: Crystalline PV and thin film modules of approximate identical peak wattage, radiation source, radiation meter, temperature sensors, data- logger

9. Design and layout of Solar Home System

Objective: Given a load profile of electricity requirements of a house (building), the student should be able to find out the capacity of PV module, battery and select Other BOS. He should be able to connect and conduct the experiment.
Requirement: Photovoltaic module, charge controller, battery storage, inverter,
voltmeter, ammeter, electric meter, pyranometer, temperature sensor.

Solar Energy Utilization

EEML 201P **3-0-0=3**

Solar radiation and modeling, solar collectors and types: flat plate, concentrating solar collectors, advanced collectors and solar concentrators, selective coatings, solar water heating, solar cooking, solar drying, solar distillation and solar refrigeration, Active and passive heating and cooling of buildings, solar thermal power generation, solar cells, Home lighting systems, Solar lanterns, Solar PV pumps, solar energy storage options, Industrial process heat systems, solar thermal power generation and sterling engine.

Text Books :

[1] S.P. Sukhatme, Solar Energy : Principles of Thermal Collection & Storage, Tata McGraw Hill, Publications, New Delhi, 1984

[2] Duffie J.A. and Beckmann W.A., Solar Engineering of Thermal Processes, 2nd edl, Wiley Interscience,New York, 1991

[3] Bansal N.K., Photovoltaic Systems, ISBN 81-901296-0-0, Omega Scientific Publishers, New Delhi, 2003

[4] Solanki Chetan Singh, Solar Photovoltaics, : Fundamentals, Technologies and Applications, ISBN-978-81-203-3760-2, PHI Learning Pvt Ltd., New Delhi, 2009

Energy Economics and Planning

EEML 202P **3-0-0=3**

System economics, Reference energy systems, Econometrics, Statistical approach, Langrangian multiplier, Input–output economics, Macroeconomic growth models, Dynamic models of the economy and simple theory of business fluctuations, Multiple linear and non linear regression analysis, Environmental repercussions and economic structure ,Social costs , Decision and uncertainty.

Text Books :

[1] Ferdinand E. Banks, (2000) ; Energy Economics: A Modern Introduction, (1st ed), Kluwer,London,

[2] Robert L. Pirog and Stephen C. Stamos (1987) ; Energy Economics: Theory and Policy, Prentice-Hall New Jersey

[3] Kandpal T.C., H. P. Garg (2003) ; Financial Evaluation of Renewable Energy Technology,Macmilan India Ltd. New Delhi,.

Recommended Books:

[1] Dixon, et al, (1994) ; Economic Analysis of Environmental Impacts, Eartscan Publications Ltd.,London,

[2] Thuesen G. J, W. J. Fabrycky, (2001) ; Engineering Economy, (Ninth Ed.), Prentice-Hall of IndiaPvt. Ltd.

Solar Photovoltaic Power Plant: Planning, Design and Balance of Systems

EEML 203P **3-0-0=3**

stimating power and energy demand, site selection, land requirements, choice of modules, economic comparison, balance of systems, off grid systems, grid interface, Preparing DPR, Supporting structures, mounting and installation, junction boxes, battery storage, power condition unit, selection of cables and balance of systems, planning with software, maintenance and schedule, SCADA system, Sensors, Data logger, Monitoring, Data Management, Analysis and Performance. Financial Analysis, Life Cycle Costing, Environmental Analysis and Social Costs, worksheet, customer care

Text Books :

[1] Solanki Chetan Singh, Solar Photovoltaics, : Fundamentals, Technologies and Applications, ISBN-978-81-203-3760-2, PHI Learning Pvt Ltd., New Delhi, 2009

[2] Bansal N.K., Photovoltaic Systems, ISBN 81-901296-0-0, Omega Scientific Publishers, New Delhi, 2003

[3] Green M.A., Solar Cells: Operating Principles, Technology and System Applications, Prentice Hall Incl. Engelwood Cliffs N.J., USA, 1982

Power Plant Engineering

EEML 204P **3-0-0=3**

Economics of power generation

Choice of power plant; Load & Load duration curves; Load factor; Diversity factor; Load deviation curve; Load management; Number and size of generating unit; Cost of electrical energy; Tariff-Power factor improvement.

Different types of power generation

Types of thermal power plants; Steam power plant based on fossil fuels; Thermal power plant equipment: Boiler, Economizer, Super heater, Condenser, Combustion chamber and gas loops, Turbines etc, Auxiliaries.

Hydropower plant

Mass curve and storage capacity; Classification; Components; Turbines- Characteristics and their selection; Governor; Plant layout and design; Auxiliaries; Underground, automatic, remote controlled, and pumped storage plants.

Nuclear power plant

Nuclear reactors and fuels; Radioactivity; Mass defect and binding energy; Chain reaction; Materials used in nuclear plants; Important types of reactors.

Text Books :

[1] Soni, M.L., P.V. Gupta and V.S. A. Bhatnagar, (2000) ; A Course in Electrical Power, Dhanpat Rai & Sons, New Delhi
[2] Black and Veatch, (1998); Power Plant Engineering, CBS Pub and Distributors, N Delhi.
[3] Nag P K.(2006); Power Plant Engineering; Tata McGrawHill, N Delhi.

Recommended Books:

[1] Gupta, B.R. (2001); Generation of Electrical Energy ; Eurasia Publishing House
[2] Deshpande, M.V. (1998); Elements of Power Station Design ; Wheeler Publishers ;
[3] Wadhwa C. L.,(1991) ; Electrical Power systems, 2nd ed, New age, New Delhi

Wind & Small Hydro Systems

EEME 201P **3-0-0=3**

Wind energy conversion

Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics.

WECS design

Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss Correction.

Design of wind turbine

Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods.

Wind energy application

Wind pumps: Performance analysis, design concept and testing; Principle of WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy. Utilization; Wind energy in India; Case studies.

Small hydropower systems

Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection and civil works; Speed and voltage regulation; Investment issues load management and tariff collection; Distribution and marketing issues: case studies; Potential of small hydro power in North East India.

Text Books :

[1] Johnson G L, (1985) ; Wind Energy Systems, Prentice Hall Inc, New Jersey,
[2] Spera David A., (Editor1994) Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering,American Society of Mechanical Engineers
[3] Paul Gipe , Karen Perez, (1999); Wind Energy Basics: A Guide to Small and Micro Wind Systems,Chelsea Green Publishing Company

Recommended Books:

[1]Hau Erich (2000) ; Wind Turbines: Fundamentals, Technologies, Application and Economics :Springer Verlag
[2] Manwell J. F., McGowan J. G., Rogers A. L., (1st edition 2002); Wind Energy Explained , JohnWiley & Sons

Energy Efficiency in Buildings

EEME 202P **3-0-0=3**

Thermal , Visual and acoustical comforts , Solar architecture, Heat transfer, Natural heating and cooling of buildings, Qualitative and Quantitative methods, Glazing , insulations , Ventilation, Day lighting , Air conditioning , Load estimation , Climates and energy requirement, Ventilation and fan power, Day lighting, Dehumidification, Software and case studies.

Text Books:

[1] Bansal N.K., Minke G. and Hauser G., Passive Building Design: A Handbook of Natural Climatic Control, Elsevier Sc., Netherland, 1994
[2] Bansal N.K. and Rijal Kamal(eds.), Profiting from Sunshine : Passive Solar Heating in Mountains, ICIMOD, Kathmandu, Nepal, 2000

[3] Sodha M.S., Bansal N.K., Bansal P.K. and Kumar A., Solar Passive Building : Science & Design, Pergamon Press, Oxford, 1986
[4] Bansal N.K. and Mathur J., Energy Efficient Windows, Anamaya, New Delhi, 2006
[5] Deo Prasad and Mark Snow, Designing with solar power, Images publishing house.

Solar Passive Architecture

EEME 203P **3-0-0=3**

Thermal analysis and design for human comfort
Thermal comfort; Criteria and various parameters; Psychometric chart; Thermal indices, climate and comfort zones; Concept of sol-air temperature and its significance; Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation; Introduction to design of shading devices; Overhangs; Factors that effects energy use in buildings; Ventilation and its significance; Air-conditioning systems; Energy conservation techniques in air conditioning systems

Passive cooling and heating concepts
Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces; Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel.

Heat transmission in buildings
Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; solar temperature; Decrement factor; Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.

Bioclimatic classification
Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes.

Energy efficient landscape design
Modification of microclimatic through landscape element for energy conservation; Energy conservation through site selection, planning, and design; Sitting and orientation

Text Books:

[1] Wright D. (2008); The Passive Solar Primer: Sustainable Architecture, Schiffer Publishing.
[2] Brainbridge D.A., Haggard K. (2011); Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting and More Using Natural Flows, Chelsea Green Publishing.

Decentralized Generation Systems

EEME 204P **3-0-0=3**

Introduction
Decentralized generation technologies; Costs and choice of technology, Demand and benefits forecasting and program development, Principles of cost-benefit calculations, Economic and financial analysis of stand-alone electrification projects, Decentralized versus central station generation, Traditional power systems, Load curves and load curve analysis

Different distributed generators
Basic gas turbine generator concepts; Utility system turbine generators; Mini and micro gas turbine generators; Solar thermal power generation, utility scale photovoltaic (USPV)
generation; Wind-powered generation; Biomass based generation; DG Evaluation: Cost from past, present, and future, basic DG cost analysis, cost Evaluation and schedule of demand.

Grid interconnection options
The power grid; DG-Grid interconnection issues; Case Study.

Reference Book

1. Decentralized Energy Options and Technology by N.K. Bansal Omega Scientific Publishers, New Delhi (1993)

Pollution Control in Power Plants

EEME 205P **3-0-0=3**

Pollution in power plants, particulate gaseous pollutants, thermal pollution ,solid waste pollution strategies to control pollution from coal based thermal plants, pollution control methods (1) pre combustion controls. (2) combustion controls low NOx burners, fluidized bed boilers (3) post combustion controls, particulate controls, cyclone ,wet scrubbers, ESP and fabric filters , gaseous pollutants control flue gas desulphurization FGD systems ,VSR reduction application of electron beam and non thermal plasmas for Sox and NOx treatments . Cooling towers for thermal pollution and solid waste treatment plants, fly ash disposal and utilization, efficiency improvements, PFBC, FGCC, combined cycle systems.

Cogeneration & Energy Efficiency

EEME 206P **3-0-0=3**

The cogeneration concept, cogeneration alternatives, Cogeneration potentials, Gas turbine, Steam turbine, Diesel engine, Bottoming cycle technologies, Industry/utility cogeneration, thermodynamic evaluation, environmental evaluation, cost allocation methods, Sizing & operating cogeneration systems,

Text Books:

[1] Kolanowski B.F.(2008); Small-Scale Cogeneration Handbook, Fairmont Press.
[2] Boyce M.P. (2010); Handbook for Cogeneration and Combined Cycle Power Plants, ASME Press.

Instrumentation and Control in Energy Systems

EEME 207P **3-0-0=3**

Basic measurement concepts, Measurement errors, Transducer classification, Static and dynamic characteristics of transducers, Instruments for measuring temperature, pressure, velocity and flow, heat flux, liquid level and concentration in energy systems, characterization of combustors, Flue gas analyser, Exahaust gas analyser, Solar energy measurement requirements and instruments, Meteorological data, measurements, Energy auditing instruments, Energy audit kit, humidity measurements, characterization of electrical power systems, Instruments for monitoring electrical parameters, Analysis of power system measurements. Analog and signal conditioning, A/D and D/A converters, Digital data processing and display, Computer data processing and control, feedback control system, Stability and transient analysis of control systems, Application of PID controllers, General purpose control devices and controller design, Air pollution sampling and measurement of particulates, Sox, NOx, CO, O3, hydrocarbons.

Fuel Cell and Hydrogen Energy

EEME 208P **3-0-0=3**

Hydrogen Energy

Hydrogen: Its merit as a fuel; Production: from fossil fuels, electrolysis, thermal
Decomposition, photochemical, photo catalytic, hybrid; Storage: Metal hydrides, Mettalic alloy hydrides, Carbon nano tubes; Sea as the source of Deuterium.

Fuel Cell

Priciple of working, Basic thermodynamics and electrochemical principles, Classification, Electrolytes, Fuel types, Fuel-cell electrodes and carbon nano tubes; Application of power and transportation.

Text Books:

[1] Appleby, A. John. *Fuel Cell Handbook*. New York: Van Reinhold Co., 1989.
[2] Blomen, Leo, and Michael Mugerwa. *Fuel Cell Systems*. New York: Plenum Press, 1993.
[3] Kordesch, Karl, and Günter Simader. *Fuel Cells and Their Applications*. New York: VCH, 1996.
[4] Rand D.A.J., Dell R.M.; Hydrogen Energy: Challenges and Prospects, RSC Publishing.

Energy Storage

EEME 209P **3-0-0=3**

Need for energy storage; Different modes of energy storage

Potential energy; Pumped hydro storage; KE and Compressed gas system; Flywheel storage, compressed air energy storage; Electrical and magnetic energy storage; Capacitors, electromagnets and battery storage systems; Chemical Energy storage; Thermao-chemical, photochemical, bio-chemical, electrochemical, fossil fuels and synthetic fuels and hydrogen storage

SHS mediums; Stratified storage systems; Rock-bed storage systems; Thermal storage in buildings; Earth storage; Energy storage in aquifers; Heat storage in SHS systems; Aquifers storage

Phase Change Materials (PCMs); Selection criteria of PCMs; Stefen problem; Solar thermal LHTES systems; Energy conservation through LHTES systems; LHTES systems in refrigeration and air-conditioning systems; Enthalpy formulation; Numerical heat transfer in melting and freezing process

Food preservation; Waste heat recovery; Solar energy storage; Green house heating ; Power plant applications; Drying and heating for process industries

Text Books:

[1] Baxter R. (2005); Energy Storage: A Nontechnical Guide, PennWell Cop.
[2] **Steinmann**, Wolf Dieter (2013); Thermal energy storage for medium and high temperatures, Springer.

Demand Side Management of Energy

EEME 210P **3-0-0=3**

The concepts and methods of DSM
Load control, Energy efficiency, Load management; DSM planning, design, marketing; Impact assessment.

Customer load control
Direct, Distributed, and Local control, Interruptible load; Configuration of control system for load control; Assessment of Impact on load shape.

Strategic Conservation and Load Management Technologies
Strategic conservation via improving building envelope, Air-conditioning, Lighting; Electric motor, and other industrial processes and equipment; Load shifting and load leveling through Thermal Energy Storage.
Customer Incentives, Program Marketing Design and Penetration
Type of incentives and programs, Program design; Use of Analytic Hierarchical Process for assessment of Customer Acceptance and Program penetration

Assessment of Impact on System Load Shape
Energy Audit and assessment of customers' load shape for different customer groups; Impact of DSM programs on load shapes in customer groups, Categorized in economic sub sectors, and by geographical location.

Cost/Benefit Analysis and Feasibility of DSM Program
DSM program costing and Load Shape Impact on system; DSM program cost/benefit and
Feasibility; Environmental benefits.

Integrated Electric Utility Service under Deregulated Situation
Institutional, Legal, and Political environments and the stages of development of Electric Utility Service; The mechanism of competition and development of the financial environment for economic utilization of resources for electric service.

Solar Refrigeration and Air-conditioning

EEME 211P **3-0-0 = 3**

Potential and scope of solar cooling. Types of solar cooling systems, solar collectors and storage systems for solar refrigeration and airconditioning. Solar operation of vapour absorption and compression refrigeration cycles and their assessment. Solar dessicant cooling system. Open cycle absorption/desorption solar cooling alternatives. Advanced solar cooling systems. Refrigerant storage for solar absorption cooling systems. Solar thermoelectric refrigeration and airconditioning. Economics of solar cooling.

Text Books:

[1] Sayigh A. A. M., McVeigh J.C. (1992); Solar Air Conditioning and Refrigeration, Pergamon.
[2] Prasad M. (2007); Refrigeration and Air Conditioning, New Age International.

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Architecture & Landscape Design

PREAMBLE

The Bachelor of Architecture course has been designed to infuse confidence in the would-be-Architect. In nut shell the Architect from the institute has to be made aware of the changing scene put forth by racing progress with its tools. Decadence in built-up environment is a major concern. To feel concerned for the up gradation of the built-up environment is the need of the hour. The basic mission of providing Architectural education is to create environment friendly Architecture through inputs from traditional skills, materials and geographical conditions. Expressing regional diversity through Architecture and promoting research on materials, energy, depletion of resources, conservation of heritage have been kept in view while framing the syllabus.

Curriculum arrived at is based on the following:

- Digesting knowledge by clarity of concepts to be of utmost importance than making process of learning examination-oriented.
- The course content shall be defined in advance with reference materials so that students come to some extent prepared and the teacher shall assume the role of a catalyst.
- All basic concepts shall be made clear through examples, visual aids and site observation to make the students apply mind on practical lines with an open view.
- **Architectural Design** shall be of prime importance with inputs from other related subjects.
- Timing and importance of all the subjects has been kept in view.
- Working drawings shall be part of both **Architectural Design** and **Building Construction.**
- Seminars on topics of professional concern to be part of studies with issues regarding environment, energy, heritage, landscape, etc. – Reference material to be made available as an introduction.
- To be concerned about the subject with an open mind keeping in view the crush on space and services and dilution of natural values (fitting buildings in natural settings) and heritage elements.

  By coalescing the subjects of the course in a natural flow, the Architect shall have confidence in Planning, Architectural Design, drafting details and shall be ready for discussion. In other words it will make Architecture truly a language of heart than a language of becoming and Architect. Form-Function, both in the interiors and exteriors and the relationship of structure with the site and location (HARMONY) in truthfulness shall be the theme of the course. With this approach in mind the Architects from the institute shall be ready to face challenges in the field of Architecture. Programmes in the Preamble are realized through practical approaches like field studies and special lectures.
  Field studies help students to understand human activities, behaviour and the value of space inside and outside.
  - Students are made to prepare measured drawings in first year for particular functions to give the realistic understanding of anthropometry, scale and dimension.
  - To create interest and awareness special lectures are conducted on the works of famous architect's and their philosophies and other related topics in tune with times like Green Architecture.
  - Topics are made tangible through slide shows and power point presentations.
  - Outdoor study and sketching not only helps to understand Art and Aesthetics but side by slow decadence brought by human hands is made clear.
  - Hand on training on latest architecture computer software's like AutoCAD, ArchiCAD and Revit put the programme of teaching on latest lines.
  - Talks and lectures are conducted by various companies dealing with interior hardware and students are made conscious of constant changes in building industry regarding wastage, pollution and conservation by explaining the ever changing trends in products.
  - Students are made aware of the various facets of the state having three regions of varied climate, customs and architecture to establish differences in approach to design and along with it the understanding of Hill Architecture and Energy Conscious buildings.
  - To keep students well informed about Architecture and widen their horizon and allow healthy competition, students attend NASA (National Association of Students Architects) meets in January every year.

Program Structure of
Bachelor of Architecture programme

Semester I **First Year**

Course Code	Course Title	L-T-P	Credit
ALU 1101	Architectural Drawing	2-0-2	3
ALU 1102	Architectural Design-I	1-0-8	5
ALU 1104	Building Material & Construction-I	3-0-2	4
ALP 1205	Structure-I	2-0-2	3
ALP 1106	History: Art, culture & civilization	1-0-0	1
ALP 1707	Workshop-I (Masonry & Carpentry)	0-0-2	1
ALP 1708	Computer Applications	1-0-2	2
ALU 1110	Arts & Basic Design-I	2-0-2	3
ALN 1115	Filed Studies-I	Non Credit	0
	NSS	Non Credit	0
Total Credits		**12-0-20**	**22**

Semester II **First Year**

Course Code	Course Title	L-T-P	Credit
ALL 1121	Theory of Design-I	2-0-0	2
ALU 1122	Architectural Design-II	1-0-8	5
ALU 1123	Arts & Graphics II	2-0-2	3
ALU 1124	Building Materials & Construction-II	3-0-2	4
ALP 1225	Structures-II	2-0-2	3
ALL 1126	History of Architecture-I	2-0-0	2
ALP 1827	Surveying & Leveling	1-0-2	2
ALP 1728	Computer Applications	0-0-2	1
ALN 1135	Field Studies-II	Non Credit	0
	Total Credits	**13-0-18**	**22**

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credit
ALS 2100	Self Study (During Summer Vacation)	50 Days	2
ALL 2101	Climatology & Energy	3-0-0	3
ALU 2102	Architectural Design-III	1-0-8	5
ALU 2103	Arts & Graphics-III	2-0-2	3
ALU 2104	Building Material & Construction-III	3-0-2	4
ALP 2205	Structure-III	2-0-2	3
ALL 2106	History of Architecture-II	2-0-0	2
ALP 2707	Workshop-I (Model Making)	0-0-2	1
ALL 2808	Sociology	1-0-0	1
ALN 2115	Filed Studies-III	Non Credit	0
	Total Credits	**14-0-16**	**24**

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credit
ALL 2121	Theory of Design-II	2-0-0	2
ALU 2122	Architectural Design-IV	1-0-8	5
ALU 2123	Arts & Graphics IV	2-0-2	3
ALU 2124	Building Materials & Construction-IV	3-0-2	4
ALP 2225	Structures-IV	2-0-2	3
ALL 2126	History of Architecture-III	2-0-0	2
ALP 2727	CAD	0-0-2	1
ALP 2128	Building Services-I	1-0-2	2
	Environmental Studies	2-0-0	NC
ALN 2135	Field Studies-IV	Non Credit	0
	Total Credits	**15-0-18**	**22**

Semester V **Third Year**

Course Code	Course Title	L-T-P	Credit
ALL 3101	Theory of Design-III	2-0-0	2
ALU 3102	Architectural Design-V	1-0-8	5
ALU 3103	Interior Design	1-0-3	3
ALU 3104	Building Material & Construction-V	3-0-2	4
ALP 3205	Structure-V	2-0-2	3
ALL 3106	History of Architecture-IV	2-0-0	2
ALP 3108	Building Services-II	2-0-0	2
ALL 3110	Hill Architecture	2-0-0	2
ALP 3111	Measure Drawing	0-0-2	1
ALN 3115	Filed Studies-V	Non Credit	0
	Total Credits	**15-0-17**	**24**

Semester VI **Third Year**

Course Code	Course Title	L-T-P	Credit
ALU 3122	Architectural Design-VI	1-0-8	5
ALU 3123	Working Detail	1-0-2	2
ALU 3124	Building Materials & Construction-VI	3-0-2	4
ALP 3225	Structures-VI	2-0-2	3
ALP 3826	Specification & Estimation	2-0-0	2
ALL 3427	Theory of Human Settlement-II	2-0-0	2
ALP 3128	Building Services (Lighting)	1-0-0	1
ALP 3730	Advanced Computer Applications	1-0-2	2
ALN 3135	Field Studies-VI	Non Credit	0
	Total Credits	**13-0-16**	**21**

Semester VII **Fourth Year**

Course Code	Course Title	L-T-P	Credit
ALT 4101	Practical Training	100 days/ sem	21
	Total Credits		**21**

Semester VIII **Fourth Year**

Course Code	Course Title	L-T-P	Credit
ALL 4421	Town Planning & Building Bye Laws	1-0-2	2
ALU 4122	Architectural Design-VII	1-0-8	5
ALU 4523	Urban Design	1-0-2	2
ALU 4124	Building Materials & Construction-VII	3-0-2	4
ALU 4326	Landscape Design-I	1-0-2	2
ALP 4127	Building Services-IV	1-0-2	2
ALU 4128	Housing	1-0-2	2
ALU 4131	Working Detail-I	1-0-2	2
ALN 4135	Field Studies-VII	Non Credit	0
	Total Credits	**10-0-22**	**21**

Semester IX **Fifth Year**

Course Code	Course Title	L-T-P	Credit
ALS 5500	Self Study of Urban/Rural Situation	50 Days	2
ALE 5xxx ALE 5100 ALE 5101 ALE 5102 ALE 5103 ALE 5504 ALE 5505 ALE 5106 ALE 5107	Elective Sustainable Architecture Vernacular Architecture & Vastushastra Earthquake Resistant Buildings Hill Architecture Urban Infrastructure Planning Urban Waste Management Environmental Impact Assessment Environment & Sustainable Development	2-0-0	2

ALE 5508 ALE 5609	Climate Change & Urban Environment Energy Management & Renewable Energy		
ALL 5601	Project Management	1-0-2	2
ALU 5102	Architectural Design-VIII	1-0-8	5
ALU 5104	Building Materials & Construction-VIII	3-0-2	3
ALU 5306	Landscape Design-II	1-0-2	2
ALC 5107	Dissertation	1-0-4	3
ALL 5110	Low Cost Buildings	2-0-0	2
ALN 5115	Field Studies-VIII	-	Audit
	Total Credits	**11-0-18**	**21**

Semester X **Fifth Year**

Course Code	**Course Title (EALE 5xxB – Elective)**	**L-T-P**	**Credit**
ALE 5xxx ALE 5110 ALE 5611 ALE 5112 ALE 5113 ALE 5620 ALE 5621 ALE 5622 ALE 5423 ALE 5624 ALE 5625 ALE 5626	Elective Disaster Management Total Quality Management Traffic & Transportation Building Maintenance Land & Real Estate Development Site & Project Management Contract Management Housing Finance Project Risk Management Materials & Supply Chain Management for Construction Industry Construction Safety Management	2-0-0	2
ALL 5121	Professional Practice	2-0-0	2
ALD 5122	Thesis		18
	Total Credits	**4-0-0**	**22**

Total Credits **= 220 credits**

FIRST YEAR B.ARCHITECTURE SYLLABUS (SEM-1)

ALU 1101 **2-0-2=3**

INTENT

The course has been started with Architectural drawing as support to familiarize the students with basic instruments of drawing & how to draw by scaling, tracing, enlarging and basic understanding of viewing diff. solids followed by further understanding of plan, elevation, section of a three dimensional object. In a way it paves the way to the understanding of drafting skills & the quality of drafting with different presentation techniques and representation of materials.

CONTENT

- Drafting & its instruments & good drafting principles & techniques, Types & Characteristics of lines, Measured drawing, Tracing-simple shapes-reduction-enlargement, Lettering-types-characteristics-styles-techniques & Lettering for Titles, Scale-metric-FPS-use of metric scale understanding.
- Rendering with Representation of materials in pencil – building components such as doors, windows, steps, chajjas, balcony, roofs, levels, furniture, fittings like sanitary, Graphic representation of trees, human figures, automobiles etc – medium pencil & ink, Complex building structures such as shells, vaults saddles. Only sketches and basic understanding.
- Descriptive Geometry-study of geometrical forms in various position projections of solids-spheres cones-pyramids, Orthographic projection-Plan elevation section, Introduction to Isometric, Axonometric and Oblique Projections, Development of surfaces of simple solids, Compound objects & their penetration.

Recommended Reading:

- Architectural Graphics: Ching Francis
- Engineering Drawing: N.D Bhat
- Drafting & Drawing : Muller
- Rendering with Pen & Ink
- AJ Metric Hand Book.
-

Architectural Design-I

ALU 1102 **1-0-8=5**

INTENT

The aim is to introduce students to the subject of Architecture, to introduce Architectural Design as core subject of study & its relationship with other subjects, to introduce the design fundamentals, design vocabulary and emphasize Basic Design as dominant feature of Architectural activity.

CONTENT

- Introduction to Architecture & Design, Approaches through times, Factor affecting architecture of a region, Relationship with other disciplines. School of Architecture, Architectural practice- role of an architect, Professional Bodies.
- Primary elements in Architectural Design: Point, line, plane & volume. Space form order, Exercises related to elements of Architectural Design, Introduction to Principle of Design, 2 D composition, Specific design exercise like textile floor pattern - **door, gate**, mural, screen, compound wall in geometric shapes or any interesting elements-Repetitive pattern & applications.
- Design in nature, Basic design forms & space articulation, 3 D composition- with Cubes, Cylinders, Pyramids, models of space studies explaining organization of form & space, Sketches from observation of Space, Scale, Forms & Proportion natural & man made, Positive & Negative space, An architects work, Design of an object of every day use.
- Anthropometric data as parameter of Design, Furniture layout, Model, sketches & words. Inter relation of Form, Structure, Material to nature as contextual setting.
- Analyzing single activity, single space structures. Keeping in view – Form, Construction, Anthropometric space layout & relationship with surrounding environment, structural and functional components for light, ventilation, Designing single activity or basic shelter – Architectural form with function of space, single space e.g. Gate cabins, Electronic gate, Bus shelters, Monuments, Kiosks, **Children play area**, courtyard with levels etc.

Recommended Books:

- Form, Space & Order: D.K Ching
- Fundamentals in Architecture: Parmar V.S
- Neufert Data Book.

Building Materials & Construction -I

ALU 1104 **3-0-2=4**

To understand basic building elements, their function & behaviour under various conditions. Load bearing & Frame Structure. Basic understanding of materials & construction & the practice.

Various elements of building foundation to roof. Besides materials and construction, processes, skills & equipment used are to be introduced to familiarize students by direct handling and observation.

Workmanship & quality control understanding are also part of the subject teaching.

- **Load bearing construction**- Materials used, **Brick masonry –** tools and equipment, **Brick** – general definitions, bonding , English and Flemish bonds for corner, tee and cross junction in 35 cms,23cms,11cms brick walls, jambs , buttress , pilasters and piers of 45, 35 and 23cms size, section of a compound wall, **Foundation types –** simple foundation in brick, **Stone masonry-** rubble work, uncoursed, coursed, polygonal, ashlar, plain beveled and rebated joints, dowels and cramps, through stones, walls with stones facing and brick backing, **General Wall section -** General wall section from foundation to roof.

BUILDING MATERIALS

- **Stones** - Rocks, Quarrying, Selection, Deterioration , Preservation, Texture, Classification of stones, Tests on rocks, Hardness test, Properties of good stone, Stone dressings of various types, **Bricks -** Clay for bricks, Size, Manufacturing, Characteristics & Properties of good brick, **Sand** - Pit, River, Sea sand, Properties of good sand, Impurities in sand and their removal, **Aggregates, Water.**

Structures-I

ALP 1205 **2-0-2=3**

INTENT

To help students, understand the basic principles of structural behavior and requirements of buildings with emphasis laid more on exposions of principals involved rather than situational intricacies and computational rigour.

CONTENT

- Structure in nature, Man made structures, Functions of structures.
- Static system of coplanar forces and conditions of equilibrium analytical and graphical treatments.
- Reactions for simple statically determinate beams with simple loads, and their combinations analytical treatments.
- Bending moment and shear force diagrams for simple beams with simple loading.
- Centre of gravity and moment of inertia of geometrical figures and structural sections, analytical treatments.
- Graphical analytical solutions of frames.

Note: Following minimum preparatory exercise are recommended to be conducted for better performances at the theory examinations.

- Bending moment and shear force diagrams for simple beams with calculations [min. two empirial sizes sheets A1 – 594x841 mm]
- Graphic solution to at least two types of perfect frames [min. Two Imperial sizes sheets A1 594x841 mm]

Recommended Readings

- Strength of Material By Khurmi R.S.

- Applied Mechanics and Strength of Material by Khurmi R.S
- A text book of Applied Mechanics By Kurmi. R.S.

History: Art, Culture & Civilization

ALP 1106 **1-0-0=1**

INTENT

A Brief reference to shelters with emphasis on development of Art , Architecture & Town planning.

CONTENT

- Pre - Historic Cultures
- Culture – Man, Society& Nature.
- Shelter of Paleolithic, Neolithic's, Bronze & Iron age.
- Development of Art & Architecture in:
  Eastern: Vedic, Indus, Hindu, Chinese, Japanese.
  Western: Egyptian, Inca Mayan, Aegean Greek, Roman, Christian world.
  Central: West Asiatic, Persia, Mesopotamia, Islamic, Indian Art.

Recommended Readings

- Indian Architecture – Maheshwari & Garg.
- The great ages of world Architecture – G.K.Hiraskar
- History of Architecture –Sir Benister Fletcher

Workshop-I

ALP 1107 **0-0-2=1**

- Masonry Works: - Tools used in stone masonry; various kinds of dressing of stone; laying techniques;
- Brick masonry; tools used in laying, bonding, curing etc
- Carpentry and joining: - Tools used. Construction of simple joints such as halved joints single mortice & tenon joint, tongue & groove fixing, butt joint etc. rafter joint in tension and compressive members.
- Mechanical- Machining, Welding, etc.
- Plumbing
- Electrical.

Computer Applications

ALP 1708 **1-0-2=2**

- Introduction and Fundamentals computer (Historical background)
  Binary Number system, Hardware and Software, Block Diagram of representation of computer CPU and Memories, Operating system.

- Basic understanding of Input and Output devices (function of Input and Output devices in computer) Key-board, Mouse, Scanners, Secondary memory devices, Joy stick, Light pen, video, Input devices.
- Video display unit, Printers.
- Introduction to MS Word, Excel & Power point.
- Introduction to basic understanding of application of software- such as Auto Cad.

Art & Basic Design –I

ALU 1110 **2-0-2=3**

CONTENT

- Composition- Basic Design: Chaos to order scale, proportion, proximity, surface tension, balance and rhythm co-ordination skills (eye-mind-hand/perceptual) drawing and painting: drawing with both the hands-lines and geometrical shapes, plants and man made objects. Creative skills Media exploration, ideograms and art lettering.
- Basic Design- harmony character, negative and positive space, form-space interrelation, juxtaposition, and a contrast. Co-ordination skills: (Eye-mind hand / perceptual)
- Drawing and painting: indoor and outdoor sketching, life drawing (Rapid sketching *of* man in action/ motion) creative skills: Sculpture or optics or kinetics.

FIRST YEAR B.ARCHITECTURE SYLLABUS (SEM-II)

Theory of Design-I

ALL 1121 **2-0-0=2**

Aim is to evolve a framework for appreciation of Architecture and Design viz a viz aesthetics. A basic understanding used for translating ideas into architectural expression. The elements that make a design, Awareness of environment, Shapes & Forms used in designing, Materials & their structure –aesthetic limits by way of construction.

CONTENT

- Introduction to Theory of design.
- Scope and application.
- Elements of Design (Line, Plane, Point, Volume)
- Compositions (2D & 3D) in buildings.
- Positive and Negative spaces.
- Objects of everyday use.

- Principles of Design
  a) Axis b) Symmetry c) Balance d) Color e) Texture f) Rhythm g) Hierarchy h) Repetition i) Contrast j) Harmony
- Pattern and Decoration in Design
- Variety & Objective of Design
- Massing (Solids & Voids)
- Exercises related to above with examples from Nature & relating it to architectural form, Exercises from existing architectural forms highlighting above principles.

Architectural Design-II

ALU 1122 **1-0-8=5**

INTENT

Analyzing relationships of more than one activity in a building of simple nature and understanding it from the point of Form, Construction, Materials, Structure, Circulation and Anthropometry.

CONTENT

Analysis of problems

- Space Standards, Human dimensions in various postures, their relationship to dimensioning of everyday utilities like different items of furniture & fixture, Relationship between occupied & unoccupied spaces.
- Importance of Functional & Physical factors in Architectural Design, Basic requirements of Design e.g. Climate, Ventilation, Light, Orientation, Site Planning and Landscaping, Site information and design, Structural stability & behavior of material, Designing progressively complex spaces & buildings e.g. **Snack** bars, Exhibition stalls, **Weekend cottages**, Bandstand etc.
- Study spaces in the cluster environment & their interrelationship, Study of settlement environment-visit to nearby settlement to study spaces in the cluster environment with emphasis on Life style, Climate, Vegetation, Social structure, Common space.

Art & Graphics-II

ALU 1123 **2-0-2=3**

(A)

- Section of solids
- Inter penetration of solids
- Development of surfaces
- Axonometric, one point perspective with method
- Presentation of exterior views in one point perspective (drafted and free hand)

(B)

- Effect of line drawing
- Light & shade
- Elements and Principles of visual composition
- The emphasis shall be on free hand sketching based on previous exercises by highlighting the following- small building along with human fig trees, automobiles to give sense of scale.
- Introduction of colours, colour wheel, application in pattern, mural, building & landscape.
- Use of crayons, water colour, pastel colour
- Clay modelling

Building Materials & Construction-II

ALU 1124 **3-0-2=4**

BUILDING CONSTRUCTIONS

- **Foundations**- in bricks & in different soils, **Lintels and arches-** Brick, stone, timbers and R.C.C. lintels, flat, segmental, semicircular, parabolic, elliptical arches in brick and stone , **Joinery in timber** – doors- types & construction, individual door designs, windows- types & construction, windows with vent, fixing frames in masonry & jamb casing & window sills, **Roof types & construction-** terms, singled purline roofs, trussed rafter roofs, **Detailed Wall section –** detailed exterior wall section from ground to roof, **Models**- models of roofs or windows / doors.

BUILDING MATERIALS

- **LIME-** Ore, quick lime, hydraulic lime, lime mortar mix and preparation, efflorescence peeling and flaking, **CEMENT-** composition and manufacture, properties, kilns, testing for cement mortars & plasters, Cement concrete & Structural concrete, **TIMBER-** Method of felling trees, Seasoning. Sawing and Planning, timber sections, Timber Boards, Plywood and Preservatives, Block Boards and Fibre Boards.

Structures-II

ALP 1225 **2-0-2=3**

- Stress, Strain, elastic constants, elastic behavior of material and Hook's law and yield point, stress stain diagrams for steel, timber and concrete.
- Compressive, tensile and shear stresses and strains.
- Theory of simple bending, bending moment and moment of resistance, section modulus.
- Bending and shear stress distribution in simple sections.
- Direct and bending stresses in compression members.
- Deflections in simply supported beams and cantilevers.

- Double integration method [problems of full, uniformly distributed load and point load]
- Types of supports & their characteristics.
- Concept of statically indeterminate structures, Degree of indeterminacy.
- Propped cantilevers: standard loadings.

SESSIONAL WORK

- Minimum one tutorial based on problems set on following topics [for better preparation at Theory Examination], Stress and strains, Bending and shear stresses, Deflection of simple beam with simple loading.

Recommended Readings

- Strength of Material By Khurmi R.S
- Applied Mechanics and Strength of Material By Khurmi R.S
- A text book of Applied Mechanics By Khurmi R.S

History of Architecture-I

ALL 1126 **2-0-0=2**

- **Pre historic :** Terre Atma, Skara Brae, the megaliths, Composite such as stone henge,
- Beginning of Agriculture and settled life, First settlement like Jericho, catal Huyuk.
- **The First Civilization:** Mesopotamia & Elam, Sumerians, Assyria & the new Babylon,
- Persian & Sassanian empire
- **Indus valley civilization & Aryans and Vedic Age:** Mohenjodhero and Harappa, Forest Dwellings,
- Kutia and Grama
- **Egypt:** Social system, religious beliefs, science and writing, Evolution of tomb architecture, Mastabas, pyramids at Saqqara, Medum and giza, Mortuary temples: Hatseshut, Cult Temples at luxor and karnak
- **Greek Architecture:** Ancient Greeks
- **Roman Architecture:** The Romans

Surveying & Levelling

ALP 1827 **1-0-2=2**

INTENT

To acquaint students with the physical Surveying and Leveling work in order to:

- Measure and document built and un built interior and exterior open spaces.
- Preparation and documentation of rural / urban open and built spaces.
- Preparation and interpretation of Base Map for Architectural Design Projects.
- Reading and interpretation of existing and historical maps and other related documents.

CONTENT

Unit I: Methods of Surveying: Chain and Compass, Plane Table Survey, Computation of areas.
Unit II: Methods of Leveling: Contour Survey, Use of Theodolite.
Unit III: Use of electronic equipment like EDM, Total Station etc.
Unit IV: Introduction of remote sensing and photographic surveying etc.

RECOMMENDED READING:

- Surveying and Leveling Vol. 1 and 2 – T.P. Kanetkar and S.V. Kulkarni.
- Surveying – Banister and Raymand.
- Surveying and Leveling – G.B. Deshpande.
- Surveying and Leveling – R.S. Deshpande.
- Concise Practical Surveying R.F. Lane and W.C. Cartin.
- Elements of Civil Engineering A.P. Dongre.

TEACHING PLAN

PART I: SURVEYING:
UNIT I:

1.1 Definition, Objective, Fundamental principles, Plane and geodetic surveying classification of surveying, scale of drawings, representative fraction of scale, plain diagonal and vernier scales.

1.2 Methods of surveying: chain surveying and its suitability, selection of survey stations, ranging a survey line, direct and indirect method, offsets, equipment required for chain surveying, principles of chain surveying, field work, base line, tie line, check line, errors in chain surveying.
Chaining on sloping ground, direct and indirect method, obstacles in chaining, chain and cross staff survey, and calculation of area.

1.3 Chain and compass surveying: open and closed traverse, prismatic compass, its component parts and adjustments, bearing of survey line, whole circle bearing, reduced bearing for line, fore and back bearing, true and meridian and magnetic meridians, computation of included angles from bearing, local attraction and its correction, chain and compass, closed traverse survey, plotting and its adjustments by Bowditch Method.

1.4 Plane table surveying: Merit and demerits, equipments required, adjustments of plane table, orientation by different method, radiation and intersection method. Plane table traverse survey, errors in plane table surveying.

UNIT 2:

2.1 Computation of areas.

2.2 Computation of areas of figures having irregular boundaries by mechanical planimeter, introduction to digital planimeter.

UNIT 3: Leveling:

3.1 Definition of level surface, level line, horizontal surface, horizontal line, datum surface, bench mark, types of bench marks, fore sight, back sight, intermediate sight, change point.

3.2 Dumpy level, tilting level, leveling staff, temporary adjustments, introduction to automatic levels, simple and differential leveling, recording of levels in field book, reduction level by collimation plane method and rise and fall method, fly and check leveling, profile leveling and cross sectioning.

3.3 Contour Survey: contour line, contour interval, horizontal equivalent, characteristics of contours, use of contour maps, methods contouring, direct and indirect method of preparation of contour maps, interpolation of contours.

3.4 Theodolite Survey: various uses, least count, temporary and permanent adjustments of vernier theodolites, measurement of horizontal angle by repetition and reiteration methods, measurement of vertical angles, computation of building height by theodolite, lining in, prolonging a given line, checking, verification etc.

UNIT 4: MODERN ELECTRONIC EQUIPMENTS:

Application of electronic distance meter, classification of electronic distance meter, basic principle, modulation and types of modulation, operating procedure of EDM, total station, features and functions, use of computer tools like scanning, digitizing, for mapping purpose, photographic surveying and its use.

SESSIONAL WORK:

The sessional work shall be based on following type of assignments drawn to appropriate scale.
Measuring and documentation private built and open space and its surroundings with tools like chain compass, plane table etc.
Measuring and documenting public built and unbuilt spaces by using equipment like Theodolite and Dumpy level.
Measuring, updating and preparing base map using latest modern equipments.
Improving and upgrading the existing drawing maps to computer generated drawings of old cities of India.

NOTE: All the above practicals to be formulated in consultation with Architectural Design and Architectural Drawing and Graphics Faculty. For graphical presentation all the references of above mentioned subjects shall be used.

Computer Applications

ALP 1728 **0-0-2=1**

CONTENT

Computer Aided Design, presentation, 3 D Design using different softwares like ArchiCAD, Revit and AutoCAD.

SECOND YEAR B.ARCHITECTURE SYLLABUS (SEM-III)

Climatology & Energy

ALL 2101 **3-0-0=3**

Climate and Weather as determinants of Design Form of Habitat and Landscape with historical reference. Introduction to climatology, Global Climatic Factors, Basic elements of climate, temperature, humidity, wind, solar radiation, vegetation etc. Their measurements and effect. Climatic zones and classification - tropical climate, cool temperature, hot - dry, hot - humid etc.
Means of Thermal control, Thermal Qualities- Heat and Temperature, Heat Flow, Solar Factors, Thermal Comfort, conditions effective temperature and heat balance---Solar Radiation Position of sun and methods of recording it, solar penetration inside buildings; Solar charts and shadow angle protector and their use. Solar control design of shading devices, Solar Azimuth and Altitude, Angle of incidence, Wall Azimuth, Shadow angles, over heated periods sun path diagrams structural controls
Control of heat through vegetation--- Wind: - Seasonal variations. Wind direction and speed and their impact on planning various land uses in city. Heating and cooling effects through topography and location of buildings
Ventilation and air movement, Air flow pattern inside and around buildings.
Macro Climate:- Effects of topography and natural build up surroundings. Human comfort conditions and design of various building element to gain comfort, Site selection, site planning and orientation of buildings---energy crisis, solar radiation, active passive methods of cooling and heating
Light and lighting Principle of Illumination & day lighting,
Response to climate by man & building. Application in various climates for shelters.
Sound and Noise control, problems in tropics
Study of building materials & construction techniques of energy efficient buildings design for tropical climate.

Text Books: 1. Koneigs berger – Manual of Tropical Housing and Building
2. Arvind Krishan – Climate responsive architecture

Architectural Design-III

ALU 2102 **1-0-8=5**

INTENT

The aim of the course is to emphasize and evolve the methodology for Architectural Design with reference to the previous knowledge of function and aesthetics. The design should highlight the clear approach to the design with idea (concept), analysis, synthesis and clarity of details and Architectural expression with use of appropriate graphic presentation techniques. Data collection, climatic considerations shall form part of the work. Emphases to be given on load bearing construction methods.

CONTENT

Design of progressively complex spaces like small domestic building with particular reference to room use and circulation like field rest house, hostel or **nursery school** etc. (detailed aspects of important constructional details and elements of structure). Role players in the design of building. Followed by computer rendering of one topic.

Designing progressively complex spaces and buildings together with site planning. Initially single storied of low rise nature e.g. Bank with Managers Residence, Professional Office/ Work Space with Residence, Colony level Community center, Convenient shopping center, Polyclinic, Town Bus stand, Small Hostel/Hotel etc.

Study of small town environment- visit to nearby town to study its anatomy & growth and the form as it is; brief analysis of function of spaces.

Art & Graphics-III

ALU 2103 **2-0-2=3**

Perspective by two point perspective.

- Sciography of Planes.
- Study of Paper Forms: This assignment shall include explorations of various folded paper forms and its possible use in Architectural Spaces.
- Study of Solids and Voids: This assignment shall include creation of abstract and semi abstract symbolic sculptural forms and spaces.
- Mural in relief work with scale model – Wood, Clay and P.O.P.

Building Materials & Construction -III

ALU 2104 **3-0-2=4**

BUILDING CONSTRUCTION

- **Steel windows-** steel casement windows, with fixtures and fitting and method of fixing, **Timber floors-** Single, double and framed floors with joints between joist with wall plate, corbels in timber floors, joist with beam and sub beam with main beam, strutting of joists, use of templates for support- G.F. & F.F., **Stair cases-** All types, relation of tread and riser , Flights of stairways in stone and timber, balusters and handrail in stone, timber and steel, details of joints, Construction detail of timber stairs, **Models** – models of free standing, cantilever, dog-legged stair.

BUILDING MATERIALS

- **PAINTS AND VARNISHES-** composition, manufacture and properties and uses of ordinary paints. Varnishes and wood preservatives, method of distempering wall surfaces, and painting of timber and iron work, **ROOFING SHEETS AND TILES-** Corrugated galvanized iron sheets and asbestos cement sheets with accessories shingles etc. and method of their fixing. Clay tiles- Mangalore, Allahabad and country type tiles, their properties and method of fixing, slating & tiling, **GLASS-** History, manufacturing, Use, Etching, Beveling, Stained glass, **Ferrous and Non-Ferrous Metals-** Cast iron, Steel, Aluminium & its alloys, Steel in market- hot rolled bars, CTD bars, TMT, Prestressed, Mild steel sections

Structures-III

ALP 2205 **2-0-2=3**

- S. Structure sections, study of Steel tables, tension members: single & built-up sections.
- Compression members: single and built-up sections, column base: slab & gussetted base.
- Beams: Simple & built-up.
- Steel joints and connections.
- Design of roof truss:
  a) To determine the forces in members due to various loads.
  b) Complete design of truss (sessional work only).

* Introduction to castellated girders.

* Introduction to crane girders, steel plate girders.

Note:

- Sessional work should include design and analysis of simple elements as stated above with drawings.
- Steel table & I.S. code 800 is permitted in examination.

History of Architecture-II

ALL 2106 **2-0-0=2**

- **South Asia :** Hindu, Buddhist and Jain Style
- **Buddhist Architecture:** Its origin and association in India

- **Hindu Architecture:** North Indian Temple Architecture (circa 6th -1tn C) , Important temples in North and Central India, Orissa, Khajoraho etc, South Indian temple architecture under the Chalukyas, Pallavas, Cholas, Pandyas and important temples like Meenakashi
- **Jain Architecture**
- **China and Japan :** Traditional Wooden Architecture & Buddhist Influence
-

Workshop (Model Making)-II

ALP 2707 **0-0-2=1**

INTENT

To help students learn the importance of model making and acquire the skills in constructing three dimensional forms using different model making materials and equipment, using different scale and also develop dexterity of hand in manipulation of different materials.

CONTENT

- Introduction to various materials used for model making.
- Use of various instruments required for model making.
- Use of various adhesives and joining techniques.
- Importance of appropriate use of colours in model making and methods of colouring the models.
- Experiments with various materials and equipment in terms of preparation of basic forms/geometrical forms with appropriate scale and dimensions.
- Introduction to various types of models such as site model, study model, block model and finished presentation models.
- Importance of various types of models to appropriate stages of Architectural Design.
- Use of appropriate scales, suitable to various types of models.
- Study & preparation of model of a complete built structure.
- Elementary joinery in wood & plywood.
- Working with metal sheets, wires, etc.
- Tools used for stone and brick masonry and surface covering.
- Paper/Cardboard, Thermocol---Corks sheet.--- Plaster of Paris, Clay. --- Wood Plywood, Acrylic Sheets --- M.S Wires.

Sociology

ALL 2808 **1-0-0=1**

INTENT

To understand importance of social environment. To expose students to aspects that effect built up environment.

CONTENT

Man and Environment. Man as social animal. Traditional patterns and trends of change in Indian society. Human nature and processes of socialization. Types of society. Concepts of social structure, culture and social institutions. Cultural identity and diversity. Elements of culture-folkways. Norms, meres, values, laws. Social and cultural change. Resistance to change. Meaning of Environment, natural & cultural. Relation of natural environment & culture, cultural choice. Population and Demograpgy. Globalization and social life. Traditional city. Urbanization. Relation between social structure and spatial structure. Social aspects of housing. Human behaviour in high rise buildings. Social problems of slums. Perception and Principles of Perception. Attitude and Behaviour. Various types of environments and related patterns of behaviour. An area level study of settlement with reference to social-economic aspects

SECOND YEAR B.ARCHITECTURE SYLLABUS (SEM-IV)

Theory of Design-II

ALL 2121 **2-0-0=2**

- Introduction to Principles of Design
- Interdependence of Function, Structure and Form of Architectural Design
- Form & Structure of any organism regarded as a whole
- Form & its relationship to function
- Form & Space
- Organization
- Circulation (Vertical & Horizontal)
- Orientation
- Proportion & Scale
- Types of Planning
- Function & style in Architecture.
- Exercises related to above.

Architectural Design-IV

ALU 2122 **1-0-8=5**

Emphasis on Site planning & environmental concerns with inputs of construction methods, structural awareness. Data collection and its utilization shall also be emphasized.

Problems relating to two – storeyed & split level structures such as houses, community halls, libraries, **art gallery**, etc. with Drafting & Presentation skills. Problems related to Emphasis on site planning & concepts of shared open space. Typical Details regarding Materials, Construction & Structure.
Followed by one small computer rendering.

Art & Graphics-IV

ALU 2123 **2-0-2=3**

(A)

- Three point Perspective.
- Sciography in Perspectives.
- Example of an urban scape.

(B)

- Study of Fluid / Plastic Forms: This assignment shall include use of clay, plaster or any other mouldable material and create plastic and free flowing Sculptural forms.
- Building Appraisal: In this assignment the students shall be asked to present analytical study of any sculptural building form with critical appraisal.
- Mural or sculpture in clay, wood & p.o.p or any building material – one exercise with theme.

Building Materials & Construction -IV

ALU 2124 **3-0-2=4**

BUILDING CONSTRUCTION

- **Timber Trusses-** King post and queen post trusses with details of joints, alternative arrangements for tile and sheet roof covering, detail of eaves projection with soffit boarding, details of gutter at eaves, sprocket joint, **Light Partitions-** timber, asbestos sheet and soft board and glazed partitions, W.I. and R.C.C. grilled enclosures, bison board
- **False Ceiling-** False Ceiling of asbestos sheets, soft boards, acoustic boards, plaster of Paris etc. on timber and steel or aluminum frame work, details of lighting and air conditioning grid panels, concealed lighting, plastered ceilings, **Hollow Walls-** Cavity walls in brick and hollow concrete blocks, **Foundation-** All types- details- isolated, eccentric, combined.

BUILDING MATERIAL

- **Eco Friendly Boards -** Eco-boards, Soft Boards, Nuwood, Industrial timber products, Ply- plywood manufacturing, laminated boards, Particle board, Fibre board, Block board, Bison board, Laminates, **Natural Floor Finishes-** Shahabad, Kotah, Marble, Granite etc.
- **Artificial Floors Finishes-** Vitrified tiles, Ceramic tiles, Mosaic tiles, Cement tiles, Paver Block- with typical design & layout as.

Structures-IV

ALP 2225 **2-0-2=3**

CONTENT

- Fixed beams.
- Continuous beams , three moment theorem.
- Moment distribution method (Beams only).
- Approximate methods for an analysis of frames by Portal & Cantilever methods.
- Introduction to R.C.C: (working stress method). Design of singly-reinforced beams.
- Introduction to doubly and T-beam (No design).
- Strength, Stiffness, Stability and factors affecting them.

Note: Sessional work should include the analysis of simple elements along with the drawings.

History of Architecture-III

ALL 2126 **2-0-0=2**

- **Early Christian and Byzantine Style**
- **Islamic Architecture:** Early Islamic architecture in the Middle East, Architecture in Mediterranean regions & Islamic architecture in India
- **Romanesque:**
- **Gothic Architecture in Continental Europe and England:** Great Cathedrals- Notre Dam, Canterbury etc.

Workshop-III (CAD)

ALP 2727 **0-0-2=1**

Contents: CAD Application,REVIT, & ARCHICAD

Building Services-I

ALP 2128 **1-0-2=2**

A) SANITATION:

Basic principles of sanitation, introduction to modern plumbing system. Study of Indian standards & plumbing bye laws. General introduction to various sanitary fitting & fixtures their placement & functions. Study of

internal & external drainage system including study of duct for large variety of buildings including small residences, apartments, block of houses, public buildings etc.
Study of various types of sanitary pipes & drains in CI, stoneware, asbestos cement. Construction of joints & laying of pipes. Study of traps, inspection & interception, chamber, manhole, refuse chutes & methods of refuse disposal, septic tanks, soak pit & public sewage line. Study of various stages of disposal of domestic effluent from fitting to sewer line. Study of toilet details. Study of storm water disposal in various buildings & road side.
Importance of sanitary services in the economics of buildings, planning, & design disposal of city effluent, various treatment methods of city effluent & recycle of waste water. Study of refuse chutes in multistoried buildings & collection of refuse & recycle of city solid wastes.

B) WATER SUPPLY:
Purification, filtration, sterilization, water softening etc. Study of sources of water & water treatment for city domestic purpose using
Water supply fittings-Plumbing systems.
Study of Indian standards & water supply network. Architectural approach to plan the domestic water storage facilities & water distribution system in a building. Hot water supply, etc. (under ground & over headed)

THIRD YEAR B.ARCHITECTURE SYLLABUS (SEM-V)

Theory of Design-III

ALL 3101 **2-0-0=2**

Seminars and study on Contemporary Architectural thoughts, works and lives of Architects. Methodologies – Design as problem solving process. Chicago school and Louis Sullivan, Frank Lloyd Wright's organic Architecture -----Le Corbusier-his life, works, principles of design, Chandigarh - Design concept-Mies Van Der Rohe less is More, skin and bone construction.- Walter Gropius- his works, Bauhaus. The Architects, Collaborative----An Introduction to:- Alvar Aalto-----Eero Sarinen---Paul Rudolph.---Philip Johnson------Charles Correa---Louis L. Kahn. --- U C Jain --- Ranjit Sabiki—Raj Rewal---Kanvinde

Architectural Design - V

ALU 3102 **1-0-8=5**

INTENT
To progressively introduce students to multiuse and complex Architectural-Structural situations, in continuity to the previous work and introduce students to philosophies followed by Architects.
CONTENT
Study of interior spaces with reference to walls, openings, placements of furniture etc while keeping in view efficiency of circulation & spatial design concepts.
Problem relating to Design of building involving circulation, interrelation of different spaces such as small college, hospital office building, **flats** etc.
Followed by computer design with emphasis on 3-D.

Interior Design-I

ALU 3103 **1-0-3=3**

Part-I
- Role , Importance & purpose of Interior Design
- Interior design in historical prospective
- Principles, elements of interior design and Space organization their application in the context of residential, commercial. institutional interior spaces.
- Colours and Texture in interiors.
- Elements of Interior Furnishings, Accessories, Decorative Elements and their role in interior design – furniture, fabrics, murals, paintings, sculpture, lighting fixtures, floor coverings, wall coverings and related materials.
- Artificial and Natural Lighting in Interior Designing.

Part-II
- Traditional and modern building materials for interior finishes.
- Built in furniture and moveable furniture.
- Electrical and mechanical services and their integration into interior design schemes.
- Interior Landscaping – Elements, Plants etc.
- Treatment of Floors, Walls, Partitions, Ceilings in Interior Design.

Part-III
- Students would be required to take up a small project during the semester such as Commercial Building , Office/Public Building, Conference Hall, Auditorium etc. and prepare a detailed Interior Design Scheme including preparation of Presentation/Working Drawings based on the study of the subject and Library/Live Projects.

- Student would also be required to visit actual site where Interior Designing work is being carried out.

Building Materials & Construction-V

ALU 3104 **3-0-2=4**

BUILDING CONSTRUCTION

Advanced Doors and Windows- Heavy Panelled and moulded doors in timber, fully glazed sliding & folding doors and windows sliding and bay windows, rolling shutters, **Curtain Walls-** Curtain walls in glass, aluminum, Precast concrete units etc. for buildings like laboratories, offices, cinemas etc, **R.C.C. Construction-** Frame Construction, advantages over load bearing construction, study of column grid, detailing of R.C.C. work with reinforcement for slabs, beams, columns, footing, **DPC-** Bitumen as the well or asphalt felt, PVC -0.5 or 1mm thick, Fire places & niches in different materials.

BUILDING MATERIAL

- **Concrete blocks-** manufacturing, hollow & solid, dimensions, classification, use in buildings, testing of blocks, **Plastics –** PVC-Reinforced Plastics, **Rubber, Cork, Parquetry.**

Structures-V

ALP 3205 **2-0-2=3**

CONTENT

- Introduction to ultimate load theory.
- Introduction to characteristic requirements of Structural Design.
- Introduction to Limit State method.
- Structural properties of basic materials like Masonry, Concrete & Steel.
- Design of doubly reinforced beams.
- Design of 'T' and lintel beams.
- Design of slabs: one way, cantilever, continuous.
- Design of axially loaded column & column footing (isolated)
- Design of stair-cases: Dog-legged & open well.

NOTE:

- I.S code 456 is permitted in examination.
- Sessional work should include the analysis and design of simple elements along with the drawings.

History of Architecture-IV

ALL 3106 **2-0-0=2**

- **Renaissance Architecture in Europe:** Early to High Renaissance, St. Maria Del Fiore, Florence, Late Renaissance, Baroque, Michelangelo, Palladio, St. Peters (Rome), St. Paul's (London)
- **Baroque and Neo Classicism:**
- **19th Century and Industrial Revolution:** Technical Transformation, Industrial Revolution New Materials, Concrete, Iron, Glass
- **Modern Architecture:** Introduction to " Modernity" " Modernization" " Modernism" Culture, Territorial & Technical transformations that let to Advent of Modern Architecture Cultural Transformation, Frank Lloyd Wright Organic Architecture, Prairie House, Usonian House, Antonio Gaudi, Otto Wagner, H.P. Berlage, Le-Corbusier & Esprit Nouveau, Bauhaus- Walter Gropius, Cubism De Stijl & New Conception of Space, Mies Van Der Rohe, Spatial Compositions & Abstract Masses, Aalvar Aalto, Louis Kahn, Pluralism in the 1970s
-

Building Services – II (Electrical, Mechanical & Fire Fighting)

ALP 3108 **2-0-3=2**

ELECTRICAL:

Fundamentals of electricity, principles of wiring & electrical circuits. Ohm's Kirchol's law. Wires specification & current carrying capacity--- Fitting & accessories used in electrical installation of buildings including water proof & spark proof installation. Schematic diagrams of installation for different building types, lighting conductors, earthing, distribution & calculation of loads.---Brief study of electrical appliances, transformers, sub-station, location & space requirement, relevant electricity board rules for various types of buildings.---Illumination: Laws of illumination. Direct, indirect & semi direct lighting, reflectors, decorative lighting. Flood lighting & use artificial lighting as an element in architectural schemes particularly in exhibition, cinemas, theaters, concert, concert halls & stadiums.---Rules & layout for telephone wiring & connection with EPBX.

MECHANICAL:

He fundamentals of psychometric & heat transfer. Physiological effects of air conditioning. ---Difference between air cooling & air conditioning.---Air conditioning methods, systems, types & equipment to maintain the atmosphere at required temperature, humidity & cleanliness. Requirement of comfort conditions, control of temperature & humidity. Means of mechanical ventilation. Blowers & exhaust fan like propeller fans & centrifugal fans system. Fan coil units & air handling units.---A.C duct designing, detailing & layout.(No calculations required)---Lifts, moving walkways & escalators, layout of lifts & or escalators in buildings. Operation & how it functions. Lift well, machine room etc.---Ideal locations ventilation, number & size of lift cars. Escalators functioning, installation & suitability of escalators.

FIRE FIGHTING:

Apparatus & system of alarms, fire fighting equipments, firefighting bye-laws governing various types of public buildings.---Fire protection causes & spread of fire, combustibility of material & fire resistance, fire protection means of escape staircases smoke detectors, fire dampers, fire doors, water curtains etc.

Hill Architecture

ALL 3110 **2-0-0=2**

CONTENTS

UNIT . I

- Historical perspective of hill architecture and its unique attributes and concerns.
- Major hill settlements in various regions of the world.
- A broad view of traditional hill architecture of medieval European settlements and other places.

UNIT . II

- Traditional hill settlements in India.
- An overview of vernacular hill architecture of Himachal Pradesh.
- Building Types, techniques and materials of vernacular architecture of Himachal Pradesh.
- Lessons from vernacular architecture and their time tested indigenous technology.

UNIT . III

- Modern buildings on hills in India.
- Constraints of climate, topography and availability of materials.
- Design factors such as access, circulation and gradients.
- Structural aspects of modern buildings and necessary safeguards.
- Environmental and ecological concerns and safeguards.

RECOMMENDED BOOKS

- The Architectural Heritage of Himachal Pradesh . Thakur
- Hill Cities of Eastern Himalayas . Sinha & Chacko

Measured Drawing

ALP 3111 **0-0-2=1**

CONTENTS

Students will have to prepare detail measured drawing of the historical monument whuch they have studied, surveyed and measured in the study tour conducted during the vacations before the commencement of the semester. Drawings shall include detailed plans, elevations , sections, views and architectural details.

THIRD YEAR B.ARCHITECTURE SYLLABUS (SEM-VI)

Architectural Design - VI

ALU 3122 **1-0-8=5**

INTENT

Architecture with emphasis on layout of services and availability of technology.

CONTENT

Design of group housing, flats, **commercial complex**, working drawing with specifications, layout of services and estimate of cost.

Working Detail

ALU 3123 **1-0-2=2**

Intent: To understand the significance of detail drawings in the process of construction.

Content: To prepare the detailed working drawings of any of the design studio problems held in semester II/III/IV.

Building Materials & Construction -VI

ALU 3124 **3-0-2=4**

BUILDING CONSTRUCTION

- **Decorative Wall Finishing and Treatment** – Stone facing of various types (stone, marble, granite slab etc.) for walls, decorative patterns in brick, stone for wall treatment, wall lining in soft board timber etc. for offices, **Structural Steel Construction** – Detailing of structural steel with connections for beams, stanchions, grillage footings, stairways, plate girders, **Trusses**- trusses of various types including those for North Light Factories, verendeel girders, castelleted beams. Expansion Joints, **Patent Glazing** - Patent glazing for skylights, lanterns, north light trusses etc.

BUILDING MATERIAL

- Abrasives, Lubricants, Epoxy resins, Joint fillers, Sealants, Adhesives, Asphalt, Bitumen & Tar, Anti Termite treatment & Wood Preservatives , Fly-ash, Fly-ash concrete, Ferro cement.

Structures-VI

ALP 3225 **2-0-2=3**

INTENT

To acquaint students with different structural systems.

CONTENT

- Introduction (no calculations) to concepts only and IS requirements of
    1. Flat Slabs
    2. Ribbed and hollow block slabs.
    3. Pre-cast and pre-fabricated units.

- Introduction to use of computers in structural analysis.

- Introduction (no calculation) to advanced structures.

    1. Conceptual structural systems for high-rise buildings such as vierendeel, trusses, sheer walls, etc.
    2. Domes, shells, vaults, arches (all types) in masonry, RCC, timber.
    3. Space frames, geodesic domes.
    4. Modern construction systems such as lift slab, folded plates, tensile structures, etc.
    5. Large –span roofing, special areas like gym, airports, stadiums.

- Compound stanchion:
    1. Simple problems
    2. Lacing: Finding spacing and size of lacing.
    3. Battens: Finding spacing and size by IS provisions (no detail design).

- Structural design aspects of important building types (no calculations)
    1. Theatres and Auditoriums
    2. Sports pavilion and Gymnasium building.
    3. Swimming pools.
    4. Cantilever Canopies.

- Specific constructional considerations for earthquake resistant structures, structures in coastal areas, eco-friendly structures.
- Introduction to Prestressed concrete : Definitions, difference between R C C & pre stressed concrete, advantage & dis-advantages, type of methods pf pre-stressing, simple problem on calculate on of resultant stresses of external force etc.

Specifications & Estimation

ALL 3826 **2-0-0 =2**

Definition, importance and scope of the subject correct form of writing specifications, avoiding ambiguity and confusing statements, from and sequences of clauses. Study and uses of standard specifications viz. Drafted by CPWD etc.---Writing detailed specification for various building material, bricks, lime, sand, timber, glass and paints etc---Writing detailed specifications for various building construction work etc. earth work for foundations, trenches for foundations, super structure in cement mortar, R.B.Work, plastering and painting and lime flooring, white washing, distempering and painting, Snow-Cem wash stone masonry, Mud phuska, terracing and others.

Estimates, types of estimate approximate and detailed methods of approximate estimating, plinth area methods, carpet floor area method, cubic content methods, approximate content method and number system---Detailed estimate, procedure of estimating, taking out quantities, bill of quantities, schedule of rates---Exercise in estimation (with different methods) of small buildings, estimating exercises for interior schemes, plumbing work, and electrical installation etc---Rate analysis: Principles and analysis of different rate of Labor and material, exercises in rate analysis of different building work i.e. Earth work for foundation, flooring, timber work etc---Introduction to P. W. D. accounts procedure, measurement book, daily Labor and master roll stores, stock issue of material from stock indent from, imprested account, cash book mode of payment.

Theory of Human Settlement-II

ALL 3427 **2-0-0=2**

Intent: To understand the role of cultural, Environmental, Physical, Social, Political and Economic Systems in the evolution of Human Settlements in Modern Context.

Contents:

- Industrial Revolution and its impact on Urban Settlement
- Improvement and expansion of existing towns and various theories proposed by renowned architect like F.L W & Le-Corbusier
- Garden City Movements- philosophy, Principals of planning and study of Letch worth & Welwyn
- Study of New Towns in India like Chandigarh, Gandhi Nagar, Navi Mumbai and Bhubaneshwar.
- Need for Planning, Planning norms and its importance in shaping cities.

Building Services-III (Lighting)

ALP 3128 **1-0-0=1**

Architectural Lighting. Aesthetics and Functions-Day light and Interior Lighting: Concept-----Calculation of illuminance and glare. Luminance Design. Luminance Light Source.---Calculation of daylight factor, Design of India sk---illumination required for various types of building such as residential commercial, Industrial, educational, recreational, health cultural buildings.

Advanced Computer Applications in Architecture

ALP 3730 **1-0-2=2**

CONTENTS

- 3D Rendering in 3d Max, Revit and Photoshop:-Introduction to 3D Rendering, Simulating the Sunlight angle,
- Adding shadows, Adding Materials and adjusting it.s appearance, Adding a background scene, Effects with light,
- Adding Reflections and details with Ray Tracing, Creating and adjusting Texture maps, Adding Landscape and people and Improving your images and editing.

FOURTH YEAR B.ARCHITECTURE SYLLABUS (SEM-VII)

PRACTICAL TRAINING

ALT 4101 **100 days/ Sem=21**

FOURTH YEAR B.ARCHITECTURE SYLLABUS (SEM-VIII)

Town Planning & Building Bye-Laws

ALP 4121 **1-0-2=2**

INTENT

To study Town Planning & Bye-laws. Their evolution from time to time & discipline of placing buildings, there by evolved.

CONTENT

- Introduction to Town Planning, Origin & Growth. Principles of objectives of town planning (Zoning, open spaces, land use etc).
- Neighborhood definitions, its relationship with the town planning and its functions and elements, street patterns, neighborhood density.
- Master Plan and its components. Suitability of site for town development: Planning acts, Bye-laws land acquisition act, urban land ceiling Act etc. State bye laws
- City Plan Pattern based on road systems. Road section and their function in residential area and their connections with roads.
- Appraisal of existing condition in India and remedial measures with emphasis on physical planning.
- National Building code. DCR, Fire Fighting, Etc.
- F.S.I F.A.R, Building Bye- Laws
- Exercise based on subdivision of land with area approx. 5 Hectares. For this example understanding of norms and standards of Land use Allocation, Public amenities, Open spaces, Road site, is to be incorporated.

Architectural Design-VII

ALU 4122 **1-0-8=5**

INTENT

In the design studio, stress is to be given on building design with use of modern technology. Multistoried building with use of lifts, escalators, air conditioning etc. Stress is also to be given on detailing of the services, parking & fire fighting.

CONTENT

Problem should be of different nature in terms of scale, site potentials & constraints e.g. Factories, Educational, Hotel, Multistoried offices, Apartments, Commercial, Institutional.

Design constraints like climate, site, circulation, structure services & context shell in the design be emphasized.

Urban Design

ALU 4523 **1-0-2=2**

CONTENTS

- Definition of Urban design, scope of urban design under Indian context and its integration with urban planning.
- Historical development and approach to urban design – spatial organization, classical, functional, ornamental, etc.
- Urban form, its elements, visual order of form, sequence, scale, and visual space dynamics. The various surveys needed to document visual aspects of environs.

- Urban structure and design rational inter - relationship between economic activities, public organization, communication systems, urban conservation and land- use structure.
- Review and designing of urban renewal and redevelopment projects for old and new towns.
-

Team work:
Case studies of any one Urban design project in detail or works of any one of the Urban Designers. A report on the same of 5000 words with photographs or sketches.

Building Materials & Construction -VII

ALU 4124 **3-0-2=3**

BUILDING CONSTRUCTION

- **Advanced Foundations** – Combined and Eccentric footing, raft foundations, pile foundations, details of pile and pile cap, diaphragm wall in timber, R. C. C. and Steel, buoyant foundations, basement and methods of water proofing, (stepped foundation for sloping sites) **Advanced floors** – Flat slab, diagonal and rectangular ribbed floor hollow floors , reinforced brick floors, **Canopies and Balconies** – Canopies for office buildings in R. C. C., steel, glass and cinema balconies in R. C. C. and steel with false ceiling and concealed lighting, **Furniture Design** - Counters of various types for enquiry, bar and bank, cooking ranges, room divider furniture, built in ward robe, speakers rostrum, kitchen cabinets, **Sound Proof Construction** - Sound proof partitions and doors for recording studios, Cinemas, broadcasting studios etc.

BUILDING MATERIAL

- **Thermocol, Glasswool, Asbestos, Asbestos cement, Sound absorbent materials like Gypboard, Acoustic tiles- Anutone , Light roofing materials-** AC sheets, CGI sheets, AL sheets, PVC roof sheets, Glass fibre, Polycarbonate etc.

Landscape Design-I

ALU 4326 **1-0-2=2**

INTENT

The idea is to establish linkage between Architecture & Nature.

CONTENT

- INTRODUCTION: definition, Scope, objectives, design process & profession of landscape architecture in relation to architecture. Elements of landscape architecture. Linkages with nature & built environment.
- Signage & Graphics in landscape architecture.
- HISTORICAL REVIEW: History of the art of garden design of India, China, Persia, Japan, Italy, France & England. Garden design of the modern world.
- HORTICULTURE: Plant classification & nomenclature; Plant identification.
- Propagation & care of plants; Planting preparations & methods.
- CHARACTERISTICS AND USE OF PLANTS: Characteristics of various types of plants & their suitability of landscaping; plant selection criteria; Landscape design elements & principles.
- LANDSCAPE DESIGN: Landscape design for various building types; Landscaping parks & roads, rock gardens, interior & terrace gardens; Formal & informal design; Use of water & man-made elements in landscape; Garden furniture & embellishments; Landscape construction; Preparation of landscape schemes.
- Ecological & environment aspects of landscape design.

Building Services-IV (Acoustics)

ALP 4127 **1-0-2=2**

Fundamental characteristics of sound. It's behavior in enclosed spaces in general & few enclosed functional spaces in particular without involving much of mathematical complexity. Need to study acoustics. Development of this science through different periods. Pioneers & their works.---Properties of sound, its origin propagation & sensation. Definitions of sound. Behavior of sound with respect to various surfaces in an enclosed space.---Factors influencing the hearing of conditions, noise, Reverberation, resonance, reflection & absorption of sound. Reverberation time, echo. Acoustical defects with solutions. Sabine's formula, Sound application systems. Constructional & planning measures for good acoustical design.---Acoustical material, sound absorption & coefficient of different material from various sound absorbing materials, panel absorbers, porous materials & cavity resonators.

Effect of noise on man. Physiological & psychological principles of noise control including acoustical, insulation for various domestic services & industrial fitting & constructions.

Control of noise pollution by landscape, buffer zones etc. in urban areas, control of traffic noise.

Housing

ALU 4128 **1-0-2=2**

CONTENTS

- Introduction: Housing as Architecture basic need, housing as an integral part of urban & rural development, housing problem and statistic, etc.
- Housing Design and Policies: Qualitative and quantitative demands of housing, housing estimates, various government policies and programmes, etc
- Housing Surveys and Standards: Sources of Data and information, methods and techniques of housing surveys, housing standards, etc.
- Housing Cooperative and Financing Agencies: Objectives and general principles of cooperatives, self help housing, financing agencies and their functions etc.

- Housing Design: Introduction to methods and approaches to housing design. Study analysis and design of housing schemes. Redevelopment of slums and squatters settlements.

Working Details-I

ALU 4131 **1-0-2=2**

Intent: To understand the significance of complex construction details for the purpose of execution of building project.
Content: To prepare the detailed working drawings of any of the design problems held in semester V or VI.

FIFTH YEAR B.ARCHITECTURE SYLLABUS (SEM-IX)

Elective **2-0-0=2**

Sustainable Architecture

ALE 5100

CONTENTS

- Introduction to the ideas, issues and concepts of sustainable Architecture,global environment and the built environment, principles of environmentally and ecologically supportive architecture
- Study of sustainable architecture, use of energy, materials, health and global environment as related to the construction and operation of buildings
- Sustainable and conservation practices – water conservation, sewerage treatment, solid waste treatment, economics and management
- Low energy design, hybrid systems, modeling and simulation of energy systems, integration of PV and wind systems in the building, wind solar and other non conventional energy systems, solar thermal applications for heating and cooling, electricity generation in buildings
- Case studies on specific contemporary sustainable architecture.

Note : The sessional will be oriented towards live case studies and modelling

Vernacular Architecture and Vastushastra

ALE 5101

CONTENTS
Definations of vernacular architecture, its scope and importance in present context, various types of vernacular architectures. Study of different vernacular styles prevailing in various parts of country in different climatic conditions.
Introduction to vastu shastra and its application, Study of man, functions and structures and their interrelationships. Application of Vastu Shastra in buildings and planning schemes. Assessment of building performance. Interior and exterior design as per Vastu principles

Earthquake Resistant Buildings

ALE 5102

CONTENTS

- Introduction to earthquake and its cause, phenomenon, focus and epicenter
- Introduction to seismic map of India
- Behaviour of different building types in earthquake
- Study of the impact of previous earthquakes on built environments
- Earthquake resistant designs and construction techniques for low rise, high rise and cost effective buildings
- Study of Architectural controls for earthquake resistant design

Advanced Hill Architecture

ALE 5103

CONTENTS

UNIT . I

- Historical perspective of hill architecture and its unique attributes and concerns.
- Major hill settlements in various regions of the world.
- A broad view of traditional hill architecture of medieval European settlements and other places.

UNIT . II

- Traditional hill settlements in India.
- An overview of vernacular hill architecture of Himachal Pradesh.
- Building Types, techniques and materials of vernacular architecture of Himachal Pradesh.
- Lessons from vernacular architecture and their time tested indigenous technology.

UNIT . III

- Modern buildings on hills in India.
- Constraints of climate, topography and availability of materials.
- Design factors such as access, circulation and gradients.
- Structural aspects of modern buildings and necessary safeguards.
- Environmental and ecological concerns and safeguards.

RECOMMENDED BOOKS
- The Architectural Heritage of Himachal Pradesh . Thakur
- Hill Cities of Eastern Himalayas . Sinha & Chacko

Project Management

ALL 5601 **1-0-2=2**

INTENT
To make students aware of the importance of management in construction with easily accessible modern technology.
CONTENT
Introduction: Introduction to project management concepts, objectives, goals and different aspects of management. Traditional management systems, Gantt's approach, bar charts, project programming, time estimates, etc.
Project programming, resource balancing, phasing of activities, program scheduling, project control, reviewing, updating and monitoring, modern management concepts.
Project assessment and project cost jobs size, divisions of responsibilities, liaison with owner's and their representatives, feasibility study, project report, construction financing facilities, etc.
Construction Management: Conditions of contract, their applications, quality & quantity controls, time & cash contract, recording, checking & certifying with coordination of all building activities.
Project Monitoring: C.P.M., P.E.R.T. & other unidimensonal techniques for project planning scheduling & control.

Architectural Design-VIII

ALU 5102 **1-0-8=5**

Design studio programme in this semester focuses on urban & metropolitan problems and issues of larger environmental contexts. The design problem shall be of large scale, handling of a group of buildings or a cluster of buildings, preferably urban in nature to develop & understanding for problem associated with site planning, layout of roads & services, traffic pollution, land use etc. A visual & functional study of urban space in use, urban activities, services & evolution of various spaces e.g. Mass scale residential, institutional, commercial, transportational, **healthcare building**/center/campus

Building Materials & Construction -VIII

ALU 5104 **3-0-2=3**

BUILDING CONSTRUCTION
- **Communication Systems** – Lifts of various types such as passenger, goods, hospital etc. (With special reference to Design of lift cage) Escalators. **Arches and Portals** – Arches and Portals in R. C. C. Steel and Laminated timber construction. **Domes Shells and Folded Plates** - Folded Plates and barrel shells hyperbolic paraboloids, And domes in R. C. C., Geodesic domes and space frames. **Prestressed & prefabricated Concrete** - Precast Prestressed construction for large span structures (general principal & use). **Prefabricated Housing construction** – Methods of prefabrication of components of a Building and their assembly, aspect of economy involved in larger repetitive work such as community housing etc.

BUILDING MATERIAL
- **Geo Synthetics, Water proofing & damp proofing materials-**concrete chemicals, ready mix concrete, water proofing mixtures**, Pipes used in building construction, Door & Window fittings, Materials used in Scaffolding, Centering, Shuttering.**

Landscape Design-II (Region specific)

ALU 5306 **1-0-2=2**

- Study of Mughal gardens, Study of setting of historical complexes with relation to site planning, its interpretations, scope & its importance.
- Natural & Man-made environment. Ecosystem, Ecological balance, interaction between build environment & ecosystem.
- Ecological approach to design--Natural Resources, Land, Water & Plants, their environmental & ecological consideration---Macro & Micro climate, Microclimatic analysis, climatic.
- Elements & their modification---Site selection criteria, site survey, inventory & analysis, site planning process.
- Site development, guidelines for excavation & grading, circulation, site drainage, water supply, vegetation cover & Landscape furnishings---circulation systems.

- Types, hierarchy & layout patterns, planning & design criteria for pedestrian movement, vehicular movement & parking areas.
- Building & outdoor spaces, their relationship & composition
- Elements of visual design - point, line, form, color & texture. Site volumes, enclosures, site structure expression.
- Practical Application.

Dissertation

ALC 5107 **1-0-2=2**

Scope for design consideration:

Design dissertation on a topic (project) approved by the college separately for each student and each student shall carry out dissertation considering the following aspect:

Method of construction, advance technology (concrete and steel), advances building services, climatology, theory of structures
Research analysis and data collection

Site selection and justification

User requirements and justification

Climatic conditions

Socio-economic problems

Communication

Transportation

Landscape and town / urban planning

Each student's work shall include intensive dissertation on the above points and shall include briefs on selection of site, methodology of dissertation, designing of the selected project and proper presentation of the drawings as volume i and the detail of the site, its analysis and justification, case studies and analysis, data, brief on structural system and services selected for the project, programme for the selected project.

Low Cost Buildings

ALL 5110 **2-0-0=2**

- An introduction to the subject as also the building processes adopted in different climatic zones of the country, resulting in varied vernacular expressions.
- Use of cost effective technologies through the use of local materials, up gradation of traditional technologies, prefabrication etc.
- Need for low cost construction, both in the rural and the urban sectors.
- Innovations of building techniques for low cost construction.
- Analysis of space norms for low cost buildings.
- Study of usages pattern of low cost buildings by the habitants.
- Comparative analysis of building materials and costing

FIFTH YEAR B.ARCHITECTURE SYLLABUS (SEM-X)

Elective **2-0-0=2**

DISASTER MANAGEMENT (ALE 5110)

- Types of disaster, meanings and related definitions.
- Causes and effects of natural hazards
- Disaster profile of India.
- Disaster preparedness and response and rehabilitation.
- Roles and responsibilities of different agencies

TOTAL QUALITY MANAGEMENT (ALE 5611)

The students will be introduced to Quality Management, Quality: Definition, Dimension, and Cost of Quality, the role of quality standards in construction industry and construction materials. They will also be exposed to ISO standards (9000&14000 Series), quality circles and Total Quality Management (TQM**).**

TRAFFIC AND TRANSPORTATION (ALE 5112)

Students are given campus design and urban design as major design problems, traffic and transportation is one of the major surveys to be undertaken by the students. In the surveys traffic volume, traffic speed vehicle ownership, etc. are to be undertaken. Parking need, parking design, road design, traffic furniture, etc will be taught in the subject.

BUILDING MAINTENANCE (ALE 5113)

- Introduction: Maintenance defined. Need and Importance of building maintenance. Its economic and social significance.
- Categories of maintenance: Planned maintenance, preventive maintenance, running caretaker maintenance, PWD patter of maintenance; A/R and S/R, maintenance cycles, maintenance profiles.
- Maintenance Generators: Climatic conditions; usages, defects in original design/construction, changing standards and tastes.
    - Maintenance standards, determinants of maintenance standards, statutory standards, defective premises act, building bylaws & act, legislative controls, building & housing act.
    - Organizing Maintenance; Managing maintenance, Financing & Budgeting for maintenance. Understanding technology and techniques involved in maintenance. Execution of maintenance work. Controlling costs. Information systems in maintenance. Inspections: annual, periodical, special, checklist and proformas.
    - Creating database for maintenance, maintaining building registers, inventories, inspection reports, records, User complaints, buildings in danger.
    - Understanding building defects & ailments, examining symptoms of various types and patterns of buildings disease and ailments, structural, non-structural finishes, stains, services ailments, leakages & dampness, corrosion protection, Sulphate attacks. Diagnosing & determining causes, prescribing effective remedial action

Professional Practice

ALD 5121 **2-0-0=2**

Introduction to Architectural Profession, Role of Professional Bodies, the Architects Registration Act, 1972.
The duties, liabilities and relationships of client, contractor & other technicians. The code of professional conducts and conditions of engagement of Architects. Scale of remuneration for Architectural services and mode of payments.
Types of tenders, tendering process, Execution of contract, Problems in operation of contract.
Architectural competitions, office organization, administration & management, documentation & maintenance of accounts, Arbitration, Easement & laws relating works. Valuation, Dilapidation and waste.
Office organization and administration, nature of partnership, registration and desolution of firms. Statutory obligations, office managements, filling of documents and drawings, accounts and audits, staff personals, their salaries, incentives etc.

Thesis (B.Arch)

ALD 5122 **7-0-22=18**

The subject of the thesis project will be selected by the students and approved by the department at the beginning of the eighth semester. The project selected may be either a live one or a research-oriented one or one pertaining to urban design or of a conceptual nature related to building or allied programs, so that student gets experience in tackling projects similar to what he is likely to face in the chosen stream of his professional career. The project and its programming shall be worked out by the student himself under the guidance of the thesis advisor (s).
The project work shall include an intensive study of relevant literature, case studies, climatology and analysis of problems concerned with the development of functional organization of space and structure, based on correlation and interpretation of the social, economic and physical data. Solution to the identified designed problems must be worked with the integrated approach of the architect, planner, engineer and other environmental designers, both in the preparation of the report and drawings.

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Business

Vision and Objectives

- To be a leading Institution in the field of business studies through excellence in research and teaching.
- To run state-of-the-art postgraduate and doctoral programs to develop human potential so that they emerge as leaders in the specilised areas.
- To concentrate on areas of specilisation as per industrial requirements at national and global level.
- To develop academic and industry interaction by undertaking collaborative research projects, training and consultancy.
- To promote entrepreneurial activities in the region by training and motivating prospective entrepreneurs.

Values

- Academic integrity and accountability
- Respect and tolerance for the views of every individual
- Attention to issues of national relevance as well as of global concern.
- Appreciation of intellectual excellence and creativity.
- Ceaseless aptitude of scientific exploration

Two-Year MBA Programme

Overall Structure

	Minimum	Maximum
Duration	2 years	3 years
Total Credits	80	
Non-Credit Courses	2 courses	
Core Module	17 Modules of 3 credits 1 module of 2 credits 1 modules of 1 credit	
Non-Credit courses	3 modules	
Elective Module	**Specialization streams** **Dual Specializations:** Elective A 5 (10 credits) Elective B 5 (10 credits)	
Research Module -	Major Project in any Elective area that carries 3 credits (Evaluated through Project report/ Dissertation with viva voce by an external examiner)	
Industrial Training-	Summer Training for 8-10 weeks that carries 3 credits (Evaluated through internal expert panel)	

LIST OF COURSES

SEMESTER I

General Courses

Semester I

BUL 6021	Organization Behaviour	3 credits (3-0-0)
BUL 6041	Management Accounting	3 credits (3-0-0)
BUL 6061	Business Economics	3 credits (3-0-0)
BUL 6011	Business Environment	3 credits (3-0-0)
BUL 6012	Qunt. Analysis for Managerial Decision	3 credits (3-0-0)
BUL 6031	Marketing Management	3 credits (3-0-0)
BUL 6013	Business Communication	2 credits (2-0-0)

Non-Credit Courses

BUN 6014	Computer Applications for Managers	(2-0-2) Non-Credit
BUC 6011	Viva-voce	Non-Credit

Semester II

BUL 6022	Human Resource Management	3 credits (3-0-0)
BUL 6042	Corporate Finance	3 credits (3-0-0)
BUL 6015	Management Science	3 credits (3-0-0)
BUL 6016	Production & Operations Management	3 credits (3-0-0)
BUL 6051	Supply Chain Management	3 credits (3-0-0)
BUL 6221	Research Methodology	3 credits (3-0-0)
BUL 6018	Business Laws	3 credits (3-0-0)
BUC 6012	Viva voce	1 credit

Semester III

BUL 7011	Strategic Management	3 credits (3-0-0)
BUL 7012	Entrepreneurship Development	3 credits (3-0-0)
BUT 7011	Summer Training Report Presentation and Viva-voce	3 credits

Non-Credit Courses

BUN 7011	Basics of French Language	Non Credit (2-0-0)

Semester IV

BUL 7013	Total Quality Management	3 credits (3-0-0)
BUL 7014	Project Management	3 credits (3-0-0)
BUD7011	Major Project	3 credits

Specialisations

Finance

Semester III

BUE 7041	Advanced Financial Management	2 credits (2-0-0)
BUE 7042	Working Capital Management	2 credits (2-0-0)
BUE 7043	Security Analysis & Portfolio Management	2 credits (2-0-0)

Semester IV

BUE 7044	Financial Derivatives and Risk Management	2 credits (2-0-0)
BUE 7045	Financial Markets & Institutions	2 credits (2-0-0)

Marketing

Semester III

BUE 7031	Strategic Marketing	2 credits (2-0-0)
BUE 7032	Advertising & Branding	2 credits (2-0-0)
BUE 7033	Rural Marketing	2 credits (2-0-0)

Semester IV

BUE 7034	Services Marketing	2 credits (2-0-0)
BUE 7035	Retailing & Merchandising	2 credits (2-0-0)

Human Resource Management

Semester III

BUE 7021	Management of Industrial Relations	2 credits (2-0-0)
BUE 7022	Organizational Psychology	2 credits (2-0-0)
BUE 7023	Management of Change & OD	2 credits (2-0-0)

Semester IV

BUE 7024	Strategic & International HRM	2 credits (2-0-0)
BUE 7025	Performance Management	2 credits (2-0-0)

Supply Chain Management

Semester III

BUE 7051	Logistics Management	2 credits (2-0-0)
BUE 7052	Global Logistics Management	2 credits (2-0-0)
BUE 7053	Relationship & Supplier Management	2 credits (2-0-0)

Semester IV

BUE 7054	Information Management & Supply Chain Networking	2 credits (2-0-0)
BUE 7056	Supply Chain Modeling & Corporate Practices	2 credits (2-0-0)

Semester I

Organization Behaviour

BUL 6021 **3-0-0=3**

Management: Nature & Functions; Development of management thoughts; Planning, Organizing, Staffing, Directing, And Controlling; Coordination and Cooperation, Techniques for effective coordination.

Challenges and Opportunities for OB, OB Model; Foundations of Individual Behaviour: Learning, Attitudes, Personality, Perception, Emotional Intelligence, Motivation Theories and Applications.

Foundations of Group Behaviour: Group Development; Group Behaviour; Sociometry; Conflict management.

Transactional analysis; Johari Window; Organization as a system: Organizational Change; Organizational Culture; Organizational Development; Stress management.

Recommended Books:

1. Koontz & Weihrich, Essentials of Management, TMH
2. Mullins, Management & OB, , Pearson
3. Robbins, Judge, Sanghi, Organsiational Behaviour, Pearson
4. Greenberg et al. ,Managing Organsitional Behaviour , Phi
5. Fred Luthans, Organisational Behaviour, TMH

Management Accounting

BUL 6041 **3-0-0=3**

Introduction: Nature and Scope of Management Accounting, cost accounting vs. management accounting,
Evolutionary background of cost and management accounting
Concepts and Classification of Cost
Assessment of Cost: Preparation of Cost Sheet and Statement of Cost.
Financial Statement Analysis
Cost-volume-profit analysis; Standard Costing and variance analysis
Budget and Budgetary Control
Responsibility accounting and reporting, activity based costing, Target costing
Theory of constraints; Life cycle costing
Balanced Score card and Strategic cost Management
Cost audit and Management audit

Recommended Books::

- M. Y. Khan, P. K. Jain: Theory and Problems of Management and Cost Accounting
- I.M. Pandey :Management Accounting
- Jawahar Lal: Cost Accounting
- C.T.Horngren: Cost Accounting-A Managerial Emphasis

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Business Economics

BUL 6061 **3-0-0=3**

Nature and scope of Business economics; role and responsibility of business economist;

Demand and supply; factors determining demand and supply; law of demand and supply;; market equilibrium; application of equilibrium price in business and pricing decision.

Demand functions: linear and non-linear; elasticity of demand; demand forecasting.Firm and industry; firm and its goals; time elements; production function; long run and short run, fixed and variable inputs; law of production; expansion path of output.cost analysis: concepts, short and long run cost output relationship; economies and diseconomies of scale.Price output decision under perfact competition, monopoly, discriminating monopoly, monopolistic competition, oligopoly. Managerial Approaches (Baumol, Marris and Williamson), Behavioral Approach (Cyert and March), Business Cycles.

Recommended Books:

1. A.Koutsoyiannis ,Modern Micro Economics ,Macmillian Press Limited
2. Yogesh Maheshwari ,Managerial Economics ,Prentice Hall
3. H.L Ahuja ,Managerial Economics ,S Chand
4. Thueses & Fabrycky ,Engineering Economy,Prentice Hall
5. D.M Mathani ,Managerial Economics, Himalaya Publishing House

Business Environment

BUL 6011 **3-0-0 =3**

Nature, role and changing profile of business environment; Micro & macro environments and their significance for business; factors affecting corporate governance, mechanism of corporate governance, Social Responsibility of Business; Social Audit; Role of business pressure groups in changing Business Environment. Indian Economic Environment: Macro economic environment, Economic Reforms in India. Industrial policy in India; Monetary policy and Fiscal policy in India; Foreign Trade Environment and Policy: WTO and the new international Trading Regime and its Implications for India; Environmental and Related Issues in Global Trade. Self-help Groups Industrial labour environment industrial disputes: trade unions; SEZ, FEMA, MRTP, Competition Act, Business Ethics and Rationale of Ethics in Business. Intelectual property rights & Indian industry.

Recommended Books:

1. Francis Cherunilam, Business Environment: Text and Cases, Himalaya
2. Justin Paul, Business Environment: Text and Cases, McGraw Hill
3. Paul Wetherly, Dorron Otter, The Business Environment :Themes and Issues,Oxford.
4. Morrison, International Business Environment, Palgrave.
5. John D. Daniels, Lee H. Radebaugh, International Business : Environments and Operations, Pearson

Quantitative Analysis for Managerial Decision

BUL 6012 **3-0-0=3**

BASIC MATHEMATICS FOR MANAGERS: Quantitative Decision Making-An Overview, Functions and Programmes, Basic calculus and Applications, Matrix algebra and applications
DATA COLLECTION AND ANALYSIS: Collection of Data, Presentation of Data, Measures of Central tendency, Measures of variation and Skewness
PROBABILITY AND PROBABILITY DISTRIBUTION: Basic Concepts of probability, discrete probability Distributions, Continuous Probability Distribution, decision Theory
SAMPLING AND SAMPLING DISTRIBUTION: Sampling methods, sampling Distribution, Testing of Hypothesis, Chi Square Testing
FORECASTING METHODS: Business Forecasting, Correlation, Regression, Time Square Analysis.

Recommended Books:

1. Gupta S.P. and Gupta M. P., Business Statistics, Sultan Chand.
2. Levin Richard I & Rubin David, Statistics for Management, Prentice Hall of India.
3. Narag A .S., Linear Programming and Decision-Making, Sultan Chand & Sons.
4. Stephen K.C., Harper and Row, Applied Business Statistics- Text Problems & Cases.
5. Chadha N.K., Statistics for Behavioral and Social Sciences, Reliance Publishing House.
6. Kazmiot L.J and Phol N.F., Basic Statistics for Business & Economics, McGraw Hill.
7. Sharma, J.K., Fundamentals of Operations Research, MacMilan.
8. Tery Sineich, Collior, Business Statistics by Examples, MacMilan.

Marketing Management

BUL 6031 **3-0-0=3**

Definition & Concepts of Marketing Management; Needs, Wants and Demands, Marketing Mix, Extended Marketing Mix, Customer value delivery process.
Scanning Marketing Opportunities: Macro and micro environment. Consumer Behavior: Introduction, Need for studying Consumer Behavior, Consumers and Organization Buying process.
Market segmentation, Market Targeting and Positioning. Integrated Marketing communication, Promotion mix.
Product characteristics and classification, Product differentiation and design, Product mix, Product Life Cycle.
Channel Management: Nature of Distribution Channels, Channel Evaluation, Channel profitability analysis, Channel Conflicts, Retailing and Wholesale.
Sales Management: Theories of Personal Selling, Selling Process, Sales budget & Sales Quota, Sales Territory, Sales meetings and Contests, Contemporary Issues in Sales management.
Marketing research: Introduction & Objectives, Marketing research process.
Managing Services: Characteristics of services, Differentiating services from goods.

Recommended Books:

1. Kotler Phillip, Armstrong Gary, Agnihotri P. Haque ul E, Principals of marketing: A South Asian Perspective, Pearson.
2. Saxena Rajan, Marketing Management, Tata McGraw Hill.
3. Namakumari R., Marketing Management, McMillan, New Delhi
4. Tybout M Alice & Calder J. Bobby, Kellog on Marketing, John Wily & Sons, NY
5. Applied Case Studies in Marketing, S Shajahan, Primus Books, New Delh
6. Marketing Concepts and Cases, Etzel, Walker et. al, Tata McGraw Hill, New Delhi

Business Communication

BUL 6013 **2-0-0=2**

Nature and Process of Communication: Role of communication, its classification, purpose and process. Barriers to communication, conditions for successful communication, universal elements in communication.
Organizational Communication: Importance of communication in management, managing and communicating, communication structure in an organization.

Polishing your writing: Editing for grammar and punctuation, choosing the right word, Idiomatic use of preposition, common errors in English.

Forms of Coomunication:Written Business communication, writing letters and memos, Report writing, oral communication, Non-verbal communication.Negotiation skills, presentation skills, summer project report, writing CVs, group discussion and attending interviews.

Recommended Books:

1. Peter Hartley and Clive G. Bruckmann, Business Communication Routledge Press
2. Henk T.Van der Molen and Yvonne H.Gramsbergen-Hoogland, Communication in Organizations Basic Skills and Conversation Models Psychology Press
3. Joep Cornelissen, Corporate Communications Theory and Practice, Sage Publications

Computer Applications for Managers

BUN 6014 **2-0-2 Non-Credit**

Computer System: evolution on computers, classification of computers, computer architecture, hardware: input/output units, computer memory, processor; software; modes of use: batch, real time, on-line, and off-line; data representation, binary arithmetic, data processing concepts, generations of languages, translators.
Operating Systems: meaning and purpose of operating systems, the characteristics of different types of operating systems and their uses, operating system types: batch, real-time, single-user, multi-user and network systems, disk operating system, unix, windows, introduction to open operating systems. Windows XP
Internet: introduction to the internet, internet tools, e-mail, ftp, protocols, telnet, gopher, world wide web, search engines, security issues.
Office Automation Systems: Microsoft Word(MS Word): getting started with.
Computer applications in business: application in project management, management information systems, personnel and administration, inventory management, customer management system, computerized financial accounting, computer aided design, computer applications in production, planning and control, multimedia presentations, marketing information system, manufacturing information system, computer applications of the future.
Algorithms and Flowcharts: The concept of data storage using variables, constants and literals, data types, control structures: iterative and selection; programming language syntax, program design, producing tested programs to meet given specifications programming standards and practice, use of comments, code layout eg. Consistent indentation and descriptive identifiers, functions/procedures, scope of variables: global, local, static and external variables; parameters: passing data by value and reference, using return values; error types: semantic; syntax and run-time; test documentation: test plan and related evidence of testing.

Recommended Books:

1. Sanjay Sexana, MS-Office 2000.
2. Rajaraman, Fundamentals of Computers
3. Peter Nortan, Introduction to Compters

Semester II

Human Resource Management

BUL 6022 **3-0-0=3**

HRM-concept and philosophy, Need for HRM-nature and scope, Job Analysis-nature and methods of collecting information, Corporate objectives and Human Resource Planning-concept, need quantitative and qualitative dimensions, HRM in the changing environment.
Recruitment and Selection, Methods of Manpower Search, Attracting and Selecting HR, Induction and Socialisation, Manpower training and development- training need analysis, process, techniques, evaluation, Performance Appraisal, 360-degree Feedback, Potential Appraisal, Career and Succession Planning,

Compensation-Aim and components, Factors determining pay rates, Job Evaluation, an overview of performance incentives, Human Resource Development: Instruments, Processes and Outcomes, Motivational aspects of HRD, Industrial Relations: Conceptual framework of Industrial relations in India.

Recommended Books:

1. Dessler,Human Resource Management ,PHI
2. Mondy,Human Resource Management, PHI
3. Gomez et al.,Managing Human Resources, Pearson
4. Aswathappa, Human Resource and Personnel Management , TMH
5. Armstrong,Handbook of Human Resource Management Practices, Sage
6. V.S.P.Rao, Human Reseurce Management , Excel Publisher

Corporate Finance

BUL 6042 **3-0-0= 3**

Modern approach to financial management, financial management and accounting function, financial market and intermediation, taxation and finance, time value of money, risk and return, capital budgeting techniques, capital budgeting under risk, cost of capital, corporate financing decision, payout policy, capital structure and leverage, working capital management.

Recommended Books:

1. Damodaran, Aswath, Corporate Finance Theory and Practice, John Wiley
2. Breaaley, Myers, Allen and Mohanthy, Principles of Corproate Finance, TMH
3. Ross Westerfield Jaffe, Corporate Finance, TMH
4. I.M.Pandey, Financial Management , Vikas Publishing

Management Science

BUL 6015 **3-0-0= 3**

Linear programming: Linear programming: general structure of LP model, assumptions, formulation of product mix problems. Linear programming solutions: graphical solutions, simplex algorithm application for maximizing and minimizing solutions, and duality in LP, sensitive analysis.
Transportation models: statement of problem, minimization algorithm, methods for finding initial solution: north-west corner rule, Vogel's approximation method (VAM), testing for optimality: stepping stone method, modified-distribution method (MODI method), unbalanced supply and demand, degeneracy and its resolutions, alternative optimal solutions, prohibited routes,
Assignment models: mathematical statements of problem, minimization using Hungarian algorithm, resolve unbalancing, multiple optimal solution and restriction,
Queuing theory: Essential operational features of a queuing system, performance measures of a queuing system, and classification of queuing models, single-server queuing models, Simulation theory: Nature of simulation, simulation process, random number generation, application of process to business related problems.
Game theory: introduction, two-person zero sum and constant sum games, saddle point, probability, nature as a player, two-person zero sum games: mixed or randomized strategy equilibria, domination, graphical solution, Games: Strategic form of prisoner's dilemma,
Decision Analysis: Decision-making process, types of decision making environment: under certainty, under risk, under uncertainty, criteria of decision-making under uncertainty: outline methods only, criteria of decision-making under risk; outline method only.

Recommended Books:

1. J.K Sharma**,** Operations Research - Theory & Applications, Mcmillian
2. S Kalavathy, Operation Research, Vikas
3. N.D Vohra, Quantitative Techniques in Management, Tata Mcgrew Hill
4. Taha, Operation Research, Pearson.
5. Natarajan, Balasubramani & Tamilarasi, Operation Research, Pearson

Production & Operations Management

BUL 6016 **3-0-0=3**

Issues in production / operation management: Production / operation management- overview, Production system: Issues & environment,Total Quality Management (TQM)

Forecasting: Need & importance of forecasting, Qualitative methods of forecasting, Quantitative methods of forecasting

Production system design: Capacity planning, Facilities planning, Work system design, Managing information system for production system

Production planning & scheduling: Aggregate production planning, just-In-Time (JIT), Scheduling & sequencing

Materials planning: Issues in material management, Independent demand system, Dependent demand system.

Emerging issues in planning / operations management: Total productive maintenance, advanced manufacturing system, Computers in planning / operations management.

Recommended Books:

1. B.Mahadevan,Operations Management(Theory & Practice), Pearson
2. Gaither, Butta & Sarin, Operations Management, Thomson.
3. Richard.B, Operations & Supply Managemen, Chare.
4. Nigel Slack, Operations Strategy, Pearson Education.
5. Vallmann , Manufacturing Planning & Control, McGraw Hill.

Supply Chain Management

BUL 6051 **3-0-0= 3**

Introduction to Supply Chain Management, supply chain orientation, Value Chain and Supply Chain, Logistics and Supply Chain. Lean and Agile Supply Chain. Dispersed Manufacturing, Assortment Packaging. Transportation, Warehousing& Location Decisions.

Network modelling and strategic lead time management; Demand Uncertainty issues in supply chain management, Aggregate Planning in Supply Chain, Postponement strategies, Bullwhip effect,

Inventory Management, VMI, Supplier Selection and Management; Order processing, Supply Chain Coordination and Integration, International issues in Supply Chain

Information Technology in Supply Chain, third party logistics, and Fourth party logistics Performance measures of Supply chain .Supply chain management in Indian environment.SCOR Model

Recommended Books:

1. Sunil Chopra ,Supply Chain Management; Strategy, Planning & Operations, Pearson Printice Hall.
2. Stanley E Fawcell, Supply Chain Management, Pearson Education.
3. Donald J Bowersex,Supply Chain Logistics Management, Tata McGraw Hill.
4. Martin Cristopher, Logistics & Supply Management, Strategies for reducing cost & improving services, Pearson Education.
5. John T Mentzer, Fundamentals Of Supply Chain Management; Sage Publication

Research Methodology

BUL 6221 **3-0-0=3**

Research in Business for managerial decision making, Value of Information, The industry: structure, evaluation and ethics.
Research Processes, Types of Research, Designing of Research.
Types of data and various methods of collecting data, Questionnaire construction, Attitude Measurement,
Sampling: Theory and designing, Sampling methods and planning. Coding, editing and tabulation of data, Hypothesis testing, bi-variate and multivariate methods of data analysis, such as, Factor Analysis, Discriminant Analysis, Conjoint Analysis, Canonical Correlation Analysis and Cluster Analysis..
Research report preparation: Guidelines and principles for written report and use of tables and figures, Bibliography and Annexure in report.

Recommended Books:

1. C R Kothari, Research Methodology: Methods and Techniques, New Age International
2. Prasant Sarangi, Research Methodology, Taxmann
3. R. Panneerselvam, Research Methodology, PHI
4. Dahlia K. Remler & Gregg G. Van Ryzin, Research Methods in Practice- Strategies for Description and Causation, Sage Publication

Business Laws

BUL 6018 **3-0-0=3**

Company Law: Companies Act 1956; Essential characteristics of a company and Kinds of Companies, Company and Partnership firm, Formation of a company, Memorandum of Association, Article of Association, Prospectus, Shares
Business law: Indian Contract Act, 1872; Nature and Kinds of Contracts, Essentials of a valid Contract: Offer and Acceptance, Consideration, Capacity of Parties, Lawful Object, Free Consent, Discharge of Contract, Remedies for breach of contract, Contract of Indemnity and Guarantee, Bailment and Pledge.
Sale of Goods Act, 1930: Contract of Sale, Sale and Agreement to sell, Conditions and Warranties, Negotiable Instruments Act, 1881: Essentials of Negotiable instruments and Kinds of negotiable instruments, Competition Act, 2002, Information Technology Act, 2000.

Recommended Books:

1. Garg, Sareen, Sharma, Chawla, Mercantile Law, Kalyani
2. A. Pathak, Legal Aspects of Business, TMH
3. V.S. Datey, Business & Corporate Laws, Taxmann
4. Maheshwari & Maheshwari, A Manual of Business Laws, Himalaya

Second Year

In the second year of the programme, students are required to study the core modules and non credit modules given in the semester III and semester IV. Besides they have to choose elective subjects from the any two areas of specialization. During this period they have to study 3 Modules from each of the areas of specialization.

Semester III

Core Subjects:

Strategic Management

BUL 7011 **3-0-0=3**

Importance of strategic management, model of strategic management, vision, mission, policies and objective Culture and leadership for strategy formulation, Strategic Process-Strategic Business planning. Theory of competitive advantage

External analysis-generic industry environment, Porter's five forces model, competitive analysis, forecasting tools and techniques, competitive gaming internal analysis- TWOS, SPACE matrix, Corporate Strategic Planning- Grand strategies, BCG matrix, Mckinsey 7s model

Mergers, acquisitions and takeover, HR issues, Change management,
Implementing strategies- policies, resource allocation, structuring, re engineering,

Strategy Review, Evaluation and Control- financial and operations audit, surveillance and assessment systems, Cases in Strategic management.

Recommended Books:

1. Pearce A John, Robinson Richard, Mittal Amita, Strategic Management: Formulation, Implementation and Control, Tata McGraw Hill.
2. David R Fred, Strategic Management-Concept and Cases, PHI.
3. Barney B Jay, Strategic Management and Competitive Advantage, Pearson Education.
4. Mittal Amita, Cases in Strategic Management, TMH.

Entrepreneurship Development

BUL 7012 **3-0-0=3**

Entrepreneurship development; resources and capabilities; resource types; environment of entrepreneurship development: political, technological, social, macro-micro economic factors, competition, ecological etc; entrepreneurial strategies; construction of business plans; E-entrepreneurship; business models and strategies; venture capital financing; Securing investors and structuring deals; creating the organization; corporate ventures and franchising; etc.; Training Development Programmes, Various Agencies for Entrepreneurship Development. Entrepreneurship and small business units, ancillary units etc. Strategies of the government for the promotion of SSIs.

Recommended Books:

1. Dollionger,Entrepreneurship Development, Pearson
2. Vasant Desai, Dynamics of Entrepreneurship Development in Mgt, Himalaya
3. P.M. Charantimath, Entrepreneurship Development in Small Business Enterprises, Pearson
4. Saji Kumar, Impact of Globalisation on SMEs Industries, ICFAI
5. B.N.T.Singh, Industrial Development under Strutural adjustment Programme, D.D. Publication
6. B.S.Bhatia, G.S. Batra, Entrepreneurers and Small Business Management, D.D. Publisher.

Semester IV

Core Subjects:

Total Quality Management

BUL 7013 **3-0-0=3**

Basic TQM concepts: basic approach, awareness, defining quality, historical review, the Deming philosophy, obstacles Approaches: Deming, Juran, Crosby, Armand Feigenbaum, Masaaki Imai (Kaizen and Gemba Kaizen), Shigeo Shingo (fail-safe design), Taguchi and Garvin, Quality Circles and Six Sigma.
Managing Quality: Leadership: leadership concepts, implementation, role of senior management, quality council, core values and concepts, shared values, ethics, quality statements: vision statement, mission statement, quality policy statement; strategic planning, communications, decision-making, the 7 habits of

highly effective people, characteristics of leaders, and leadership survey Customer Satisfaction: who is the customer, customer perception of quality, feedback, using customer and customer retention.
Performance Measures: quality costs, Deming Prize and Malcolm Baldrige National Quality Award criteria.
TQM techniques: Tools and Techniques: Pareto diagrams, process flow diagram, cause-and-effect diagram, House of Quality, check sheets, histogram: ungrouped data, grouped data, histogram shapes; and scatter diagrams.
Quality analysis and control: process variation, statistical process control, inspection, acceptance sampling, quality control and reliability
Quality systems: Introduction: different quality systems, ISO 9000 series of standards, and other quality systems: QS-9000, TE- 9000, and AS9000; implementation, documentation ISO/QS 9000 elements: management responsibility, the quality system, contract review, design control, document and data control, purchasing, control of customer-supplied product, product identification and traceability, process control, inspection and testing, control of inspection- measuring and test equipment, inspection and test status, control of nonconforming product, corrective and preventive action, handlingstorage- packaging- preservation and delivery, control of quality records, internal quality audits, training, servicing, statistical techniques, writing the documents, internal audits, registration
Benchmarking: Definition, reasons to benchmark, process of benchmark, deciding what to benchmark, understanding current performance, planning, studying others, learning from the data, using the findings, pitfall and criticisms of benchmarking.

Recommended Books:

1. H.Besterfield, Sacre. Total Quality Management ,Besterfield,Michna, PHI
2. SKMandal,TQM Principles and Practices,Vikas Publishing
3. K.Shridhar, TQM Text & Cases , HPH
4. Dale ,Managing Quality, Blackwell publisher
5. Poornima M. Charantimath TQM, Pearson education

Project Management

BUL 7014 **3-0-0=3**

PROJECT FORMATION AND APPRAISAL: Project Management – An Overview Feasibility & Technical Analysis, Market and Demand Analysis, economic and Financial Analysis, Formulation of Detailed Project Reports.
PROJECT PLANNING AND SCHEDULING: Planning Time Scales – Network Analysis, Material and Equipment, Human Resource, Project Costing and Financing, Project Organization.
IMPLEMENTATION AND CONTROL: Project Management Orientation System, Material and Equipment, Human Resource, Financial Aspects.
PROJECT COMPLETION AND EVALUATION: Integrated Project Management Control System, Managing Transition from Project to Operation, Project Review.

Recommended Books:

1. Jack Gido, James P. Clements,Project Management, Cengage
2. Jeffrey K.Pinto ,Project Management, Pearson
3. Prasan Chandra, Project Planning, Analysis, Financing, Implementing and Review, TMH
4. Samuel Mantel, Jack Meredith, Project Management: A Managerial Approach, Wiley
5. Clifford Gray, Eerik Larson, Project Management, TMH.

Elective Modules

Finance Specialisation

Advanced Financial Management

BUE 7041 **2-0-0=2**

Financial objectives, policies on investment, financing policies, financial planning and forecasting, fund flow and cash flow analysis, strategic financial decisions, corporate valuation, management of corporate restructuring, management of corporate distress, governance and corporate control, international finance and risk management, contemporary issues in financial management.

Recommended Books:

1. Damodaran, Aswath, John, Corporate Finance Theory and Practice, Wiley
2. Myers, Allen and Mohanthy, Principles of Corproate Finance, Breaaley, TMH
3. Ross Westerfield Jaffe, Corporate Finance, TMH.

Working Capital Management

BUE 7042 **2-0-0=2**

Conceptual framework, operating cycle concept, methods of calculating working capital, over capitalization and under capitalization, poor working capital management symptoms, committee recommendations, management of cash, management of marketable securities, management of debtors and inventory, sources of working capital finance, contemporary issues in working capital management

Recommended Books:

1. Hrishikes Bhattacharya, Working Capital Management: Strategies and Techniques, Prentice
2. James Sagner, Essentials of Working Capital Management, Wiley
3. F.C.Scherr, Modern Working Capital Management Text & Cases, Prentice Hall
4. J.J.Hampton, Financial Decision Making: Concepts, problems and Cases, prentice
5. S.B.Mathur, Working Capital Management and Control: Principles and Practices, New Age International Pvt., Ltd.

Security Analysis & Portfolio Management

BUE 7043 **2-0-0=2**

Investment environment, Investment process, Securities market and institutions, Valuation of securities, Fundamental analysis, Technical analysis, Efficient market hypotheses, Portfolio analysis, Portfolio selection, Capital Assets Pricing Model (CAPM), Arbitrage Pricing Theory (APT), Portfolio evaluation and revision, Contemporary issues in Security Analysis and Portfolio Management.

Recommended Books:

1. Fisher and Jordan ,Security Analysis & Portfolio Management , PHI.
2. S. Kevin ,Portfolio Management , Prentice Hall India
3. Prasanna Chandra ,Investment Analysis and Portfolio management , Tata McGraw Hill
4. Alexander, Sharpe, Bailley, Fundamentals of Investment – Pearson / PHI
5. Reilly , Investment Analysis & Portfolio Management , Thamson / Cengage Learning

Financial Derivatives and Risk Management

BUE 7044 **2-0-0=2**

Introduction to Financial Derivatives, Evolution of commodity, currency, stocks and interest rate derivatives, Growth of Financial Derivatives in India, Types of Derivatives; Forwards, Futures, Options, Swaps and other sophisticated derivatives, trading mechanism of different derivatives products

Risk Management using forwards and futures: application of forwards and futures in Hedging, speculation and arbitrage, pricing of futures and forwards

Options: factors affecting options pricing, pricing of options, option trading strategies, risk hedging through options. Contemporary developments in derivatives and Derivatives scams

Recommended Books:

1. John Hul, Options, Futures and Other derivatives, Prentice
2. R.Stafford Johnson, Introduction to Derivatives: Options, Futures and Swaps, Oxford
3. Jayanth Rama Varma, Derivatives and Risk Mgt., McGraw Hill
4. Robert W.Kolb, James A. Overdahl, Financial Derivatives, Wiley
5. Marshall and Bansal,Financial Engineering; A Complete Guide to Financial Innovation, Eastern Economy.

Financial Markets & Institutions

BUE 7045 **2-0-0=2**

Financial System: Introduction, Components of Indian Financial System, Institutions, Instruments, Market & Services, Nature and Role of Financial System in Economic Development, Financial Sector Reforms.
Capital Market: Constituents, Functions, Capital Market instruments, New issue Market, Private Placement, Secondary Market: Stock Exchange; Rules & Regulation of Trading & Settlement, Listing of Shares, Depositories System, Securities and Exchange Board of India, Regulation and Investor Protection, Stock Market Reforms.

Money Market: Constituents and functions , Types of Money Market, Government Security Market, Money Market Instruments, Regulations of the Money Market in India.

Financial Institutions: Banking, securities and insurance sector financial institutions, role of central bank in financial markets

Changing role of International financial institutions (World Bank, IMF etc.) and contemporary developments in domestic and international financial markets

Recommended Books:

1. Eitman, Stonehill, Mofett and Pandey, Multinational Business Finance, Pearson
2. Jeff Madura, Financial Markets and Institutions, Cengage
3. Alan C. Shapiro,Multinational Financial Management, Wiley
4. Frank Fabozzi, Franco Modigliani, Frank Jones, Foundations of Financial Markets and Institutions, Pearson
5. Peter Howells, Financial Markets and Institutions, Pearson

Marketing Management Specialization

Strategic Marketing

BUE 7031 **2-0-0=2**

Customer focus and profitability, customer loyalty, profit impact of customer intention, marketing performance metrics, marketing profitability, Marketing strategies and profitable growth, marketing profitability metrics, environment analysis, internal analysis.

Market potential, market demand, market share, customer analysis and value creation

Segmentation analysis, Competitor analysis and source of advantage. Marketing knowledge, marketing leadership

Strategic position, growth strategies, product –market diversification, strategies in declining and hostile markets, Global strategies, merger and acquisition, joint venture.

Marketing mix strategies, positioning strategies, branding and brand management strategies, brand and product line strategies, brand equity
Portfolio analysis and strategic market plans, offensive core strategy I : invest to grow sales, offensive core strategy II: Improve Competitive position, offensive core strategy III: enter new markets, Defensive core strategies I: protect position, Defensive core strategies II: Optimize position, Defensive core strategies III : monetize, harvest, or divest.

Recommended Books:

1. Cravens, Piercy, Strategic Marketing , TMH
2. West, Ford, Ibrahim,Strategic Marketing, Oxford
3. Aaker,Strategic Marketing Management, Wiley
4. Hooley, Piercy, Marketing Strategy competitive position, Nicoluland.
5. Michel Porter,Competitive strategy, The free press

Advertising & Branding

BUE 7032 **2-0-0=2**

Advertising and the marketing process, integrated marketing communication, advertising planning processes, AIDA, DAGMAR, Client agency relationship. Creative strategy, Copy and layout, Media planning and media selectionVarious medias, Budgeting, Advertising effectiveness.
Branding concept, Branding challenges and opportunities, Brand equity, Strategic brand management processes, Designing and implementing branding strategy, Customer based brand equity, brand positioning and values. Brand equity measurement, Current issues in branding, legal issues, online branding, Business to business trading of brand.
Recommended Books:

1. Kazmi, Balve, Advertisement and Sales Promotio, Excel Books
2. D. Guinn,Allen,Semenik, Advertisement & integrated Brand promotion, Thomson.
3. Batra, Mayers, Aaaker ,Advertisement Management ,PHI
4. Kellers, Strategic Brand Management, Pearsons

Rural Marketing

BUE 7033 **2-0-0=2**

Difference between rural and urban marketing, Projection of demand and supply of farm products, Rural market environment, Rural marketing Index, Rural marketing skills, STP for rural marketing. Rural Marketing Mix, Legal Framework of Rural Marketing:

Marketing of agriculture inputs, Problems in rural marketing, Rural market structure, Market forces and price determination, Scientific marketing of farm products, Transportation of farm products, Grading and standardization, Rural information Processing, Marketing Agencies and institution, Food processing and manufacturing.

Rural integration, contract farming, marketing development and planning, modern infrastructural facilities, Problems in agriculture export zones, Roles of Financial Institution, in rural marketing, Role of Cooperative Institution in rural marketing, Role of govt. in rural development, Agriculture credit and crop insurance, Marketing of fruits and vegetables, Mobile trading in rural marketing.

Recommended Books:

1. K.S Habeebur Rahman ,Rural Marketing,HPH
2. Badi & Badi ,Rural Marketing, HPH

Services Marketing

BUE 7034 **2-0-0=2**

Differences between goods and services, Services marketing mix, Classification of services, Consumer analysis – Behavior, expectation perceptions of services

Understanding customer expectation and perception through research, customer relationship, Service recovery.

Service development and design, customer defined service standard, physical evidence, and Quality issues in services.

Employees' role and customer role in service delivery, Electronic channel managing demand and capacity Intgrated services marketing communications, pricing of services, practical analysis of banking, tourisms, hotel, and hospital etc.

Recommended Books:

1. Lovelock H Christopher, Services Marketing, Pearson.
2. J A Fitzsimmons and T S Sullivian, Services Operations Management, Tata McGraw Hill.
3. Verma V Harsh, Services Marketing Text and Cases, Pearson.
4. Schmitt H Bernd, Customer Experience Management, John Willey and Sons.

Retailing & Merchandising

BUE 7035 **2-0-0=2**

Overview of retailing, The evolution of retail formats, Theories of retail development, Concept of retail cycle, The evolution and current issues of retail in India.

Information gathering and processing in Retailing, Types of retailer, Types of ownerships, Understanding consumers, strategic planning in retailing, Trading area analysis, Reilly's Law, Huff's Law,

Food, Apparel and Book retailing, Pharma retailing, Telecom retailing, Health care and spa retailing, Petroleum retailing.

Financial dimensions, Operational dimensions, Pricing strategy, communication strategy, Merchandise Management, Buying systems, Store layout, Design and Visual merchandising, Store loyalty, Technology in retailing.

Mall Managements, Parking Management, Retail entertainment, Multiplex retail strategy, Shopping centers, Online entertainments, E –retailing, E-Banking.

Recommended Books:

1. Berman & Evans ,Retail Mangement , PHI
2. Leivy & Weitz. Retail Management, TMH
3. Sinha & Unniyal ,Managing Retail. Oxford.

Human Resource Management Specialisation

Management of Industrial Relations

BUE 7021 **2-0-0=2**

Industrial Relations (IR): evolution, contextual and constitutional framework: relations, approaches to Industrial relations, contextual , Industrial relations strategy, future of Industrial relations in India,

Trade Unions: historical evolution and types of Unions, growth of Unions, functions of Unions, national level federations, judicial delineation of statutory definition of Trade Union, registration of trade unions, Trade Unions Act 1926 and recent amendments.

Collective Bargaining: Perspective, concept, stages and prerequisites for Collective Bargaining Process, types of Collective bargaining contracts, strategies. Unfair labour practices

Grievance Redressal and Discipline mechanisms: Discipline mechanisms**:** Judicial approach to discipline, misconduct, disciplinary proceedings, domestic enquiries, and charge sheets, Grievance edressal: Approaches and nature of grievances, causes, procedure and grievance redressal mechanisms

Industrial Conflict and regulations of Industrial disputes: Industrial conflict: Nature of conflicts and its manifestations, data analysis, labour administration machinery, instruments of economic coercion; strikes, lockouts inter industry propensity for strikes, strike patterns, environmental influences, arbitration, conciliation, adjudication, settlement of disputes, powers of union government, layoff, retrenchment transfer and closure, discharge and dismissal, managements prerogative pending proceedings. Industrial Disputes Act 1947;

Workers Participation: Evolution and nature of participation, degree of influence and involvement, forms of participation, impact of participation, prerequisites for successc ful participation, limitation of participation, Constitutional commitment, current trends in participation in Indian.

Recommended Books:

1. C.V.Venkatratnam, Industrial Relations, Oxford
2. C.B.Mamoria, Dynamics of Industrial Relations, Himalaya
3. P.R.N.SInha, Indu Bala Sinha, Seema , Industrial Relations, Trade Union and Labour Legislation, pearson
4. Debdas Banerjee, Globalisation and Industrial Restructuring and Labour Standards, Sage Publishers.
5. B.D.Singh, Industrial Relations- Emerging Paradigms, Excel

Organizational Psychology

BUE 7022 **2-0-0=2**

Organizational Psychology, Role of psychologist in Industry, Growth & development of organizational psychology in India, human factors and Industry problems, psychographic factors involved in employee's job performance, psychological tests in Industries: their utility, reliability and validity, Conceptual framework of attitudes: factors influencing development of attitudes, implications for organizations, employee morale, job satisfaction, practical implications of motivational theories, new directions in leadership research, emotional management, work environment: noise, illumination, colour, vibration etc., accidents at work place, monotony, stress and fatigue and their impact on work psychology, stress management interventions.

Recommended Books:

1. Schultz & Schultz, Psychology & Work Today, Pearson Ed.
2. Muchinsky, Psychology Applied to Work, Thomson Wadsworth
3. Coon & Mitterer, Introduction to Psychology: Gateways to Mind & Behavior, Thomson Wadsworth.
4. Kaplan & Saccuzzo, Psychological Testing- Principles, Applications & Issues, Thomson Wadsworth.

Management of Change & Organization Development

BUE 7023 **2-0-0=2**

Organizational Change, Types of organizational change, elements of change, Theories of Organizational change, Process of planned change, Dimensions of Planned change, resistance to change, overcoming resistance to change, Organizational structure and change, Virtual organizations, Factors affecting organizational design, Structural changes in Indian organizations, Organizational culture and management of change, Managing change with respect to Human resource management: Issues involved, Role of HRD professional in managing change, Change through behaviour modification, positive and negative reinforcement, change and strategy in organizations, Role of information technology in managing change

Organizational Development: Characteristics of Organization development, History of Organization Development, Process of Organization Development, Organizational Development Interventions, Consultant-Client relationship, Role of OD consultant, Applications of OD in India, Problems of OD work in India.

Recommended Books:

1. French & Bell, Organizational Development , PHI
    1. Sengupta, Bhattacharya, Sengupta Managing Change in Organizations, PHI
    2. Kavita Singh, Organizational Change & Development, Excel,
    3. K. Harigopal, Management of Change, Sage

Strategic & International HRM

BUE 7024 **2-0-0=2**

Strategic Human Resource Challenges, planning and Implementing Strategic HR policies: HR planning, Procurement, Training and Development, Compensation, Benefits, Separation, Performance Appraisal, Strategy and Organizational Structure, Job Designing, Human Resource Information Systems, HR Audit, Managing Diversity, Managing Knowledge workers.

International HRM: Role and distinguishing activities, Stages of Internationalization, Approaches to managing an international subsidiary using local and expatriate employees to staff International subsidiaries, Managing Expatriate Employees: Selection, Training, Career Development, Compensation, factors affecting success of expatriate employees, Repatriation, Women and global assignments, International Labour Relations.

HRM policies in Global context, National Culture, Organizational Characteristics and HRM practices, HR issues in outsourcing.

Recommended Books:

1. Tanuja Agarwal, Strategic Human Resource Management, Oxford
2. Dowling & Welch ,International HRM, Thomson.
3. Sparrow & Vernon, International HRM, Brewster, University Press
4. Schuler & Jackson, Strategic HRM, Wiley.

Performance Management

BUE 7025 **2-0-0=2**

Concept, characteristics, role and significance of performance; performance appraisal vis-à-vis performance management, process of performance management; performance management and strategic planning linkages.
Establishing and operationalising performance management system; measuring performance-results and behaviour; Defining Performance and Performance Measurement Metrics, Employee Assessment Systems.
Managing Performance Management; Coaching and counselling, feedback and day-to-day planning of meetings, motivation, self-monitoring, training and development activities, Conducting performance review; formal review of performance.
Compensation and its various dimensions, Implementation of Pay for Performance Plans: measuring and pay for performance: Reward Philosophy, strategy and policy, incentives for shop-floor, sales force, executives, non-financial rewards, fringe benefits.
Harnessing performance management system for performance improvement through skill based compensation, competency based compensation, Contribution of Human Resource Management Practices to Employee Performance.

Recommended Books:

1. Richard I.Henderson, Compensation Management in Knowledge based World, Pearson
2. Dewakar Goel, Performance Appraisal & Compensation Mgt.,- A Modern Approach, Phi
3. Joseph J.Martocchio, Strategic Compensation- A HRM Approach, Pearson Publishers.
4. Herman Aguinis Performance Management, Prentice Hall;
5. T.V.Rao Performance Management And Appraisal Systems : Hr Tools For Global Competitiveness, , Response Books

Supply Chain Management Specialization

Logistics Management

BUE 7051 **2-0-0=2**

Logistic as a core strategic competency, Marketing and logistics interface, Service driven logistics organization, developing logistics organization. logistical performance cycle. Integrated logistics, logistics planning, casting & pricing.
Transport system, functionality, infrastructure, basic transport economics and pricing, transport decision making. Technological development in transportation in India, factors effecting transport system selection. Warehouse Management and design,Integrating Warehousing and transportation

Logistics reengineering, time based logistics. Alternative logistics strategies, Japanese philosophy and implications for logistics, quick response logistics, logistics system dynamics, identifying logistics performance indicators,

Concept of lead time, logistics pipe line management, logistics value engineering, Modularisation.

Recommended Books:

1. Ballon Srivastava, Business Logistics Supply chain Management, Pearson Education.
2. Carlos Daganzo,Logistics Systems Analysis, Springer.
3. John Fernie, Logistics & Retail Management, The Institute of Logistics & Transport.
4. Cayle, The Management of Business Logistics -A Supply Chain Perspective,Thomson.
5. Gimchi-Leri,The Logic Of Logistics, Springer.

Global Logistics Management

BUE 7052 **2-0-0=2**

Trends towards globalization, Logistics in global economy, Challenges of global logistics, Global supply chains, organizing for global logistics, international logistics system. Clearing and forwarding agents, freight forwarders Containerization, history, benefits, global trade and containerization, multimodal transportation, International maritime bureau, operations, freight structure and practice.

Shipping industry , open registry system, liners and tramp operation, port operation, types of ships and international trade, shipping, conferences, costal shipping and inland water ways, air transport, documentation and clearing procedure of air cargo, air logistics and perishables.

Legal aspects in logistics. Responsibilities of shipping line, legal aspects of carriage of goods by air. Overview of CONCOR, Reassessing the global supply chain, global supply chain and manpower selection.

Logistics Network design for global operations,Complexities and uncertainties in global logistics.Incoterms,Comercial documents

Recommended Books:

1. John T Mentzer & Sage ,Handbook of Global Supply Management,.
2. DF Barone,International Logistics, Springer.
3. Dornier, Global Operations & Logistics, Wiley.
4. David, International LogisticsBiztantra
5. Kent N Gaurdin,Global Logistics Management;A competitive advantage for 21st Century , Blackwell Publishing.

Relationship & Supplier Management

BUE 7053 **2-0-0=2**

Drivers of SCM competitive advantage.

Functional coordination in supply chain, sales, industrial service, retail, R&D, Inventory and order processing coordination, Integrating warehousing and transportation function in supply chain

CRM and multi-channel integration, Buyer focus and supply chain integration, SCM integration and performance, supply chain coordination by revenue sharing contracts.

Rewarding structures and supply chain strategies aligned, Rewarding sales force, rewarding operations, Rewarding and supply chains performance. Supplier selection, Supplier evaluation, Building deep supplier relationship.

Outsourcing Frame work,Purchasing Process,Conceptual Framework of supplier relationship,Kralagic Model,quality management practices and buyer supplier relationship.

Recommended Books:

1. Monckza, Trent & Handfield, Purchasing & Supply Chain Management, Cengage learning
2. Gopalakrishnan, Purchasing and Materials Management, McGraw Hill
3. Jaya Krishna S, Supplier Relationship Management - An Introduction, ICFAI Publishers
4. Timothy M. Laseter, Balanced Sourcing: Cooperation And Competition In Supplier Relationships, Jossey-bass Publishers

Information Management & Supply Chain Networking

BUE 7054 **2-0-0=2**

Supply Chain Network design, Designing options, Factors influencing network design, frame work for network design, Distribution networks in practice.
Role of information in supply chain, Goals of supply chain information technology, IT uses in supply chain management, IT infrastructure requirements.

Integrating Supply chain information technology, Information for assets to satisfy customers, Intra-company information system, inter-company information system, Information system in supply chain integration.

Overview of ERP, ERP implementation and national differences, DSS for supply chains EDI, RFID uses in supply chain, Global positioning systems in supply chain, e- procurement technology model, adaptation of B2B technologies, information enrichment and Bullwhip effect.

Recommended Books:

1. Ray, Enterprise Resource Planning, McGraw Hill
2. Jahat Shah, Supply Chain Mgt., Text & Cases, Pearson
3. Walker et al., Supply Chain Architecture; A Blueprint for Networking the Flow of Material, Information and Cash, CRC Press.
4. Heinrich & Betts, Adapt or Die: Transformation your Supply Chain into an Adaptive Business Network, John Wiley.

Supply Chain Modeling & Corporate Practice

BUE 7056 **2-0-0=2**

Supply chain Environments: Infrastructure, Technology, Transportation, Protectionism, Supply chain orientation in China, India, USA, Japan

Foreign Factories, Strategic role, Constraints Management in Food Service Supply Chain.

Supply Chain Practices in the following Sector. Retail, Textiles, Automobiles, Computers, Food Supply & Agriculture.

Supply Chain Strategies of Compbell Soup, Xerox, Seven Eleven Japan.
Supply chain models and modeling systems,Mathematical modeling frame work for strategic supply chain,Unified optimization methodology,Simulation models.

Recommended Books:

1. Hadley Rees,Supply Chain Management in the Drug Industry, Deliverying Value for Pharmaceutical and Biologics, Wiley Int.
2. Joseph Berk ,Cost Reduction & Optimization For Manufacturing & Industrial Companies, Wiley INT.
3. Simchi-Levi ,Handbook of Quantitative Supply Chain Analysis, Springer.
4. Duxbury, Modelling The Supply Chain, Cengage.
5. Strategic Supply Chain Management, Cengage Learning.

Program Structure of
Five Years Integrated Dual Degree M.Sc. Economics Program

Duration: Five Years

Minimum Credits Required (for the award of the degree): 180

Semester-Wise Details Of The Course Work

SEMESTER-I			
1	BUL 1081	Micro Economics	3 credits (3-0-0)
2	BUL 1082	Indian Economy & Planning	3 credits (3-0-0)
3	BUL 1091	Mathematics for Economists	3 credits (2-1-0)
4	BUL 1092	Applied Statistics	3 credits (2-0-2)
5	BUL 1211	Computer Applications in Economics	3 credits (2-0-2)
6	BUL 1011	Communication Skills	3 credits (1-1-2)
	SEMESTER-II		
1	BUL 1083	Macro Economics	3 credits (3-0-0)
2	BUL 1084	Development Economics	3 credits (3-0-0)
3	BUL 1093	Research Methodology	3 credits (3-0-0)
4	BUL 1041	Management Accounting	3 credits (3-0-0)
5	BUL 1212	Indian Philosophy	3 credits (3-0-0)
6	BUL 1213	Programming & Data Structure	3 credits (2-0-2)
	SEMESTER-III		
1	BUL 2201	Public Finance	3 credits (3-0-0)
2	BUL 2081	Demographic Economics	3 credits (3-0-0)
3	BUL 2091	Mathematical Economics	3 credits (3-0-0)
4	BUL 2082	Business Cycles & Economic Fluctuations	3 credits (3-0-0)
5	BUL 2021	Organisation Behaviour	3 credits (3-0-0)
6		Open Elective-I	3 credits (3-0-0)
	SEMESTER-IV		
1	BUL 2121	International Economics	3 credits (3-0-0)
2	BUL 2191	Econometric Theory	3 credits (3-0-0)
3	BUL 2131	Environmental Economics	3 credits (3-0-0)
4	BUL 2041	Indian Financial System	3 credits (3-0-0)
5	BUL 2022	Human Resource Management	3 credits (3-0-0)
6		Open Elective-II	3 credits (3-0-0)
	SEMESTER-V		
1	BUL 3111	Money & Banking	3 credits (3-0-0)
2	BUL 3121	WTO & International Trade	3 credits (3-0-0)
3	BUL 3011	Entrepreneurship Management	3 credits (3-0-0)
4	BUL 3041	Financial Management	3 credits (3-0-0)
5	BUT 3081	Seminars	3 credits
6	BUD 3081	Minor Project	3 credits
	SEMESTER-VI		
1	BUL 3191	Applied Econometrics	3 credits (3-0-0)
2	BUL 3101	Agriculture Economics	3 credits (3-0-0)
3	BUL 3161	Labour Economics	3 credits (3-0-0)
4	BUL 3081	Economics & Management of IPRs	3 credits (3-0-0)
5	BUL 3031	Marketing Management	3 credits (3-0-0)
6	BUP 3081	Economics Research Lab	3 credits (0-0-6)
	SEMESTER-VII		
1	BUL 6081	Advanced Micro Economic Analysis	3 credits (3-0-0)
2	BUL 6191	Economic Models & Simulations	3 credits (3-0-0)
3	BUL 6161	Industrial Economics	3 credits (3-0-0)
4	BUL 6121	International Trade and Policies	3 credits (3-0-0)
5	BUL 6091	Decision Science for Economic Applications	3 credits (3-0-0)
6	BUL 6016	Production & Operations Management	3 credits (3-0-0)
	SEMESTER-VIII		
1	BUL 6082	Advanced Macro Economic Analysis	3 credits (3-0-0)
2	BUL 6171	Economic Growth & Development Models	3 credits (3-0-0)
3	BUL 6111	Economics of Banking and Insurance	3 credits (3-0-0)
4	BUL 6192	Economic & Business Forecasting	3 credits (3-0-0)
5	BUL 6019	Project Management	3 credits (3-0-0)
6	BUL 6092	Advanced Research Techniques	3 credits (3-0-0)
	SEMESTER-IX		
1	BUL 7191	Financial Econometrics & Applications	3 credits (3-0-0)

2	BUL 7192	Time Series Analysis	3 credits (3-0-0)
3		School Elective - I	3 credits (3-0-0)
4		School Elective – II	3 credits (3-0-0)
5		School Elective – III	3 credits (3-0-0)
6		School Elective – IV	3 credits (3-0-0)
	SEMESTER-X		
	BUD 7081	M.Sc. Dissertation	18 Credits

M.Sc. Dissertation: Every student shall be required to undergo 16-18 weeks Internship (Training) in the 10th Semester in Corporate/Cooperative Sector or Government Institution (RBI, Planning Commission, Ministry etc.) or any other approved Organization. After successful completion of the Internship, every student shall be required to prepare and submit, within the stipulated time, a dissertation on the work done during the Internship period. Each student will have Mentor(s) from the Internship organization and Supervisor(s) from SMVDU as allotted by the School. Each student may be required to submit a report to the Interning organization as per the requirement of the organization whereas a dissertation based on the work done in the organization will be required to be submitted to the School by the due date as per the Academic Calendar of the University. Each student will have to make a power point presentation on the dissertation work before a Panel of Experts comprising internal and external members as per the announced schedule. Due weightage will be given to the Mentor, Supervisor and other experts, including the External, in the evaluation for award of the grade in the dissertation.

OPEN ELECTIVES			
1	BUE 2211	Sociology & Society	3 credits (3-0-0)
2	BUE 2212	Indian History	3 credits (3-0-0)
3	BUE 2201	Public Administration	3 credits (3-0-0)
4	BUE 2021	Industrial Psychology	3 credits (3-0-0)
5	BUE 2215	Political Science & Society	3 credits (3-0-0)
6	BUE 2216	Geography	3 credits (3-0-0)
7		Any other elective (from any School)	3 credits (3-0-0)

SCHOOL ELECTIVES			
1	BUE 7201	Public Economics	3 credits (3-0-0)
2	BUE 7101	Agricultural Marketing and Price Analysis	3 credits (3-0-0)
3	BUE 7102	Agricultural Development and Policies	3 credits (3-0-0)
4	BUE 7103	Agricultural Finance	3 credits (3-0-0)
5	BUE 7104	Farm Management and Production Economics	3 credits (3-0-0)
6	BUE 7131	Natural Resources Management	3 credits (3-0-0)
7	BUE 7141	Economics of Infrastructure	3 credits (3-0-0)
8	BUE 7132	Economics of Environment and Policies	3 credits (3-0-0)
9	BUE 7111	International Finance	3 credits (3-0-0)
10	BUE 7031	International Marketing	3 credits (3-0-0)
11	BUE 7122	Regional Economic Blocks	3 credits (3-0-0)
12	BUE 7081	Economics of Services	3 credits (3-0-0)
13	BUE 7181	Rural Economics	3 credits (3-0-0)
14	BUE 7133	Economics of Hilly Regions	3 credits (3-0-0)
15	BUE 7142	Transportation Economics	3 credits (3-0-0)
16	BUE 7082	Health Economics	3 credits (3-0-0)
17	BUE 7151	Economics of Tourism	3 credits (3-0-0)

Semester-I

MICRO ECONOMICS

BUL 1081 **3-0-0=3**

Micro Economics and its scope. Wants & scarcity, Functions of Economic system, Circular flow of economic activity – price determination and functions of prices-concept of margin, Economic Models, Methodology, Value judgment, Positive and normative analysis. Market analysis-market demand and market supply-market equilibrium-adjustment to changes in demand and supply / static and dynamic analysis-comparative static analysis, Types of elasticity-price, income & cross elasticity.
Utility Analysis – Total and Marginal Utility – Cardinal & Ordinal Utility. Indifference Curves-Characteristics, MRS-Special Types of Indifference Curves, Consumer's Income. Budget Line-Changes in Income and Prices and Budget line, Consumer's choice, Utility Maximisation, The Changes in demand and Engel's Curve, Changes in Price Substitution Effect and Income Effect / Hicksian and Slutskys Analysis Normal, Inferior and Giffen Goods, Revealed preference theory. Strong Ordering and Weak Ordering. Fundamental Theorem of Consumption Theory, Derivation of Demand Curve under Cardinal, Ordinal and Revealed Preference Theory . Production function –AP and MP Production with one variable input, Production with two variable inputs, Cost of Production, Nature of Production, Costs, Short run and Long run Costs. Least cost input Combination, Expansion path, Introduction to Modern Cost Curves. Concepts of revenue. Price and output determination under different market structure. Price output decision under perfect competition, monopoly, discriminating monopoly, monopolistic competition, oligopoly.

Recommended Bookss:

1. Stigler G. "Theory of Price", Prentice Hall of India, New Delhi (Latest Edition).
2. Sen A. "Microeconomics: Theory and Application", Oxford University Press, New Delhi (Latest Edition).
3. Kreps David M. "A Course in Microeconomic Theory", Princeton University Press, Princeton (Latest Edition).
4. Verian H. "Microeconomic Analysis", W.W Norton New York (Latest Edition).
5. Koutsoyiannis, A. "Modern Microeconomics", Macmillan Press, London (Latest Edition).
6. Layard, P.R.G. and Walters A.W. "Microeconomic Theory", McGraw Hill, New York (Latest Edition).
7. Ahuja H.L. "Advanced Economic theory: Microeconomic Analysis", S.Chand and Co. Ltd. New Delhi (Latest Edition).
8. Sen A. "Microeconomics: theory and Applications", Oxford University Press, New Delhi (Latest Edition).

INDIAN ECONOMY & PLANNING

BUL 1082 **3-0-0=3**

Economic Geography of India – Basic features - Human Resource: Demographic features, extent of unemployment, poverty, and inequality: Recent trends and conceptual issues. HDI of India. Social Responsibility of Business; Social Audit; Role of business pressure groups in changing Business Environment. Indian Economic Environment: Macroeconomic environment Trend in National Income and Per capita income. Sectoral composition (output and employment) Primary, Secondary and Tertiary Sectors, Trends and Composition of Output of major crops. - Trends in Investment, Credit and Agricultural Subsidy. New Agricultural strategy of 1960s (Green Revolution), Food security and PDS in India, Evaluating Land Reforms in India, New Agricultural Policy (In the context of liberalization.)
Industrial structure in India: Traditional, Village, Cottage and Modern industries. MSME Sector Industrial Policy Resolution in India - New Industrial Policy and its impacts. Trends and composition of India's Imports - Trends and direction of India's Exports - EXIM Policy of India in relation to trade liberalization and its impacts-FDI, FII and MNCs in India - External Borrowing and BOP problem in India – International Institutions (IMF, WB, ADB, WTO) and the Indian Economy.

Recommended Bookss:

1. Ahluwalia I.J. and Little I.M.D. "India's Economic Reforms and Development" (Eassys in Honour of Manmohan Sing), Oxford University Press, New Delhi (Latest Edition).
2. Bardhan P. K. "The Political Economy of Development in India", Oxford University Press, New Delhi (Latest Edition).
3. Gupta S.P. "Planning and Development in India; A Critique", Allied Publishers Private Limited, New Delhi (Latest Edition).
4. Bhagwati, Jagdish "In Defense of Globalization", Oxford University Press U.K (Latest Edition).
5. Jha Raghbendra "Indian Economic Reforms", Hampshire, U.K (Latest Edition).
6. Dhingra Ishwar C "Indian Economy", Sultan Chand & Sons, New Delhi (Latest Edition).
7. Datt, Ruddar and Sundaram, K.P.M. "Indian Economy", S.Chand & Co. New Delhi (Latest Edition).

MATHEMATICS FOR ECONOMISTS

BUL 1091 **2-1-0=3**

Exponents and Logarithms - Arithmetic and Geometric Progression- Equations-Types and solutions of Linear, Quadratic and Simultaneous Equations upto three unknowns. Set Theory-
Types and Set Operations, Domain and Range of Set. Matrices-Types, Matrix manipulations and their rules, Order of Matrix, Transpose of Matrix- Determinants up to order 3x3- Properties and Value of determinant, Minor and Cofactor, Inverse and Cramer's Rule. Types of Functions- Rectangular Co-ordinate System and graphs of functions - Slope and Intercept- Equations of straight lines. Limits and Continuity- Differentiation-Rules, Derivative of Functions except Trigonometric Function, Higher Order Derivatives, Partial and Total Derivatives in two variable functions. Integration, Consumer surplus and Producer Surplus. Maxima and Minima of Functions- Curvature Properties-Convexity and Concavity. Growth rate: Simple and Compound, Depreciation- Time Value of Money- Future and Present Value, Compounding and Discounting, Net Present Value and Internal Rate of Return.

Recommended Bookss:

1. Allen R.G.D. "Mathematical Analysis for Economics" (Latest Edition).
2. Budnick, F.S. "Applied Mathematics for Business, Economics and Social Sciences", McGraw Hill (Latest Edition).
3. Chiang, A.C. "Fundamental Methods of Mathematical Economics", McGraw Hill, ND (Latest Edition).
4. Dorfman, Samuelson and Solow "Linear Programming and Economic Analysis", McGraw Hill, NY (Latest Edition).
5. Henderson "Microeconomic Theory- A Mathematical Approach", McGraw Hill (Latest Edition).
6. Baumol, W.J. "Economic Theory and Operations Analysis", Prentice Hall, ND (Latest Edition).
7. Handry, A.T. "Operation Research", Prentice Hall, ND (Latest Edition).
8. Taha, H.A. "Operation Research: An Introduction, Prentice Hall", ND (Latest Edition).

APPLIED STATISTICS

BUL 1092 **2-0-2=3**

Definition, Scope and Limitations of Statistics-Frequency distribution- Representation of data by
Frequency polygon, Ogives and Pie Diagram. Measures of Central tendency- Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean-Weighted averages-Positional values- Quartiles, Deciles and Percentiles-Business Averages-Quadratic Mean and Progressive Average- Measures of Dispersion: Absolute and Relative measures of Range, Quartile Deviation, Mean Deviation and Standard Deviation- Lorenz Curve- Gini Coefficient- Skewness and Kurtosis.
Correlation-Meaning, Types and Degrees of Correlation- Methods of Measuring Correlation- Graphical Methods: Scatter Diagram and Correlation Graph; Algebraic Methods: Karl Pearson's
Coefficient of Correlation and Rank Correlation Coefficient - Properties and Interpretation of
Correlation Coefficient-Simple linear regression-Meaning, Principle of Ordinary Least Squaes and Regression Lines. Index Numbers: Meaning and Uses- Unweighted and Weighted Index Numbers: Laspeyre's, Paasche's, Fisher's, Dorbish-Bowley, Marshall-Edgeworth and Kelley's Methods- Tests of Index Numbers: Time Reversal and Factor Reversal tests -Base Shifting, Splicing and Deflating- Special Purpose Indices-Wholesale Price Index, Consumer Price Index and Stock Price Indices. Time Series Analysis-Components of Time Series, Measurement of
Trend by Moving Average and the Method of Least Squares. Vital Statistics: Meaning and Uses- Fertility Rates: Crude Birth Rate, Net Reproduction Rate, Infant Mortality Rate and Maternal Mortality Rate-Sex Ratio and Couple Protection Ratio.

Recommended Bookss:

1. Croxton and Dudley "Applied General Statistics", (Latest Edition).
2. Gupta S .P . "Statistical Methods", Sultan Chand & Sons, N. Delhi (Latest Edition).
3. Hooda, R. "Statistics for Business and Economics", Macmillan, ND (Latest Edition).
4. Medhi, J. "Statistical Methods: An Introductory Text", New Age International, ND (Latest Edition).
5. Nagar, A.L. and R.K. Das "Basic Statistics", OUP, ND (Latest Edition).
6. Rao, C.R. "Linear Statistical Inference and Applications", Wiley and Sons (Latest Edition).
7. Hoel, P.G. "Introduction to Mathematical Statistics", Wiley and Sons (Latest Edition).
8. Johnson, R.A. and D.W. Wichern "Applied Multivariate Statistical Analysis", Prentice Hall, ND (Latest Edition).

COMPUTER APPLICATIONS IN ECONOMICS

BUL 1211 **2-0-2=3**

Computer fundamentals; Components of a personal computer system; Input-output devices; Types of computers and their applications; Operating system; Application softwares; Computer languages; IT in Business, Computer networking and resource sharing. Introduction to text processing, spreadsheets and presentation packages; Preparation of a Database; Transfer of data among different packages Electronic Transactions- Security and Digital signatures; Encryption, authentication and validation of transaction processing; Debit Cards, Credit Cards, Smart Cards, Electronic Funds Transfer, ATM, On line banking; E-Commerce; Business models of E-commerce - B2B, B2C, C2B and G2B; Electronic trading and marketing; On line shopping; Web advertising.

Recommended Bookss:

1. Introduction to Information Technology, ITL Education, Pearson Education,
2. Electronic Commerce by Ravi Kalakota, Pearson Education

COMMUNICATION SKILLS

BUL 1011 **1-1-2=3**

Nature and Scope of Communication Introduction: Functions of Communication, Communication Basics, Communication Networks, Tips for effective Internal Communication; Case Studies Non-Verbal Communication Introduction, Forms of Non-Verbal Communication, Interpreting Non-Verbal Messages, Tips for effective non-verbal Communication; Case Studies.
Effective Listening Introduction: What does listening mean? Types of Listening, Effective and Ineffective Listening Skills, Active and Passive Listening, Leadership and the role of Listening in Leadership Styles; Case Studies. Business Presentations and Public Speaking Introduction, Business Presentations and Speeches, Business Presentations: Sample Outlines; Effective Sales Presentations; Case Studies. Business Writing and Correspondence Introduction, Written Business Communication, The Seven C's of Business Letter Writing, Effective Business Correspondence: Basic Principles; Kinds of Business Letters; Writing Effective Memos; Case Study. Group Discussion and Team Presentation Introduction, Methodology of Group Discussion, Role Functions in Group Discussions, Improving Group Performance, Team Presentations, Case Studies.

Recommended Bookss:

4. Peter Hartley and Clive G. Bruckmann "Business Communication", Routledge Press (Latest Edition).
5. Henk T.Van der Molen and Yvonne H.Gramsbergen-Hoogland "Communication in Organizations Basic Skills and Conversation Models", Psychology Press (Latest Edition).
6. Joep Cornelissen "Corporate Communications Theory and Practice", Sage Publications (Latest Edition).

Semester-II

MACRO ECONOMICS

BUL 1083 **3-0-0=3**

A Methodological framework of studying Economics – Its relevance and important, Micro Economics and Macro Economics, National Income concepts Potential GNP, Actual GNP, GDP Gap, Green GNP . Macro-Economic Models – Exogenous, Endogenous, ex-ante, ex-post, Nominal, real, dependent and independent variables – Identities and Equations.
Say's Law of Markets – Wage, Price Flexibility, Classical Model of Output and Employment – Quantity Theory of Money, Fisher's Equation of Exchange ,Cash Balance Approach – Neutrality of Money – Money illusion, Pigou effect, Real Balance effect, Classical dichotomy – Concept of full employment – voluntary unemployment.
Consumption function – Psychological Law of Consumption – Determinants of Consumption – APC and MPC , APS and MPS , Paradox of thrift, Income, Consumption and Saving relationship, Investment function, determinants of investment, MEC, MEI and the role of Expectations, Principle of Effective Demand ,Underemployment equilibrium, Wage. Price rigidity, Determination of Income in two and three sectors (using Keynesian Cross diagrams and algebra) Definition & Derivation of IS and LM curves , General Equilibrium using IS & LM curves.

Recommended Bookss:

1. Scarth, W., Macroeconomics "An Introduction to Advanced Methods", Thomson (Latest Edition).
2. Hall, E. and Taylor, J. B. "Macroeconomics", W. W. Norton and Company (Latest Edition).
3. Robert J Gordon "Macroeconomics" Harper Collins (Latest Edition).
4. Richard T.Froyen "Macroeconomics", Pearson Indian Ed (Latest Edition).
5. Gregory Mankiw "Principles of Macroeconomics", Thomson, Indian Ed (Latest Edition).
6. Rudiger Dornbusch and Stanley Fisher "Macroeconomics", McGrawhill (Latest Edition).
7. Prabhath Patnaik (Ed.) "Macroeconomics", Oxford University Press (Latest Edition).

DEVELOPMENT ECONOMICS

BUL 1084 **3-0-0=3**

Distinction between Economic Growth and Economic Development: Net National Income and Per Capita Income as Growth Indicators- Concept of HDI. Development Planning & its necessity -balanced vs. unbalanced growth. Complementary Roles of Agriculture and Industry, Role of Technology in Agriculture and Industry. Population and Economic Development: The Two Way Relation. Domestic Capital Formation in an Underdeveloped Country: The Problems -Incentives for Savings and Investment. Foreign Investment: Different forms -Their roles in Economic Development. Role of IMF & World Bank in economic development of the LDCs. Gender Related Issues.

Recommended Bookss:

1. Thirlwal, AP "Growth and Development: With Special Reference to Developing Economies", Palgrave Macmillan (Latest Edition).
2. B.H.Dholakia, R.H.Dholakia "Theory of Economic Growth and Technical Progress – an introduction", Macmillon (Latest Edition).
3. Michael.P.Todaro "Economic Development in the third world", Orient Longman (Latest Edition).
4. Ray, Debraj "Development Economics", Oxford Indian Paperbacks, OUP (Latest Edition).
5. Skarstein, Rune "Development Theory: A guide to some Unfashinable Perspectives", OUP (Latest Edition).
6. Ahulwalia and IMD Little "India's Economic Reforms", Essays in Favour of Manmohan Singh.
7. R.T.Gill "Economic Development past and present", Prentice Hall of India Pvt. Ltd, New Delhi (Latest Edition).
8. Mair.GM and Riuch.J.E "Leading Issues in Economic development", Oxford (Latest Edition).

RESEARCH METHODOLOGY

BUL 1093 **3-0-0=3**

Introduction to Research Methods, Definition and Objectives of Research, Various Steps in Scientific Research, Types of Research; Research Purposes - Research Design - Survey Research - Case Study Research. Data Collection and Sampling Design, Sources of Data: Primary Data, Secondary Data; Questionnaire design- Survey and Experiments – Design of Survey and Experiments - Sampling Merits and Demerits - Control Observations - Procedures - Sampling Errors. Statistical Modeling and Analysis, Probability Distributions, Fundamentals of Statistical Analysis and Inference, Concepts of Correlation and Regression, Time Series Analysis and Spectral Analysis, Error Analysis, Research Reports -Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report.

Recommended Bookss:

5. C R Kothari "Research Methodology: Methods and Techniques", New Age International, (Latest Edition).
6. Prasant Sarangi "Research Methodology", Taxmann (Latest Edition).
7. R. Panneerselvam "Research Methodology", PHI (Latest Edition).
8. Dahlia K. Remler and Gregg G. Van Ryzin "Research Methods in Practice- Strategies for Description and Causation", Sage Publication (Latest Edition).

MANAGEMENT ACCOUNTING

BUL 1041 **3-0-0=3**

Nature and Scope of Management Accounting, cost accounting vs. management accounting, Evolutionary background of cost and management accounting. Concepts and Classification of Cost, Assessment of Cost: Preparation of Cost Sheet and Statement of Cost. Financial Statement Analysis, Cost-volume-profit analysis, Standard Costing and variance analysis, Budget and Budgetary Control**,** Responsibility accounting and reporting, activity based costing, Target costing, Theory of constraints; Life cycle costing. Balanced Score card and Strategic cost Management, Cost audit and Management audit

Recommended Bookss:

- M. Y. Khan and P. K. Jain "Theory and Problems of Management and Cost Accounting" (Latest Edition).
- I.M. Pandey "Management Accounting" (Latest Edition).
- Jawahar Lal "Cost Accounting" (Latest Edition).
- C.T.Horngren "Cost Accounting-A Managerial Emphasis" (Latest Edition).

INDIAN PHILOSOPHY

BUL 1212 **3-0-0=3**

Philosophy and *Darsana*, Orthodox (*astika*) and Heterodox (*nastika*) philosophical traditions: Carvaka, Jainism, Buddhism. Nyaya, Vaisesika, Samkhya, Yoga, Mimamsa and Vedanta, Metaphysics: Carvaka, Jainism Buddhism, Nyaya, Vaisesika, Samkhya, Yoga, Mimamsa and Vedanta, Epistemology: Carvaka, Jainism, Buddhism, Nyaya, Vaisesika, Samkhya, Yoga, Mimamsa and Vedanta, Ethical Perspectives.

Recommended Bookss:

1. Raju, P.T. "Structural Depths of Indian Thought", New Delhi: South Asian Publishers (Latest Edition).
2. Puligandla, R. "Fundamentals of Indian Philosophy", New Delhi: D.K. Printworld (P) Ltd. (Latest Edition).
3. Radhakrishnan, S. "Indian Philosophy", Vol.1&2, New Delhi: Oxford University Press (Latest Edition).

PROGRAMMING AND DATA STRUCTURE

BUL 1213 **2-0-2=3**

Introduction to the Digital Computer ; Introduction to Programming Variables, Assignment; Expressions; Input/output; Conditionals and Branching; iteration; Functions; Recursion; Arrays; Introduction to Pointers; Structures; Introduction to Data-Procedure Encapsulation; Dynamic allocation; Linked structures; Introduction to Data Structure – Stacks and Queues; Searth Trees; Time and space requirements. (A programming language like C/C++ or any advance language may be used as a basis language.

Recommended Bookss:

1.Let us C by Yashwant Kanetkar,
2. Data Structures – Schaum's Outlines by Seymour Lipschutz

Semester –III

PUBLIC FINANCE

BUL 2201 **3-0-0=3**

Public finance – Meaning and Scope – Public and Private Finance –Principles of Maximum Social Advantage – Public Goods, Private Goods, Mixed Goods and Merit Goods. Public Expenditure-Meaning and Importance – Reasons for the Growth of Public Expenditure– Wagner's Hypothesis, Peacock - Wiseman Hypothesis, Canon's of Public Expenditure – Effects of Public Expenditure. Public Revenue: Sources of public revenue, Taxes - Classification of Taxes - Canons of Taxation, Principles of Taxation. Ability, Benefit and cost of service-Impact, Incidence and shifting of Tax Burden. Effects of Taxation, Major Taxes in India. Value Added Tax in India , The concept of goods and service tax (GST) Public Debt and Budget -Public Debt : Meaning, Types of Public Debt, Debt Redemption. Budget Meaning, Types of Budget: Revenue and Capital Budget, Revenue Expenditure and capital expenditure, Revenue Deficit, Fiscal Deficit, Primary Deficit - Budget Deficit – Fiscal Policy – Contra Cyclical Fiscal Policy – Deficit financing - Preparation of Budget in India – (Introduce the latest Central and State Budgets to the students.) Federal Finance Meaning – Principles of Federalism – Finance Commission (Finance Commission Report – Latest) - Importance of Local finance in India.

Recommended Bookss:

1. Richard A. Musgrave "Public Finance in Theory and Practice", McGraw Hill Book Company, New York (Latest Edition).
2. Jha H. "Modern Public Economics", Routledge, London (Latest Edition).
3. Singh S.K. "Public Finance in Developed and Developing Countries", S.Chand and Company Ltd, New Delhi (Latest Edition).
4. Chelliah R.J. "Fiscal Policy in Underdeveloped Countries (Latest Edition).
5. Hemlata Rao "Fiscal Federalism –Issues and Policies", New Countury Publications, New Delhi (Latest Edition).

DEMOGRAPHIC ECONOMICS

BUL 2081 **3-0-0=3**

Theories of Population: Malthus, Optimum, Marxian, Leibenstein, Becker, Demographic transition theory and Optimum population theory. Population and Economic Development: Utilization of resources (Boserup thesis) technology and production of food, Population and Environment. Population Structure and Characteristics: Impact of Population growth on the age and gender structure, ageing of population. Fertility: Concepts of fertility transition, Measurement of fertility and fertility differentials in India. Mortality: Components and Measurement, mortality differentials in India. Migration: Concepts, Types, measurement, migration selectivity, causes and consequences (economic and demographic) of migration. Migration in India: Causes and Trends, Migration Differentials in India: Rural-Urban, Male-Female. Urbanization: Concepts, Determinants and Consequences; Trends of Urbanization in India. Growth and Structure of Indian Population, Literacy transition

in India, pattern of literacy and literacy differentials in India. Economic Composition of Indian Population: Work force participation and occupational structure. Estimation of Population in India: Census, sampling and vital registration methods. Population Policy in India since Independence.

Recommended Bookss:

1. U.N. "The Determinants and Consequents of Population Trends" (Latest Edition).
2. A.A. Bhende and T. Kanitkare "Principles of Population Studies", Himalaya (Latest Edition).
3. D.J. Bogue "Principles of Demography", Wiley (Latest Edition).
4. B.D. Misra "An Introduction to the Study of Population", South Asian Publishers (Latest Edition).
5. S. Nagarwal "India's Population Problem", Tata McGraw Hill (Latest Edition).
6. Government of India "Census of Indian and Related Monographs and Reports" (Latest Edition).
7. U.N. "Methods of Measuring Internal Migration" (Latest Edition).

MATHEMATICAL ECONOMICS

BUL 2091 **3-0-0=3**

Mathematical Economics: Meaning and Importance- Mathematical Representation of Economic Models- Economic functions: Demand function, Supply function, Utility function, Consumption function, Production function, Cost function, Revenue function, Profit function, Saving function, Investment function Marginal Concepts: Marginal utility, Marginal propensity to Consume, Marginal propensity to Save, Marginal product, Marginal Cost, Marginal Revenue, Marginal Rate of Substitution, Marginal Rate of Technical Substitution Relationship between Average Revenue and Marginal Revenue- Relationship between Average Cost and Marginal Cost - Elasticity: Demand elasticity, Supply elasticity, Price elasticity, Income elasticity, Cross elasticity- Engel function. Constraint optimization Methods: Substitution and Lagrange Methods-Economic applications: Utility Maximization, Cost Minimization, Profit Maximisation. Production Functions: Linear, Homogeneous, and Fixed production Functions-First order and second order differential and difference equations and their applications in economics.

Recommended Bookss:

1. Allen R.G.D. "Mathematical Analysis for Economics" (Latest Edition).
2. Budnick, F.S. "Applied Mathematics for Business, Economics and Social Sciences", McGraw Hill (Latest Edition).
3. Chiang, A.C. "Fundamental Methods of Mathematical Economics", McGraw Hill, ND (Latest Edition).
4. Dorfman, Samuelson and Solow "Linear Programming and Economic Analysis", McGraw Hill, NY (Latest Edition).
5. Henderson "Microeconomic Theory- A Mathematical Approach (3e)", McGraw Hill (Latest Edition).
6. Baumol, W.J. "Economic Theory and Operations Analysis", Prentice Hall, ND (Latest Edition).

BUSINESS CYCLES & ECONOMIC FLUCTUATIONS

BUL 2082 **3-0-0=3**

Meaning of business cycle, phases of business cycle, Cyclical pattern of several macroeconomic variables, reasons for business cycle, , the revolution of rational expectations, inflation and the business cycle, Theories of business cycle- The Classical Theory - Self-Correcting Economy, Keynesian Revolution, The New Classical Model, Real Business Cycle Theory, Bubbly Business Cycles, Shock dependent business cycle theory, , Multiplier and Accelerator model, Kalecki Model, General Equilibrium models of the business cycle, Measurement of business cycle, Political business cycle, Yield curve, Business cycles and economic growth, Depressions and the Liquidity Trap, Monetary Policy and Business Cycle, Fiscal Policy and Business Cycles.

Recommended Bookss:

1. Cooley, T. "Frontiers of Business Cycle Research", Princeton University Press (Latest Edition).
2. Krueger, Dirk, Lecture Notes
3. Ljungqvist, L. and Sargent, Thomas J. "Recursive Macroeconomic Theory", MIT Press, Cambridge, MA (Latest Edition).
4. Romer, David. "Advanced Macroeconomics", New York: McGraw-Hill. (Latest Edition).
5. Williamson, Stephen D. "Lectures in Macroeconomics" (available on his website).

ORGANISATION BEHAVIOUR

BUL 2021 **3-0-0=3**

Management: Nature & Functions; Development of management thoughts; Planning, Organizing, Staffing, Directing, And Controlling; Coordination and Cooperation, Techniques for effective coordination. Challenges and Opportunities for OB, OB Model; Foundations of Individual Behaviour: Learning, Attitudes, Personality, Perception, Emotional Intelligence, Motivation Theories and Applications. Foundations of Group Behaviour: Group Development; Group Behaviour; Sociometry; Conflict management. Transactional analysis; Johari Window; Organization as a system: Organizational Change; Organizational Culture; Organizational Development; Stress management.

Recommended Bookss:

6. Koontz & Weihrich "Essentials of Management", TMH (Latest Edition).
7. Mullins "Management & OB", Pearson (Latest Edition).
8. Robbins, Judge, Sanghi "Organsiational Behaviour", Pearson (Latest Edition).
9. Greenberg et al. "Managing Organsitional Behaviour" , Phi (Latest Edition).
10. Fred Luthans "Organisational Behaviour", TMH (Latest Edition).

OPEN ELECTIVE-I

INTERNATIONAL ECONOMICS

BUL 2121 **3-0-0=3**

International Trade: Theories-Classical - Theories of absolute advantage, comparative advantage and opportunity costs, J.S. Mill's Theory of Reciprocal Demand; Offer Curve Analysis, Empirical Testing of theory of comparative advantage; Empirical testing of theory of absolute cost and comparative cost. Role of dynamic factors, i.e., changes in tastes, technology and factor endowments. Neo-Classical Theories of International Trade Heckscher-Ohlin Model; Factor Price equalization theorem; Rybczynski theorem; Immizerizing growth, Metztor Paradox, Alternative Trade Theories; Strategic Trade Theory, Intra Industry Trade; Emergence and Measurement; Trade under imperfectly Competitive Markets. Measurement of Gains from International Trade and their distribution; Concepts of terms of trade, their uses and limitations; Hypothesis of secular deterioration of terms of trade, its empirical relevance and policy implications for less developed countries; Trade as an of engine economic growth; The Theory of Interventions (Tariffs, Quotas and non-tariff barriers); Economic effects of tariffs and quotas on national income, output, employment, terms of trade, income distribution; Balance of payments on trading partners both in partial and general equilibrium analysis. Nominal, effective and optimum rates of tariffs – their measurement, impact and welfare implications The partial equilibrium/equalization generating analysis of trade policy; Arguments for Protection; Instruments of Commercial Policy; Trade Policy and Distortions in Domestic Markets. Growth and Trade-The nature of the growth process; The effects of growth on small countries and large countries Technical Progress and International Trade; Import substitution v/s Export Push; Exports and Economic Growth; Trade Liberalization; Order, Sequencing and Speed; Liberalization experience of developing countries.

Recommended Bookss:

1. Dana, M.S. "International Economics: Study, Guide and Work Book", Routledge Publishers, London (Latest Edition).
2. Dunn, R.M. and J.H. Mutti "International Economics", Routledge, London (Latest Edition).
3. Kenen, P.B. "The International Economy", Cambridge University Press, London (Latest Edition).
4. Kindleberger, C.P. "International Economics", R.D. Irwin, Homewood (Latest Edition).
5. King, P.G. "International Economics and International Economic Policy: A Reader", McGraw Hill International, Singapore (Latest Edition).
6. Krugman, P.R. and M. Obstfeld "International Economics: Theory and Policy", Glenview, Foresman (Latest Edition).
7. Carbough, R.J. "International Economics, International Thompson Publishing", New York (Latest Edition).

ECONOMETRIC THEORY

BUL 2191 **3-0-0=3**

Classical Linear Regression Model (CLRM): Specification of the Model- Assumptions- Linearity in variables and parameters, Estimation of the Error Variance. Gauss Markov Theorem, Goodness of fit: R square –Coefficient of Determination. Inference in the Linear Regression Model- Confidence interval for the parameters and the Testing of Hypotheses -Prediction with the Simple Regression model. Concepts of Heteroscadasticity and Autocorrelation problems. Time Series: Introduction, Components, Measurements: Secular Trend (Free hand curve fitting, Moving averages, fitting mathematical curves), Seasonal fluctuation (monthly averages, ratio to moving averages, ratio to trend method.

Recommended Bookss:

1. Gujarati, D.N. "Basic Econometrics", McGraw Hill, ND (Latest Edition).
2. Johnston, J. "Econometric Methods", McGraw Hill, London (Latest Edition).
3. Koutsoyiannis, A. "Theory of Econometrics", Macmillan, London (Latest Edition).
4. Maddala, G.S. "Econometrics", McGraw Hill, NY (Latest Edition).
5. Ramanathan, R. "Introductory Econometrics with Applications", South Western Cengage Learning, ND (Latest Edition).
6. Theil, H. "Introduction to Econometrics", Prentice Hall (Latest Edition).

ENVIRONMENTAL ECONOMICS

BUL 2131 **3-0-0=3**

Pareto optimality and competitive equilibrium; fundamental theories of welfare economics; externalities and market inefficiency, property rights and externalities.

Pigouvian taxes and subsides, marketable pollution permits and mixed instruments (the charges and fees), Coase's bargaining solution and collective action, Environmental institutions and gross root movements, Global environmental externalities and climatic change - Tradable pollution permits and international carbon tax, Trade and environment in WTO regime.

Mechanism for environment regulation and protection of forest resources in India; Environmental laws and their implementation, Forest policy; People's participation in the management of common and forest lands; Social forestry - rationale and benefits. types of pollution - air, water and noise. Causes and effects, Methods of pollution Control, Industrial pollution and measures to control. Ozone layer depletion, Green House Effect, Global warming, Acid Rain, Desertification, National and International policies on environmental protection.

Recommended Bookss:

1. Kolstad, C. "Environmental Economics", Oxford University Press (Latest Edition).

2. Baumol, W.J, and W.E. Oates "The Theory of Environmental Policy", Cambridge University Press (Latest Edition).
3. Freeman, A. M. "The Measurement of Environmental and Resource Values", Resources for the Future (Latest Edition).
4. Hanley, N., J.F. Shogren, and B. White "Environmental Economics: In Theory and Practice", Macmillan India Ltd. (Latest Edition).
5. Joseph J Seneca and M K Taussig "Environmental Economics" (Latest Edition).
6. P Abelson "Cost Benefit Analysis and Environmental Problems" (Latest Edition).
7. Shyam Divan and Armin Rosencranz "Environmental Law and Policy in India", Oxford University Press (Latest Edition).
8. R Rajagopalan "Environmental Studies", Oxford University Press (Latest Edition).
9. Charles D. Kolstad "Environmental Economics", Oxford University Press (Latest Edition).
10. Häksn Nordström & Scott Vaughan "Trade and Environment, WTO (Latest Edition).
11. Roger Perman, Yue Ma, James McGilvray, and Michael Common "Natural Resource and Environmental Economics, "(Latest Edition).

INDIAN FINANCIAL SYSTEM

BUL 2041 **3-0-0=3**

Financial System- Theoretical Setting, Post independence Evolution of India, Financial system, Financial intermediaries, Development of Financial Institutions, Non Banking Financial Companies, Mutual Funds, Government Securities Market, Capital Market, Assessment of Financial Sector Reforms. Stock market – types of shares, primary and secondary market; Market indexes, GDR and ADR, Stock Market and Macroeconomic Variables, Stock Market and issues of Foreign Capital Inflows. Bond Market - Present Value, Price and Yield, Yield-To-Maturity, Yield-To-Call, Current Yield, Holding Period Return; Risks in Bonds, G-secs Market and Corporate Bond Market in IndiaMoney market - Call Money Market, Treasury Bill Market, Commercial Bill Market, Certificate of Deposit, Commercial Paper, Money Market Mutual Fund(MMMF), Repo and Reverse Repo.

Recommended Bookss:

1. Bhole, L.M. "The Indian Financial System", Tata McGraw Hill, New Delhi (Latest Edition).
2. Howells, P. and Bain, K. "Financial Markets and Institutions", Pearson Education (Latest Edition).
3. Houthakker, H.S. and Williamson, P.J. "The Economics of Financial Markets", Oxford University Press, (Latest Edition).
4. Brooks, C. "Introductory Econometrics for Finance", Cambridge University Press (Latest Edition).
5. Joel Hasbrouck "Empirical Market Microstructure", Oxford University Press (Latest Edition).

HUMAN RESOURCE MANAGEMENT

BUL 2022 **3-0-0=3**

HRM-concept and philosophy, Need for HRM-nature and scope, Job Analysis-nature and methods of collecting information, Corporate objectives and Human Resource Planning-concept, need quantitative and qualitative dimensions, HRM in the changing environment. Recruitment and Selection, Methods of Manpower Search, Attracting and Selecting HR, Induction and Socialisation, Manpower training and development- training need analysis, process, techniques, evaluation, Performance Appraisal, 360-degree Feedback, Potential Appraisal, Career and Succession Planning. Compensation-Aim and components, Factors determining pay rates, Job Evaluation, an overview of performance incentives, Human Resource Development: Instruments, Processes and Outcomes, Motivational aspects of HRD, Industrial Relations: Conceptual framework of Industrial relations in India.

Recommended Bookss:

7. Dessler "Human Resource Management" ,PHI (Latest Edition).
8. Mondy "Human Resource Management", PHI (Latest Edition).
9. Gomez et al. "Managing Human Resources", Pearson (Latest Edition).
10. Aswathappa "Human Resource and Personnel Management" , TMH (Latest Edition).
11. Armstrong "Handbook of Human Resource Management Practices", Sage (Latest Edition).
12. Rao V.S.P. "Human Resource Management", Excel Publisher (Latest Edition).

OPEN ELECTIVE-II
Semester V

MONEY AND BANKING

BUL 3111 **3-0-0=3**

Money — meaning, functions and classification; Gresham's law; Role of money in capitalist, socialist and mixed eco Uses and limitations of index numbers; Quantity theory of money — Cash transaction and cash balance approaches; The Keynesian approach; Inflation, deflation and Inflation — definition, types, causes and effects of inflation on different sectors of the economy; Demand-pull and cost-push inflation; Measures to control inflation; Trade-off between inflation and unemployment; Monetary standards — Metallic and paper systems of note issue. Meaning and types; Functions of commercial banks; The process of credit creation — Purpose and limitations; Liabilities and assets of banks; Evolution of commercial banking in India after Independence; A critical appraisal of the progress of commercial banking after nationalization; Recent reforms in banking sector

in India. Functions of a central bank; Quantitative and qualitative methods of credit control — bank rate policy, open market operations, variable reserve ratio and selective methods; Role and functions of the Reserve Bank of India; Objectives and limitations of monetary policy with special reference to India.

Recommended Bookss:

1. Roy Bailey "The Economics of Financial Markets" (Latest Edition).
2. DM Mithani:Money "Banking and Public Finance" (Latest Edition).
3. Suraj.B.Gupta **"**Monetary Economics - Institutions, Theory & Policy", S Chand publications (Latest Edition).
4. Suraj.B.Gupta "Monetary Planning for India" (Latest Edition).
5. Khan,MY "Indian Financial System", Tata-McGrawhill (Latest Edition).
6. M.K. Lewis "Monetary Economics", OUP (Latest Edition).

WTO & INTERNATIONAL TRADE

BUL 3121 **3-0-0=3**

History and evolution of WTO, WTO Agreements, The Organizations of WTO, WTO and multilateral trading system, WTO members and observers, The General Agreement on Tariffs and Trade, WTO Agreements on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and Trade-Related Investment Measures (TRIMS), Trade-related duties and negotiations, WTO Dispute Settlement System, Technical Barriers to Trade, Trade Policy Review Mechanism, WTO and Developing Countries. WTO and the challenge of climate change, WTO Agreements on Agriculture, Sanitary and Phytosanitary Measures, WTO and Genetically Modified Organisms (GMO) Issue, General Agreement on Trade in Services (GATS).

Recommended Bookss:

1. Bhagwati, J. "International Trade, Selected Readings", Cambridge, University Press, Massachusetts (Latest Edition).
2. Chacholiades, M. "International Trade : Theory and Policy", McGraw Hill, Kogakusha (Latest Edition).
3. Krugman, P.R. and M. Obstfeld "International Economics: Theory and Policy", Glenview, Foresman (Latest Edition).
4. Salvatore D. "International Economics" (JohnWiley and sons) (Latest Edition).

ENTREPRENEURSHIP MANAGEMENT

BUL 3011 **3-0-0=3**

Entrepreneurial culture - establishing entrepreneurial system - idea processing, personal, financial information and intelligence - rewards and motivation - concept bank - role of industrial fair - Theories of entrepreneurship - entrepreneurial traits - types of entrepreneurs - behavioural patterns of entrepreneurs - entrepreneurial motivation. Business proposals: Pre-feasibility study - criteria for selection of product - ownership - capital budgeting - project profile preparation - matching entrepreneur with the project - feasibility report preparation and evaluation Entrepreneurship Development ; resources and capabilities; resource type; environment of entrepreneurship development ;technological ,social, macro and micro economic factors, competition, ecological aspects etc. entrepreneurial strategies; E–entrepreneurship; Intrapreneurship; business models and strategies; venture capital financing; Industry innovation problems, new and emerging business opportunities in global dynamic environment. Ethical decision making, ethical dilemmas. Construction of business plans. Entrepreneurship development programs in India - training institutions - institutions provided technical, financial marketing assistance - role of consultancy organizations.

Recommended Bookss:

7. Dollionger "Entrepreneurship Development", Pearson (Latest Edition).
8. Vasant Desai "Dynamics of Entrepreneurship Development in Mgt", Himalaya (Latest Edition).
9. Charantimath P.M. "Entrepreneurship Development in Small Business Enterprises", Pearson (Latest Edition).
10. Saji Kumar "Impact of Globalisation on SMEs Industries", ICFAI (Latest Edition).
11. Singh B.N.T. "Industrial Development under Structural adjustment Programme", D.D. Publication (Latest Edition).
12. Bhatia B.S. and Batra G.S. "Entrepreneurers and Small Business Management", D.D. Publisher (Latest Edition).

FINANCIAL MANAGEMENT

BUL 3041 **3-0-0=3**

Concept, nature, interaction of finance function with other management functions; role of the finance manager, objectives of financial management, focus on the shareholder's wealth maximization principle; forms of business organisations. Indian financial system: Introduction on money market & capital Market, instruments in both the markets. The time value of money**:** the concepts of time value, PV & FV. Finance: Goals and functions of finance; Concepts in valuation; Market risk and return; Capital Budgeting Decision: Investment evaluation criterion; Methods of estimating cash flows and Cost of capital; Investment decisions under capital rationing. Capital Structure Decisions: Relationship between capital structure and value of a firm (Net Income Approach, Net Operating Income Approach, Traditional Approach, Modigliani and Miller Approach); Factors influencing capital structure; EBIT-EPS Analysis, Operating and financial leverage. Working Capital Management: Need for working capital, Determinants of working capital requirements and their estimate, Sources of working capital finance, Dividend Decisions: Forms of dividends, Objectives of dividend policy, Dividend theories (Walter, Gorden and Modigliani and Miller Models).

Recommended Bookss:

1. Khan, M.Y. and. Jain, P.K "Financial Management: Text, Problems and Cases", McGraw Hill, ND (Latest Edition).
2. Prasanna Chandra "Financial Management: Theory and Practice", McGraw Hill, ND (Latest Edition).
3. Van Horne, J.C. "Financial Management and Policy", Prentice-Hall, ND (Latest Edition).
4. Copeland, T. E. and Weston J.F. "Financial Theory and Corporate Policy", Addison Wesley (Latest Edition).

BUT3081 SEMINARS

BUD3081 MINOR PROJECT

Semester-VI

APPLIED ECONOMETRICS

BUL 3191 **3-0-0=3**

General linear regression model -assumptions, estimation and properties of estimators. Deviation from classical linear regression assumption (non-spherical case) and generalised least square ,Problems of heteroscedasticity, autocorrelation and multicollinearity -Nature, test, consequences and remedial measures.
Regression with Qualitative Variables and other Techniques: Dummy variable- Testing structural stability of regression models. Dummy variable trap, Regression with dummy dependent variables- LPM, Logit, Probit and Tobit models - their applications. Principal component analysis. Dynamic Econometric Model -Autoregressive and distributed lag models- Koyck's approach, partial adjustment and adaptive expectations model, instrumental variables Problem of auto-correlation; Application; Almon approach to distributed-lag models, Error correlation mechanism, causality test, Granger test and Sim's test, exogeneity. Simultaneous equation model: Structural and Reduce forms, identification problem, indirect least square method, two stage least square method, Limited Information Maximum likely hood method, Likelihood estimation. Use of Econometrics packages.

Recommended Bookss:

1. Wooldridge "Introductory Econometrics: A Modern Approach", South-Western (Latest Edition).
2. Green, W. "Econometric Analysis", Prentice Hall of India, ND (Latest Edition).
3. Baltagi, B. H. "Econometrics" Springer, New York (Latest Edition).
4. Dongherty, C. "Introduction to Econometrics", Oxford University Press, New York. (Latest Edition).
5. Goldberger, A. S "Introductory Econometrics", Harvard University Press (Latest Edition).

AGRICULTURE ECONOMICS

BUL 3101 **3-0-0=3**

Nature and scope of agricultural economics; Traditional agriculture and its modernization; Role of agriculture in economic development; Interdependence between agriculture and industry- some empirical evidence; Agricultural development, poverty and environment. Principles of land utilization; Land distribution- structure and trends; Land values and rent; Land tenures and farming systems- Peasant, capitalist, collective and state farming; Land reform measures and performance; Problems of marginal and small farmers. Agriculture wages in India, Gender issues in agricultural services, Agricultural employment- Trends and determinants.; Agricultural markets and marketing efficiency- marketing functions and costs; Market structure and imperfection; Regulated markets; Marketed and marketable surplus; Objectives of agricultural price policy- Instruments and evaluation; Food security in India and public distribution system.
Recent trends in agricultural growth in India; Inter regional variations in growth of output and productivity; Cropping pattern shifts; Supply of inputs- Irrigation, power, seed and fertilizers; Pricing of inputs and role of subsidies. International trade in agricultural commodities; Issues in liberalization of domestic and international trade in agriculture- Nature and features of agri-business; Globalization of Indian economy; Problems and prospects of Indian agriculture; Impact of World Trade Organization on Indian agriculture.

Recommended Bookss:

1. Bilgrami, S.A.R. "An Introduction to Agricultural Economics", Himalaya Publishing House, Mumbai (Latest Edition).
2. Sadhu, A.N. and J. Singh "Agricultural Problems in India, Himalaya Publishing House, Mumbai (Latest Edition).
3. Bhaduri, A. "The Economic Structure of Backward Agriculture", Macmillan, Delhi (Latest Edition).
4. Bilgrami, S.A.R. "Agricultural Economics", Himalaya Publishing House, Delhi (Latest Edition).
5. Dantwala, M.L. et.al "Indian Agricultural Development Since Independence", Oxford & IBH, New Delhi (Latest Edition).

LABOUR ECONOMICS

BUL 3161 **3-0-0=3**

Nature and characteristics of labour economics, Demand for labour, Choice of technologies and labour policies; Supply of labour , Labour market policies; Employment service organization in India.Labour Employment and development relationship — Poverty and Labour unemployment in developing countries; Labour Unemployment — Concept, Types, and Measurement, particularly in India; Modernization and Labour employment, Educated Labour unemployment; Labour Employment policy in Five Year Plans. Classical, Neo-classical and Bargaining theories of wage determination; Concepts of minimum wage, living and fair wage. Wage determination in various sectors. Non-wage component of labour remuneration; Inflation and wage, Productivity and wage, rigidity in labour markets, National wage policy; Wages and Wage Boards in India;

Bonus system and profit sharing. Theories of labour movement — Growth, pattern and structure of labour unions in India, Causes of industrial disputes and their settlement and prevention mechanism; Role of tripartism; Current trends in collective bargaining; Role of judicial activism; Labour legislation in India; Indian labour laws and practices in relation to international labour standards. State and social security of labour — Concept of social security and its evolution; Social assistance and social insurance; Social security and labour welfare in India; Problems of labour: Child labour, female labour, Discrimination and gender bias of labour, Labour market reforms.

Recommended Bookss:

1. Venkatratnam "Industrial Relations", Oxford (Latest Edition).
2. C.B.Mamoria "Dynamics of Industrial Relations", Himalaya (Latest Edition).
3. SInha P.R.N., Indu Bala Sinha, Seema "Industrial Relations, Trade Union and Labour Legislation", Pearson (Latest Edition).
4. Debdas Banerjee "Globalisation and Industrial Restructuring and Labour", Standards, Sage Publishers (Latest Edition).
5. Sharma,BA.M. "Aspects of Labour Welfare and Social Security", Himalaya Publishing (Latest Edition).
6. Borjas, G. "Labor Economics", Boston: McGraw-Hill Irwin (Latest Edition).
7. Ashenfelter, Orley and Richard Layard "*The Handbook of Labor Economics"* New York: North-Holland, (Latest Edition).
8. Varian, H. "Microeconomic Analysis", New York: Norton, (Latest Edition).

ECONOMICS & MANAGEMENT OF IPRs

BUL 3081 **3-0-0=3**

Intellectual property rights: Meaning,-Evolution - Classification and Forms. Rationale for protection of IPRs - Importance of IPRs in the fields of science and technology. Patents - Concepts and principles of patenting - Patentable subject matter. Procedure of obtaining patents - Rights of patents - Infringement of patent rights, traditional knowledge digital library, WIPO and other IPR related organization. Remedies for infringement of patent rights - Patentability and emerging issues. Type of Innovations, Exploring innovations — the processes used to explore innovations along the technology, market and strategy dimensions as the innovation moves from idea to market. Executing innovations — the structures and incentives organizations must put into place to effectively allow talented individuals (from different functions) to execute innovation processes. Exploiting innovations — the strategies that a firm must consider to most effectively exploit the value of their innovation, including innovation platforms that incorporate multiple product options, portfolios and standards. Renewing innovations — the processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their innovation foundations in the face of potentially disruptive innovations.

Recommended Bookss:

1. Marcus Holgersson ,Innovation and Intellectual Property: Strategic IP Management, Chalmers University of Technology **publisher.**
2. D.Bosworth, The Management of Intellectual Property, Edward Elgar Publishing

MARKETING MANAGEMENT

BUL 3031 **3-0-0=3**

Definition & Concepts of Marketing Management; Needs, Wants and Demands, Marketing Mix, Extended Marketing Mix, Customer value delivery process. Scanning Marketing Opportunities: Macro and micro environment. Consumer Behavior: Introduction, Need for studying Consumer Behavior, Consumers and Organization Buying process. Market segmentation, Market Targeting and Positioning. Integrated Marketing communication, Promotion mix. Product characteristics and classification, Product differentiation and design, Product mix, Product Life Cycle. Channel Management: Nature of Distribution Channels, Channel Evaluation, Channel profitability analysis, Channel Conflicts, Retailing and Wholesale. Sales Management: Theories of Personal Selling, Selling Process, Sales budget & Sales Quota, Sales Territory, Sales meetings and Contests, Contemporary Issues in Sales management. Marketing research: Introduction & Objectives, Marketing research process. Managing Services: Characteristics of services, Differentiating services from goods.

Recommended Bookss:

1. Kotler Phillip, Armstrong Gary, Agnihotri P. Haque ul E. "Principals of marketing: A South Asian Perspective", Pearson (Latest Edition).
2. Saxena Rajan "Marketing Management", Tata McGraw Hill (Latest Edition).
3. Namakumari R. "Marketing Management", McMillan, New Delhi (Latest Edition).
4. Tybout M Alice and Calder J. Bobby " Kellog on Marketing", John Wily & Sons, NY (Latest Edition).
5. Applied Case Studies in Marketing, S Shajahan, Primus Books, New DelhI (Latest Edition).
6. Etzel, Walker et al. "Marketing Concepts and Cases", Tata McGraw Hill, New Delhi (Latest Edition).

ECONOMICS RESEARCH LAB

BUP 3081 **0-0-6=3**

Semester VII

ADVANCED MICRO ECONOMICS

BUL 6081 **3-0-0=3**

Recent developments in demand Theory-Bandwagon, Snob and Veblon Effects, Demand characteristic-Kelvin Lancaster-Demand for durable goods-constant elasticity functions, Consumer choice under risks-probability and variability in measuring risks. Risk aversion –economics of insurance –cost and risks, risk-pooling and risk spreading. Choices involving risks – St 'Petersburg Paradox Neumann-Morgenstern Hypothesis, Friedman Savage hypothesis, Markowitz, Firm's behaviour under Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly. A theory of distribution, Modern approaches to firm's behaviour- Critique of Marginalist approach, Average Cost Theory. Managerial Approaches (Baumol, Marris and Williamson), Behavioral Approach (Cyert and March). Value and Distribution, Welfare Economics.

Recommended Bookss:

1. Nicholson Walter , Snyder Christopher M. "Microeconomic Theory: Basic Principles and Extensions", Cengage Learning (Latest Edition).
2. Gravelle Hugh and Rees Ray "Microeconomics", Pearson Education Ltd (Latest Edition).
3. Jehle and Reny "Advanced Microeconomic Theory", Pearson India (Latest Edition).
4. Layard, P.R.G. and Walters A.W. " Microeconomic Theory", McGraw Hill (Latest Edition)..
5. Varian, H. "Microeconomic Analysis", W.W. Norton (Latest Edition).
6. Mas-Colell Andreu , Michael Dennis Whinston and Jerry R. Green "Microeconomic theory", OUP (Latest Edition).
7. Henderson James M. and Richard E. Quandt "Microeconomic Theory- A Mathematical Approach", McGraw Hill Book Co. (Latest Edition).

ECONOMIC MODELS & SIMULATIONS

BUL 6191 **3-0-0=3**

Demand Analysis: Derivation of Demand Function, Conditions for the Specification of Demand Function, Different Forms of Demand Functions. Production Analysis: Specification and Estimation of Advanced Production Functions. Technical Analysis: Production Frontier, Measurement and Estimation of Total and Partial Factor Productivity, Technical Efficiency and Economic Efficiency, Stochastic Frontier Analysis. Preparation of Economic Feasibility Study. Simulation.-Monte Carlo Simulation; Random Number Simulation; Stochastic Simulation; Simulation with Process Model and its Applications. Advanced Optimization Techniques-Nonlinear Programming Problem, Goal Programming.

1. Greene, William H "Econometric Analysis", Macmillan (Latest Edition).
2. Desai Meghna "Applied Econometric", Tata McGraw Hill (Latest Edition).
3. Kumbhakar Subal "Stochastic Frontier Analysis", Combridge Lovell Knox CA (Latest Edition).
4. Hair, Anderson and Tatham Black "Multivariate Data Analysis", Pearson (Latest Edition).
5. Michael D,Intriligator "Econometric Models, Techniques and Applications", Prentice Hall. (Latest Edition).
6. Bridge J. I. "Applied Econometrics", North Holland (Latest Edition).
7. Cramer, J. S. "Empirical Econometrics", North Hollan (Latest Edition).

INDUSTRIAL ECONOMICS

BUL 6161 **3-0-0=3**

Industry and economic development; Industry and sectoral linkages; Industrial classification and data information. Public, private, joint and cooperative sectors; Private corporate sector; MNCs and their role; Industrial competition and monopoly; corporate governance Locations of Industries — Theories of location; Diversification; Integration and merger of industrial units; Dispersion and problem of regional imbalance. Significance of size; Major large-scale industries — Sugar, cement, cotton, iron and steel, jute, agro-processing industries; Small & Medium industries; Cottage and village industries and rural industrialization — emerging global competition and Indian industry. Industrial pricing and market structure; Pricing in India. Concept and measurement of productivity — Productivity in Indian industries; Industrial sickness; Under-utilization of capacity — factors accounting for it and consequences. Mode of financing — Equity and debt; Institutional Finance; Bank finance. Globalization and Indian industry; International competitiveness of Indian industry; Privatization and issues relating to disinvestment policy. Industrial structure at the time of Independence; Industrial policy (Role of state); New industrial policy and economic reforms; Industrial growth and pattern.

Recommended Bookss:

1. Bhagwati, J. "International Trade: Selected Readings", Cambridge University Press (Latest Edition).
2. Chacholiades, Miltiades "The Pure Theory of International Trade", McGraw Hill (Latest Edition).
3. Dana, M.S. "International Economics: Study, Guide and Work Book", Routledge Publishers (Latest Edition).
4. Dunn, R.M. and Mutti, J.H. "International Economics", Routledge Publishers, London (Latest Edition).
5. Gandolfo Giancarlo "International Trade Theory and Policy", Springer (Latest Edition).

6. Haberler, G. "The Theory of International Trade", Macmillan & Co. (Latest Edition).
7. Heller, H. Robert "International Monetary Economics", Prentice-Hall of India (Latest Edition).
8. Kenen, Peter B. "The International Economy", Prentice-Hall of India Pvt. Ltd (Latest Edition).
9. Stephen Martin "Industrial Economics: Economic Analysis and Public Policy", Prentice Hall. (Latest Edition).
10. Lynne Pepall, Dan Richards and George Norman "Industrial Organization: Contemporary Theory And Empirical Applications", Wiley-blackwell (Latest Edition).
11. Jean Tirole "The Theory of Industrial Organization", MIT Press (Latest Edition).
12. Richard Schmalensee and Robert Willig "Handbook of Industrial Organization", North Holland (Latest Edition).

INTERNATIONAL TRADE AND POLICIES

BUL 6121 **3-0-0=3**

Export documentation and information, Export contract; Foreign Exchange regulations, Exchange rate and forward exchange cover. Quality control and pre-shipment inspection; Export Trade Control; Cargo insurance; Commercial practice; Shipment of Export Cargo. Central excise clearance; Customs clearance of export/import cargo; Export by post-parcel by air; Role of clearing and forwarding agents. Export credit (letter of credit); Export credit guarantees and policies; Finance of export on deferred payment term; Duty drawback; import licensing. Export Houses/Trading Houses; Sales tax exemption on exports, Canalization, Certificate of origin; Documents prescribed by importing countries; Standardized export documents. International trade and second generation economic reforms in India. The Balance of Payments and the Exchange Rate: The Balance of Payment Account - Balance of Payment equilibrium and disequilibrium in the Balance of payments; Surplus and deficit in the Balance of Payments, Adjustment Mechanism in the Balance of Payments – Direct and Indirect mechanisms, The Gold Standard - definition, mechanism, advantages and disadvantages, operation and collapse; Pegged Exchange rates, Flexible Exchange Rates - case for and against; Fixed Exchange rates.

1. Feenstra and Taylor "International Economics", Worth Publishers,US (Latest Edition).
2. Krugman and Obstfield "International Economics: Theory and Policy", Pearson (Latest Edition).
3. Handbook of International Economics, Elsevier- Holland (Latest Edition).
4. Charles Van Marrewijk "International Economics, Theory, Application and Policy", Oxford University Press, Indian Edition (Latest Edition).
5. Michael Melvin "International Money and Finance", Pearson Education, Indian Reprint (Latest Edition).
6. Salvatore "International Economics", Wiley India (Latest Edition).
7. Robert E. Baldwin "The Development and Testing of Heckscher-Ohlin Trade Models", MIT (Latest Edition).
8. Peter B Kenen "International Economics" (Latest Edition).
9. R Batra "Pure Theory of International Trade" (Latest Edition).
10. ☐Shapiro, A.C. "Multinational Financial Management", John Wiley and Sons (Latest Edition).
11. Levi, M.D. "International Finance", Routledge (Latest Edition).
12. Hull, J.C. "Options, Futures and other derivatives", Prentice Hall, (Latest Edition).

DECISION SCIENCE FOR ECONOMIC APPLICATIONS

BUL 6091 **3-0-0=3**

Linear Programming: LP Formulations, Graphical method. Simplex method, Duality theory, Special Linear Programming Problems ; Non-Linear Programming Problems -Transportations Problems (Stepping Stone Method), Assignment Problem. Project Scheduling by PERT/CPM Project management Origin and use of PERT Origin and use of CPM. Application of PERT and CPM. Project network-Diagram representation, critical path method, construction of time chart and resource labeling, Queuing models with Poisson input and exponential service. Inventory models; Replacement Models; Queuing theory (Poisson-exponential, single server and infinite population model); Theory of Games; Markov Analysis; Simulation (Monte Carlo Method).

Recommended Bookss:

6. *Sharma*, J.K. "Operations Research - Theory & Applications", Macmillian **(**Latest Edition).
7. Kalavathy, S. "Operation Research", Vikas (Latest Edition).
8. Vohra, N.D. "Quantitative Techniques in Management", Tata Mcgraw Hill (Latest Edition).
9. Taha "Operation Research", Pearson (Latest Edition).
10. Natarajan, Balasubramani and Tamilarasi, "Operation Research", Pearson (Latest Edition).

PRODUCTION & OPERATIONS MANAGEMENT

BUL 6016 **3-0-0=3**

Issues in production / operation management: Production / operation management- overview, Production system: Issues & environment, Total Quality Management (TQM). Forecasting: Need & importance of forecasting, Qualitative methods of forecasting, Quantitative methods of forecasting. Production system design: Capacity planning, Facilities planning, Work system design, Managing information system for production system. Production planning & scheduling: Aggregate production planning, just-In-Time (JIT), Scheduling & sequencing. Materials planning: Issues in material management, Independent demand system, Dependent demand system. Emerging issues in planning / operations management: Total productive maintenance, advanced manufacturing system, Computers in planning / operations management.

Recommended Bookss:

6. Mahadeva, B. "Operations Management(Theory & Practice)", Pearson (Latest Edition).
7. Gaither, Butta and Sarin "Operations Management", Thomson (Latest Edition).

8. Richard.B. "Operations & Supply Management", Chare (Latest Edition).
9. Nigel Slack "Operations Strategy", Pearson Education (Latest Edition).
10. Vallmann "Manufacturing Planning & Control", McGraw Hill (Latest Edition).

Semester VIII

ADVANCED MACRO ECONOMICS

BUL 6082 **3-0-0=3**

National Income and Employment: National Income concepts and accounting methods; Circular Flow models – two-sector, three-sector and four sectors; Determination of the equilibrium level of income – Classical - Keynesianism.
The Consumption Function: The absolute income hypothesis; Relative income hypothesis; Permanent income hypothesis; Life-cycle hypothesis
The Investment Function: Criteria of investment decisions - present value, internal rate of return, payback period; Keynesian formulation – long and short-run relationships; Neo-classical approach to fixed investment; Kalecki's theory and Eisner's reformulation.
Monetary Theory: Classical Theory of Money; Say's Law and Walras' Law; Classical dichotomy and the neutrality of money; Friedman's Modern Quantity Theory of Money;
Pigou Effect and Real Balance Effect. The Demand and Supply of Money: The supply of money – Measures of money supply; Money Multiplier theory, determinants of money supply; The demand for money - approach of Baumol, The demand for money – approach of Tobin. Inflation and Macroeconomics of an Open Economy: Inflation and Unemployment - Philips Curve Analysis; Factor and Goods Markets – "full" inflation; The IS-LM Analysis of an open Economy; Foreign Trade Multiplier.

Recommended Bookss:
1. Mankiw N. G. "Macroeconomics", Worth Publishers (Latest Edition).
2. Levacic Rosalind and Alexander Rebman "Macroeconomics", McMillan (Latest Edition).
3. Dornbusch Rudiger and Stanley Fischer "Macroeconomics", McGrawhill (Latest Edition).
4. Brian Snowdon and Howard R.Vane "A Macroeconomics Reader", Routledge (Latest Edition).
5. Brian Snowdon and Howard R.Vane "Modern Macroeconomics Its Origins, Development and Current State". Edward Elgar Publishing, Inc. (Latest Edition).
6. Froyen Richard T. "Macroeconomics", Pearson Indian (Latest Edition).
7. Barro J. R. "Macroeconomics", PHI (Latest Edition).
8. Aghion, A. and Howitt P. The Economics of Growth, MIT Press (Latest Edition).

ECONOMIC GROWTH AND DEVELOPMENT

BUL 6171 **3-0-0=3**

Economic growth and development: Concepts and approaches, Characteristics of underdevelopment, Constraints of economic development, Measurement of economic growth and development Income, welfare and social indicators, Modern concept of economic growth, Factors affecting economic growth - Capital, labor and technology. Income distribution in developing countries, Per capita income and human development in developing countries.
Growth models - Harrod and Domar, Instability of equilibrium, Neo-Classical growth models -Solow's model of long-run growth, Growth models of Meade and Mrs. Joan Robinson. Technological progress - Neutral and non-neutral technical change - Hicks and Harrod, Embodied and disembodied technical progress. Production function approach to economic growth, Growth models of Kaldor and Passinetti, Feldman model. Growth models in Indian Five Year Plans - Harrod-Domar model, Mahalonobis Two Sector and Four Sector models, etc.
Theories of Development – Dualism- Social, technical and financial dualism, Lewis model of economic development, Ranis and Fei model, Jorgenson's model, Criticism.
Linkage effect -Hirschman and Nurkse, Rosenstein Rodan's Big- Push theory, The theory of Backwash and Spread effect, Stage theories of development - Marx and Rostow. Techniques and Problems of Development Planning: Planning techniques - Input-output analysis, Linear programming, Choice of technique, Allocation of resources, Need for investment criteria in developing countries, Present Vs future, Alternative investment criteria - Capital turnover criterion, SMP criterion, Reinvestment criterion and Time series criterion, Cost Benefit Analysis, Shadow prices, Project evaluation and UNIDO guidelines, Economic development in India - Planning strategy and pattern of investment.

Recommended Bookss:
1. Debraj Ray "Development Economics", Oxford University Press, (Latest Edition).
2. Kaushik Basu "Analytical Development Economics: The Less Developed Economy Revisited",Oxford Univeristy Press,Delhi, (Latest Edition).
3. MIT Open Courseware- Lecture notes by Abhijit Banerjee, David Donaldson and Esther Duflo (corresponsing to MIT courses- 14.73: The Challenge of World Poverty, 14.74: Foundations of Development Policy)

ECONOMICS OF BANKING AND INSURANCE

BUL 6171 **3-0-0=3**

A Brief review of the role of central Bank ,Commercial Banks, Co-operative Banks and Regional Rural Banks in Indian Financial System. Changing Profile of Indian Banking- From Security Orientation to purpose orientation – the challenges ahead- Need to revamp the organizational structural – Need to develop Excellence in Management – Need to bring down the level of Non-performing Assets- Need to improve credit administration and Management- Need to Improve customer service – Need to improve customer service – Need to transform the banking system to a global level. king sector reforms in India. Need for reforms – Narasimham Committee reports I & II – post – reform scenario. Mutual Funds in India – Introduction – Types of Mutual Funds – SEBI directives & RBI guidelines. Insurance sector – Structure and growth of Insurance companies – LIC & its progress – general Insurance companies & their functions- reforms in the Insurance sector.

Recommended Bookss:

1. Bhole, L.M. "Financial Institutions and Markets" (Latest Edition).
2. Mishkin, F.S. "The Economics of Money, Banking, and Financial Markets" (Latest Edition).
3. Samuelson, P.A. "Economics" (Latest Edition).
4. Gupta, S.B. "Monetary Economics" (Latest Edition).
5. Kumar, V.A. "Services Sector in India, Recent Policy Initiatives", New Century (Latest Edition).
6. Uppal, R.K. "Service Sector of India- Emerging Challenges",New Century Publications (Latest Edition).

ECONOMIC & BUSINESS FORECASTING

BUL 6192 **3-0-0=3**

Economic & Business Forecasting: Types and Significance of business & economic forecasting. Economic forecasting and planning, Common time series patterns, Types of forecasting methods, Statistical fundamentals for evaluating forecasting. Quantitative & Qualitative methods of forecasting. Univariate Smoothing Methods: Moving average, weighted moving average, Exponential smoothing, Seasonal indexes, Trend-seasonal and smoothing. Pricing of stocks, Fundamental and technical analysis, Real-sector financial sector interdependence, Testing and denial of Efficient Market Hypothesis Applications related to money market

Recommended Bookss:

1. Delurgio Stephen A "Forecasting Principles and Applications", McGraw (Latest Edition).
2. Patterson K "An Introduction to Applied Econometrics", Palgrave (Latest Edition).
3. Enders Walter "Applied Econometrics Time Series", Wiley (Latest Edition).
4. Diehold Francis "Elements of Forecasting", South Western, Thomson (Latest Edition).
5. Makridakis S & Wheelwright "Forecasting Methods & Application", Willey (Latest Edition).

PROJECT MANAGEMENT

BUL 6019 **3-0-0=3**

Project Formation and Appraisal: Project Management – An Overview Feasibility & Technical Analysis, Market and Demand Analysis, economic and Financial Analysis, Formulation of Detailed Project Reports. Project Planning and Scheduling: Planning Time Scales – Network Analysis, Material and Equipment, Human Resource, Project Costing and Financing, Project Organization. Implementation and Control: Project Management Orientation System, Material and Equipment, Human Resource, Financial Aspects. Project Completion and Evaluation: Integrated Project Management Control System, Managing Transition from Project to Operation, Project Review.

Recommended Bookss

1. K. Nagarajan "Project Management", New Age international, Publishers, New Delhi (Latest Edition).
2. Nicholas "Project Management for Buss. & Tech.", Pearson Education Ltd., Delhi (Latest Edition).
3. Clifford F Gray and Erik W Larson "Project Management", McGraw Hill (Latest Edition).
4. Prasanna Chandra –Selection "Financing, Implementation, and Review, Project Planning, Analysis", Tata McGraw-Hill Publishing House, New Delhi (Latest Edition).
5. Gido & Celements "Project Management", Cenage Publication (Latest Edition).
6. A guide to the Project Management Body of Knowledge, Project Management Institute, Newtown Square, Pennsylvania USA (Latest Edition).
7. Jack Gido, James P. Clements "Project Management", Cengage (Latest Edition).
8. Jeffrey K.Pinto "Project Management", Pearson (Latest Edition).
9. Prasan Chandra "Project Planning, Analysis, Financing, Implementing and Review", TMH (Latest Edition).
10. Samuel Mantel and Jack Meredith "Project Management: A Managerial Approach", Wiley (Latest Edition).

ADVANCED RESEARCH TECHNIQUES

BUL 6092 **3-0-0=3**

Multivariate Analysis: Concept, Measurement Scales, Measurement Error, Methodology of Model Building. Factor Analysis: Concept, Design, Assumptions, Deriving Factors and Assessing Overall Fit, Interpretation of Results and Validation of Factor Analysis. Multiple Discriminant Analysis: Concept, Assumptions, Objectives, Estimation of the Model, Interpretation and Validation of the Results. Role of research in marketing; Applications of Marketing Research: Product research: Product attribute / benefit research; Brand-price trade off; Consumer promotion research; Sales and distribution research; Database marketing and Relationship Marketing; Marketing Research Agencies. Conjoint Analysis: Concept, Designing Conjoint Analysis Experiment, Estimation of Conodel, Managerial Application of Conjoint Analysis for Product Design. Canonical Correlation Analysis: Concept, Objectives, Designing, Assumptions and Estimation and Interpretation of Canonical Models.

Cluster Analysis: Concept, Objectives, Research Design, Assumptions, Deriving Clusters, Interpretation and Validation and Profiling of the Clusters, Cluster Analysis for Market Segmentation, Multidimensional scaling for Brand Positioning.

Recommended Bookss:

1. Hair, J. "Multivariate Data Analysis", Pearson Publications (Latest Edition).
2. Malhotra,N. "Marketing Research-An Applied Orientation", Pearson Publications (Latest Edition).
3. Anderseon, T.W. "An Introduction to Multivariate Statistical Analysis", Wiley (Latest Edition).
4. Neil H.Spencer "Essentials of Multivariate Data Analysis", Taylor and Francis Group (Latest Edition).
5. Hans-Hermann "Advances in Multivariate Data Analysis", Springer (Latest Edition).

Semester IX

FINANCIAL ECONOMETRIC & APPLICATIONS

BUL 7191 **3-0-0=3**

Financial Econometrics; Scope & Methods, Financial Institution: Banking, Securities And Insurance Sector Financial Institution, Role Of Central Bank In Financial Market, Brief History Of Derivatives, Evolution Of Commodity, Currency, Stocks And Interest Rate Derivatives. Structure Of Derivative Markets, Forwards, Futures, Options, Swaps Etc. Derivatives Pricing Theory: Option Pricing: Black-Shoes Formula For Option Pricing, Binomial Models For Option Prices: Definitions And Terminology. Volatility: Concept, Historical Volatility, Implied Volatility, Symmetric Volatility, Asymmetric Volatility, Measurement of Volatility in Financial Time Series: Autoregressive Conditional Heteroscedasticity (ARCH), ARCH-M Model Generalised Autoregressive Conditional Heteroscedasticity (GARCH), IGARCH, EGARCH, GJR GARCH, TGARCH, Leverage Effect, Market Efficiency, Different forms of Market Efficiency, Decision Making under Uncertainty: Expected Utility and Utility Functions, Risk Aversion, Risk Lover, Capital Assets pricing Model (CAPM), Arbitrage Pricing Theory, Value at Risk (VaR).

Recommended Books:

6. Fisher and Jordan "Security Analysis & Portfolio Management" , PHI (Latest Edition).
7. Kevin, S. "Portfolio Management" , Prentice Hall India (Latest Edition).
8. Chandra, P. "Investment Analysis and Portfolio management", Tata McGraw Hill (Latest Edition).
9. Hul, J. "Options Futures and Other derivatives", Prentice (Latest Edition).
10. Johnson, R.S. "Introduction to Derivatives: Options, Futures and Swaps", Oxford (Latest Edition).
11. Varma, J.R. "Derivatives and Risk Mgt.", McGraw Hill (Latest Edition).
12. Kolb, R.W., Overdahl, J.A. "Financial Derivatives", Wiley (Latest Edition).

TIME SERIES ANALYSIS

BUL 7192 **3-0-0=3**

Time series as a realization of stochastic process. Stationarity and strict stationarity. White noise, test of randomness. Estimation and elimination of trend and seasonal components. Autocovariance function and their estimation. AR, MA and ARMA processes their properties, conditions for stationarity, inevitability, Autocovariance function and partial autocovariance function , ARIMA processes. Identification, estimation and diagnostic checks; order selection; Seasonal ARIMA processes. Prediction -Minimum MSE forecasts, including standard errors. stepwise autoregression. Exponential smoothing and its variants. Optimality of exponential smoothing. Combination of forecasts. Comparative merits of different techniques. Transfer function models - construction and use. Asymptotic properties of maximum likelihood and least squares estimators. Confidence intervals. Multivariate time series models. Threshold models, Elements of spectral analysis - estimation and use. Use of computer packages for time series analysis. Granger Causality Test. Panel Data Regression Model: Fixed Effects Model, Random Effects Model, Hausman's Specification Test.

Recommended Bookss:

1. Wooldridge, Jeffrey M.*" Introductory Econometrics: A Modern Approach"* (Latest Edition).
2. Hill, Griffiths, Lim "Principles of Econometrics", John Wiley and Sons (Latest Edition).
3. Dougherty, Christopher "Introduction to Econometrics". Oxford University Press (Latest Edition).
4. Johnston and Dinardo "Econometric Methods", Mc-GRAW Hill International Edition (Latest Edition).
5. Maddala, G.S. "Introduction to Econometrics", Wiley (Latest Edition).
6. Jan Kmenta "Elements of Econometrics", Indian Edition (Latest Edition).
7. Baltagi, B.H. "Econometrics", Springer (Latest Edition).
8. Brooks, C. "Introductory Econometrics for Finance", Cambridge University Press (Latest Edition).
9. Johnston and Dinardo "Econometric Methods", McGRAW Hill International Edition (Latest Edition).
10. Kenneth E Train "Discrete Choice Methods with Simulation", Cambridge University Press (Latest Edition).
11. William H Greene "Econometric Analysis", Pearson (Latest Edition).
12. Leamer and Heckman "Handbook of Econometrics" North Holland, Two Volumes (Latest Edition).
13. Hardle "Applied Non Parametric Regression", Cambridge University Press (Latest Edition).
14. Nachane "Econometrics, Theoretical Foundations and Empirical Perspectives", Oxford University Press (Latest Edition).
15. KL Krishna edited Book on "Applied Econometrics", DSE (Latest Edition).
16. Hayashi "Econometrics", Princeton University Press (Latest Edition).
17. Enders "Applied Econometric Time Series", Wiley Student Edition, (Latest Edition).
18. Cameron and Trivedi "Micro econometrics Using Stata", STATA Press Publication, Texas (Latest Edition).

SCHOOL ELECTIVE - I

SCHOOL ELECTIVE – II

SCHOOL ELECTIVE – III

SCHOOL ELECTIVE - IV

SEMESTER-X

1. M.Sc. DISSERTATION

M.Sc. Dissertation: Every student shall be required to undergo 16-18 weeks Internship (Training) in the 10th Semester in Corporate/Cooperative Sector or Government Institution (RBI, Planning Commission, Ministry etc.) or any other approved Organization. After successful completion of the Internship, every student shall be required to prepare and submit, within the stipulated time, a dissertation on the work done during the Internship period. Each student will have Mentor(s) from the Internship organization and Supervisor(s) from SMVDU as allotted by the School. Each student may be required to submit a report to the Interning organization as per the requirement of the organization whereas a dissertation based on the work done in the organization will be required to be submitted to the School by the due date as per the Academic Calendar of the University. Each student will have to make a power point presentation on the dissertation work before a Panel of Experts comprising internal and external members as per the announced schedule. Due weightage will be given to the Mentor, Supervisor and other experts, including the External, in the evaluation for award of the grade in the dissertation.

OPEN ELECTIVES

SOCIOLOGY & SOCIETY

BUE 2211 **3-0-0=3**

Meaning of sociology, Nature of sociology, Meaning of perspective and their uses in sociology, Major theoretical perspectives of sociology. Society: meaning, nature and types. Community: meaning and nature. The Relationship between Man and Society, Culture: meaning, characteristics and functions, Cultural contents, Elements of culture. Group. Organization: meaning, nature, formal organization and Weber's bureaucracy. Social institutions: meaning, nature, functions and types, Social Stratification in India. Marriage: meaning, characteristics, function and types, factors effecting marriage. Family: meaning, characteristics, types. Kinship. Education System. Religion. Political system. Economic System, Meaning of socialization. Meaning of social differentiation, Social Change: Meaning, nature, causal factors and Conflict approach to social change. Relation between Society and Media, Industrial Sociology: Attitude Formation and Change; Morale Audit; Values and Norms; Power and Politics; Bureaucracy.

Recommended Bookss:

1. Browne, Ken (2011), An Introduction to Sociology (John Wiley & Sons)
2. Abraham, Francis M. (1997), Modern Sociological Theory: An Introduction (Oxford University Press)
3. Abraham, Francis M. (2006), Contemporary Sociology (1st Ed., Oxford University Press: New Delhi)
4. Rocher, Guy (2000), A General Introduction to Sociology: A Theoretical Perspective (Academic Publishers)
5. Choudhary, Viswamitra Prasad (2011), Society in India (ABD Publishers)
6. White, B. H. (2005) India Working: Essays on Society and Economy (Cambridge University Press)

INDIAN HISTORY

BUE 2212 **3-0-0=3**

History of medieval India, Trade and commerce in medieval India, Evolution of humankind, the advent of agriculture and animal husbandry, urbanization, Slave society, Feudalism., History of Indian Culture, Vedic Civilization, Harappan civilization, Bronze Age Civilisations, Mauryas & Guptas, Khaljis, Tughluqs; Lodhi, Mongol, Mughal era, Bhakti movements, Rise of Maratha Power, Colonization, British India, History of National Movement, Gandhian movements, Indian National Congress, Constitutional Development of India, Vision of New India.

Recommended Bookss:

1. Carr, E. H. (2008), What is History? (Penguin Books)
2. Thapar, Romila (2003), Early India: From its Origin to AD 1300 (Penguin)
3. Thapar, Romila (2013), Readings in Early Indian History (Oxford University Press)
4. Basham, A. L. (2004), The Wonder That was India (London: Picador)
5. Danino, Michel and Nahar, Sujata (1996), The Invasion That Never Was (Mother's Institute of Research & Mira Aditi, Mysore, India)
6. Chandra, Satish (2009), History of Medieval India (Orient Blackswan)
7. Majumdar, R. C., Raychaudhuri, H. C. and Datta, Kalkinkar (2000), An Advance History of India (4/e, Comb. Ed. Macmillan India Limited)

8. Chandra, Bipin (2012), India's Struggle for Independence (Penguin India)
9. Sharma, R. S. (2009), Rethinking India's Past (Oxford University Press)
10. Guha, Ramachandra (2008), India after Gandhi: The History of World's Largest Democracy (Picador India)

PUBLIC ADMINISTRATION

BUE 2201 **3-0-0=3**

Basic Premise: Meaning, scope, nature and importance of Public Administration, Politics and Administration, the distinctions and Similarities between public and private administration, New Public Administration, New Public Management Perspective Citizen and Administration: People's Participation in Administration, Public policy process and Policy making models, Role of civil society, Right to information and Citizen's Charter, Evolution of Indian Administration-Kautilya, Mughal period & British Legacy. Constitutional framework: value premises of the Constitution, parliamentary democracy, federalism. Planning, Human Rights: National Human Rights Commission, Union Government and Administration ; President, Prime Minister, Council of Ministers, Cabinet Committees, Cabinet Secretariat, Prime Minister's Office, Central Secretariat, Major Ministries and Departments, District Administration: Changing role of the District Collector, Law and Order and Development Management. Local Government: Panchyati Raj and Urban Local Government.

Recommended Bookss

1. M. Laxmikanth Public Administration, Tata McGraw Hill, 2011
2. Mohit Bhattacharya New Horizons of Public Administration,7th Edition, Jawahar Publishers And Distributors, 2013
3. Public Administration in India by S.R. Maheshwari, Oxford University Press.
4. R.K. Arora Indian Public Administration : Institutions and Issues ,3rd Edition, New age International Publishers, New Delhi

INDUSTRIAL PSYCHOLOGY

BUE 2021 **3-0-0=3**

Industrial Psychology, Role of psychologist in Industry, Growth & development of Industrial psychology in India, human factors and Industry problems, psychographic factors involved in employee's job performance, psychological tests in Industries: their utility, reliability and validity, Conceptual framework of attitudes: factors influencing development of attitudes, implications for organizations, employee morale, job satisfaction, practical implications of motivational theories, new directions in leadership research, emotional management, work environment: noise, illumination, colour, vibration etc., accidents at work place, monotony, stress and fatigue and their impact on work psychology, stress management interventions.

Recommended Bookss:

5. Schultz & Schultz "Psychology & Work Today", Pearson Ed. (Latest Edition).
6. Muchinsky "Psychology Applied to Work", Thomson Wadsworth (Latest Edition).
7. Coon & Mitterer "Introduction to Psychology: Gateways to Mind & Behavior", Thomson Wadsworth (Latest Edition).
8. Kaplan & Saccuzzo "Psychological Testing- Principles, Applications & Issues", Thomson Wadsworth (Latest Edition).

POLITICAL SCIENCE & SOCIETY

BUE 2215 **3-0-0=3**

Politics, Approaches to Indian Politics- Liberal and Marxist, Indian Political Thinkers
Indian Constitution- Basic Philosophy and ideals of Indian Constitutions, Citizenship-Fundamental Rights and Duties, Role of the Constituent Assembly – the Preamble. Nature of Indian Federalism: Union-State Relations, Union Executive: President, Vice-President: election, position, functions ,Prime Minister, Council of Ministers, relationship of Prime Minister and President.Union Legislature: Rajya Sabha, Lok Sabha: Organisation, Functions – Lawmaking procedure, Privileges, Committee system – Speaker. Judiciary: Supreme Court and the High Courts: composition and functions – Judicial activism. Party system: features and Trends, Electoral process: Election Commission: composition-functions- role, Major Issues in Indian Politics: Religion, Caste and Reservations, Language, Regionalism, Role of business, working class, peasants in Indian politics. Society vis a vis Political economy.

Recommended Bookss:

1. Laski, Harold J. (2010), A Grammar of Politics (Anamika Pub. & Dist. New Delhi)
2. Ramaswami, S. and Mukherjee, S. (2011), History of Political Thought (2/e, PHI Learning Pvt. Ltd.)
3. Lawson, Kay (2006), The Human Polity: A Comparative Introduction to Political Science (Wadsworth)
4. Farrelly, C. (2011), An Introduction to Contemporary Political Theory (Sage Pub. Ltd.)
5. Gaus, Gerald and Gaus, Gerald F. (2000), Political Concepts and Political Theories (Westview Press)
6. Raphael, D. D. (1990), Problems of Political Philosophy (Palgrave)
7. Chandhok, Neera (1999), Contemporary India: Economy, Society and Politics (Pearson India)
8. Diamond, Jared (2011), Collapse: How Societies Choose to Fail or Survive (Penguin UK)
9. Kashyap, Subhash C. (2009), Our Constitution: An Introduction to India's Constitution and Constitutional Law (National Book Trust, India)
10. Kalam, A. P. J. Abdul (2014), Governance for Growth in India (Rupa Pub. India)

GEOGRAPHY

BUE 2216 **3-0-0=3**

Lithosphere: Nature and Scope of Physical Geography : Geological Time Scale, Origin of the Earth, Interior of the Earth Origin of Continents and Oceans, lsostacy, Earthquakes and Volcanoes, Geosynclines, Mountain Building with special reference to folded mountains, Concept of Plate Tectonics. Atmosphere; Composition and Structure of atmosphere: Insolation,
Horizontal and Vertical distribution of temperature, Atmospheric pressure and winds, Airmasses and Fronts, cyclones and anti-cyclones, Humidity, precipitation and rainfall types, Major climate types- Equatorial, Monsoon, Mediterranean, West European and Hot Desert.

Recommended Bookss:

1. Raina, N. S. (2012), *Contemporary Physical Geography* (Concept Publishing)
2. Hussain, Majid (2014), *Geography of India* (McGraw Hill Education)
3. Kale, V. S. (2010), *Introduction to Geomorphology* (Cambridge University Press: New Delhi)
4. Bharadwaj, K. (2006), *Physical Geography: Introduction to Earth* (Discovery Publishing House)
5. Rogoff, Irit (2000), *Terra Infirma: Geography's Visual Culture* (Taylor & Francis)
6. Leong, Goh Cheng (1997), *Human and Economic Geography* (Oxford University Press)
7. Aoyama Y. (2010), *Key Concepts in Economic Geography* (1/e PB, Sage Pub. Pvt. Ltd. New Delhi)
8. Wareing, R. Knowles (2004), *Economic And Social Geography Made Simple* (Rupa & Co.)
9. Sheppard, E and Barnes, Travor J. (2002), *A Companion to Economic Geography: A Reader's Guide* (Wiley)
10. Ghosh, S. K. (2013), *Structural Geology: Fundamentals and Modern Development* (Elsevier India)

7. ANY OTHER ELECTIVE (FROM ANY SCHOOL)

SCHOOL ELECTIVES

PUBLIC ECONOMICS

BUE 7201 **3-0-0=3**

Public Economic Policies: Models for Public Sector Analysis: General Equilibrium Model, Pareto Optimality and Perfect Competition, Market Failures, Externalities and Public Policies: Market Failures, Externalities and Efficiency, Public Policies to Internalize the Externalities, Public Economic Policies: Allocation, Distribution and Stabilization, Conflicts among the Public Economic Policies. Theories of Public Goods, Public Expenditures and Taxation, Demand and Production of Public Goods, Partial and General, Equilibrium Analysis, Individual Action, Voluntary Cooperation and Efficiency, Local Public Goods, Voting Models of Public Goods, The Theory of Public Expenditure: Pure Theories of Public Expenditures: Tiebout, Samuelson and Buchanan's Contributions, Theories of Taxation: Tax Neutrality, Direct versus Indirect Taxes and Equity, Buoyancy and Elasticity Estimates of Taxation, Tax Efforts. Budgeting Fiscal Policies and Income -Program Budgeting: It's Application, Zero-Based Budgeting, Budgeting Policies, Theory of Fiscal Policy: Fiscal Policy with Special Reference to Under-developed Countries. Project Evaluation: Cost-Benefit Analysis, Measuring Costs, Measuring Benefits, Market Price, Shadow Prices, Discounting and Cost of Capital, Public Failure and Public Expenditure Growth: Non-market Demand & supply Conditions; A Typology of Non-Market Failure to match Market Failure; Bureaucratic Economics, Measuring the Public Sector, Public Choice and Other Accounts of Wagner Law.

Recommended Bookss:

1. Atkinson, A., and J. Stiglitz. *"Lectures on Public Economics".* New York, NY: McGraw Hill, (Latest Edition).
2. Gruber, Jonathan *"Public Finance and Public Policy",* Worth Publishers (Latest Edition).
3. Myles, G. *"Public Economics".* New York, NY: Cambridge University Press (Latest Edition).

AGRICULTURAL MARKETING AND PRICE ANALYSIS

BUE 7101 **3-0-0=3**

Marketing in a developing economy- structure, conduct and performance analysis; marketable and marketed surplus; marketing functions; processing, transportation, storage and warehousing; forward trading, future market; channels in marketing, price spread and efficiency; problems in marketing agricultural produce; government interventions including regulated markets, procurement, buffer stock operations, co-operative marketing etc.; demand and supply models- formulation, estimation and projections; marketed surplus models: marketing of agricultural inputs; market integration; price stabilization measures and policies.

Recommended Bookss:

1. Acharaya, S.S. and Agarwal, N.L. "Agricultural Marketing In India" Oxford and IBH Publishing (Latest Edition).
2. Singh, G.N., Singh, **D.S.R. and Singh, R.** "Agricultural marketing in India: analysis, planning and development", Chugh Publications (Latest Edition).
3. Norwood, F.B. and Lusk J. "Agricultural Marketing and Price Analysis", Pearson/Prentice Hall (Latest Edition).

AGRICULTURAL DEVELOPMENT AND POLICIES

BUE 7102 **3-0-0=3**

Role of agriculture in economic development;, characteristics of developing and developed economies; theories of development; role of economic, technological, social, cultural, political and environmental factors; interdependence between agricultural and industrial development; growth models -Harrod-Domar, neo-classical, Von Neumann; development strategies in India; five-year plans and agriculture. Agricultural growth analysis - determinants of agricultural growth and their measurements; planning models, features of planning in capitalist, socialist, neo-socialist and mixed economies; types of planning - micro level, regional, sectoral, agro-eco regional development; role of non-government organizations and self help groups (SHGs) in agricultural development; characterizing agricultural growth, changes in cropping pattern, decomposition analysis and sources of output growth; analysis of instability; capital formation, crop livestock insurance, infrastructure; transfer of technology - constraints to technology adoption, yield gap analysis and research planning; agricultural information system. Agricultural policy analysis and reforms - energy, water, fertilizer, land, seed, labour, technology, rural infrastructure, marketing, pricing, trade etc. Concepts of food security, production oriented policies, food price policies, food subsidies, food safety net and food quality. Measurement of poverty, poverty alleviation programmes.

Recommended Bookss:

1. Roger, D N. "Agricultural Development Policy: Concepts and Experiences", Wiley Publishing (latest Edition).
2. Ahuja, A. "Agricultural and Rural Development in India", Jain publications (latest Edition).
3. Bhatt "Poverty and Food Security in India: Problems and Policies", Aakar Books (latest edition).
4. Pravin, T.R. and Philip, H "Agricultural Policy Planning in India", Agrobios (India) (latest Edition).

AGRICULTURAL FINANCE

BUE 7103 **3-0-0=3**

Importance of agricultural finance; rural credit structure-demand, supply, sources and forms; estimation of credit requirement; cost of credit/capital; credit appraisal- 3 Rs and 3 Cs of credit; reforms in agricultural credit policy; innovations in agricultural financing - microfinance, kisan credit cards; role of institutions in agri-finance -public and private sector banks; cooperatives, micro-finance institutions, SHGs; international financial institutions; principles of agricultural financial management; successes and failures of co-operative sector in India; Role of cooperatives under emerging economic scenario; agricultural project analysis; Internal Rate of Return, Benefit Cost ratio analysis.

Recommended Bookss

1. Ghosal, SN. "Agricultural Financing in India", Asia Publishing House, Bombay (Latest Edition).
2. Johi, S.S. and Moore, C.V. "Essentials of Farm Financial Management," Today and Tommorow's, Printers and Publishers, New Delhi (Latest Edition).
3. Hamptron, J.J. "Financial Decision Making: Concepts, Problems and Cases", Prentice-Hall of India , New Delhi (Latest Edition).
4. Kenneth, D. D. "Principles of Management in Agribusiness", Reston Publishing Company, Reston (Latest Edition).
5. Mamoria, C.B. and R.D. "Saksena. Co-operation in India", Kitab Mahal, Allahabad (Latest Edition).
6. Mamoria, C.B. and Saxena. "Agricultural Problems in India", Kitab Mahal, Allahabad (Latest Edition).
7. Mukhi, H R. "Cooperation in India and Abroad", New Heights Publishers, New
8. Delhi (Latest Edition).
9. Muniraj, R. "Farm Finance for Development", Oxford & IBH Publishing Company Private Ltd., New Delhi (Latest Edition).
10. Subba Reddy, S. and Raghuram, P. "Agricultural Finance and Management", Oxford & IBH Publishing Company Private Ltd., New Delhi (Latest Edition).
11. Subba Reddy, S., Raghuram., Sastry, P. and Bhavani Devi I. "Agricultural Economics", Oxford & IBH Publishing Company Private Ltd., New Delhi, (Latest Edition).
12. Murray, W.G. and Nelson A. G. "Agricultural Finance", The Iowa State University Press, Ames, Iowa (Latest Edition).

FARM MANAGEMENT AND PRODUCTION ECONOMICS

BUE 7104 **3-0-0=3**

Basic principles of farm management - marginal returns, opportunity cost, cost substitution, equi-marginal returns, enterprises combination, time comparison and comparative advantage; cost concepts and analysis; farm efficiency measures; farm financial analysis; farm planning and budgeting; book keeping and

accountancy; process of decision making under different knowledge situations; measurement and management of risk and uncertainty in agriculture (including livestock, horticulture, fisheries, forestry, etc.), diversification and insurance in agriculture and allied sectors.
Forms and applications of production functions – linear, quadratic, square root, spillman, cubic, semi-log, Cobb-Douglas, constant elasticity of substitution (CES), variable elasticity of substitution (VES), etc. optimization of resource allocation; product-product relationships; resource-enterprise organization; resource-use efficiency and returns to scale; frontier production function; total factor productivity; rainbow (green, white, yellow, blue, etc.) revolution.

Recommended Bookss:

1. Ankhayan, P.L. "Introduction to Farm Management", Tata–Mc Graw –Hill Publishing Company Limited, New Delhi (latest Edition).
2. Johl, S.S. and Kapur, J.R. "Fundamentals of Farm Business Management", Kalyani Publishers, New Delhi (latest Edition).
3. Heady, E. O. "Economics of Agricultural Production and Resource Use", Prentice Hall of India, Private Limited, New Delhi (latest Edition).
4. Bishop, C.E., and Toussaint, W.D. "Introduction to Agricultural Economic Analysis", John Wiley and Sons, Inc., London (latest Edition).

NATURAL RESOURCES MANAGEMENT

BUE 7131 **3-0-0=3**

The fundamental interdependency of humans and natural resources, Role of natural systems in the production and consumption of market- and amenity-based natural resources goods and services, role and importance of natural resources in society, and the role of economics in the management of natural resources. Property rights and land tenure arrangement affecting natural resource management, Time value of money and its influence on natural resource management decisions, methods for conducting financial/economic analyses of natural resource projects and/or policies; use of economic tools for evaluating project efficiency, non-market goods and services associated with natural and environmental resources, and methods for estimating the value of these goods and services, methods for valuing natural resource lands and how real estate financing arrangements influence willingness to pay for natural resource lands. Basic economic concepts, principles, decision-making criteria, and issues associated with sustainably managing natural resources (e.g., forests, wildlife, fisheries, and recreation resources.

ECONOMICS OF INFRASTRUCTURE

BUE 7141 **3-0-0=3**

Infrastructure and economic development – infrastructure as a public good; social and physical infrastructure; special characteristics of public utilities. The peak – load, off –load problem, dual principle controversy; economics of scale of joint supply; marginal cost pricing vs. other methods of pricing in public utilities; cross – subsidization –free prices, equity and efficiency.
Transportation economics –the structure of transport costs and location of economic activities. Demand for transport. Models of freight and passenger demand. Model choice; cost functions in the transport sector. Pricing principle. Special problems of individual models of transport.
Communication –rate making in telephone utilities. Principles of decreasing costs in telephone industry. Characteristics of postal services. Criteria for fixation of postal rates. Measurement of standards of service in telephone and postal services.
Energy economics –primacy of energy in the process of economic development. Factors determining energy demand. Effects of energy shortages. Energy conservation. Renewable and non-conventional sources of energy. Energy modeling. The search for an optimal energy policy in the Indian context. Social infrastructure –organization and financing of supply of social services. Private vs. public sector financing; recent debate about the fixation of pricing of social services. Development of social services in the successive Indian plans.

Recommended Bookss:

1. Crew. M.A. "Public Utility Economics", Macmillan, London (Latest Edition).
2. Kleindorfer, P.R. "Economics f Infrastructure", ICSSR, New Delhi (Latest Edition).
3. Parikh, K.S. "India Development Report –1999-2000", Oxford, New Delhi (Latest Edition).
4. Turvey, R. "Public Enterprises, Penguin, Harmonds Worth Welson, J.R. Marginal Cost Pricing in Practice". Prentice Hall (Latest Edition).
5. Kneafsey, J.T. "Transportation Economic Analysis", Lexington, Toronts (Latest Edition).
6. Munty, D. "Transport: Selected Readings, Penguin, Harmonds WorthFarirs, M.T & Public Utilities, Houghton Miffin", Boston R. Sampson (Latest Edition).
7. Asonofsky, J.A, Rao. "Energy Policy", North Holland, Amsterdam & M. Shakeen (Latest Edition).
8. Pachauri, R.K. "Energy Policy for India", Macmillan Co of India, New Delhi
9. Goyal, S.K "Public Enterprises", Indian Institute of Public Administration, New Delhi (Latest Edition).

ECONOMICS OF ENVIRONMENT AND POLICIES

BUE 7132 **3-0-0=3**

Economic principles to explain environmental problems. Environmental problems resulting from social and economic growth. Population growth and its effects on environment. Government role in preventing and mitigating of polluted environment. Institutional failure. Market failure, externalities and public goods. Property right of natural resources. Problems of resource and environmental depletion. Application of economic welfare in solving environment problem. Economic theories applied in decision making process and policy formulation concerning environment. Environmental impact of social and economic development projects. Decision between resource conservation and resource utilization for social and economic development. Long term policy formulation concerning various environmental resources. International cooperation in solving environmental problems. Analysis of economic and resource activities in various regions of the world, with emphasis on India and SAARC. International understanding, protocols and regulations on sustainable development and environment.

Recommended Bookss

1. M. L. Jhingan **and**C. K. Sharma, Environmental Economics : Theory, Management and Policy , Springer.
2. Horst Siebert , Economics of the Environment Theory and Policy 7th Edition, Printsasia.
3. Scott Callan, Janet Thomas Environmental Economics and Management: Theory, Policy, and Applications, Nlson Education

INTERNATIONAL FINANCE

BUE 7111 **3-0-0=3**

Theory of international finance, exchange rate system and foreign exchange market. Theory of balance of payments. Balance of payments adjustment under different schools of thought. International monetary system. Roles of International Monetary Fund. International liquidity. Foreign aid and loan. An analytical framework for the flexibility of foreign debt service. Problems of foreign debt repayment among developing countries. Types of international investment and theories explaining their causes. The economic effects of international investment on home and host countries. Measures for promoting foreign investment. Multinational corporations and government and international organization policies.

Recommended Bookss:

1. *David Eiteman*, *Arthur Stonehill*, *Michael Moffett*. "Multinational Business Finance: Global Edition", Pearson India
2. *Jeff Madura,* "International Financial Management**",** Abridged Edition
3. *Cheol Eun and Bruce Resnick,* "International Financial Management", Tata McGraw Hill
4. *Geert Bekaert*, *Robert Hodrick*, "International Financial Management" Pearson New International Edition.

INTERNATIONAL MARKETING

BUE 7121 **3-0-0=3**

International Marketing: Definitions, nature, scope and process of International Marketing; reasons and motivations for underlying International Trade and International Business; basic modes of process of International Marketing; Domestic Marketing versus International Marketing International Marketing Environment, Factors influencing International market selection and segmentation, Selection strategies. International Marketing Planning and control. International Marketing Mix: International product policy and planning International Product mix, Management of International Brands, labeling, packaging and organization of product warranties and services.

International Pricing policies and strategies, Process of price setting, pricing decisions, information for pricing decisions. International Advertising: International advertising strategy, elements of advertising strategy, media strategy; International Distribution Channels, Selecting distribution channels.

Recommended Bookss:

1. M.J. Mathew International Marketing Policies and Procedures, RBSA Publishers.
2. Rakesh Mohan Joshi, International Marketing, Oxford University Press;
3. Thomas Heilmann Manual of International Marketing, GWV-Vieweg
4. Philip R. Cateora, John Graham International Marketing with PowerWeb, McGraw-Hill/Irwin
5. Warren J. Keegan, Mark Green, Global Marketing, Prentice Hall
6. Vern Terpstra, Lloyd C. Russow, International Dimensions of Marketing, South-Western College

REGIONAL ECONOMIC BLOCKS

BUE 7122 **3-0-0=3**

Regionalism in the World Economy, Theory of Economic Integration, Selected Regional Blocks - NAFTA, EU, ASEAN, SAARC; Globalization Vs. Regionalization; Regional Blocks, Building Blocks or Stumbling Blocks: Ongoing challenges - Environment Volatility, Rise of Global Mania; Regional Alternatives; India's Free Trade Agreements. Basic theory of international trade policy, both export and import. Objectives of the policy. Tariff

and non-tariff barriers. The efficiency and distribution effect of export promotion, import substitution and other measures. The methodology of measuring effective rate of protection. Role of WTO in promoting free trade. Roles of UNCTAD in protecting the developing countries interest. Basic theory of economic integration. Stage of international integration and theory of custom unions. Welfare and dynamic effects of the international integration. The impact on the international trade and monetary policy. Conditions of integration success. Regional integration verses international integration. The EU, ASEAN and other international experience. Analysis of tariff and non-tariff trade barriers. Local industry protection policy. Price stabilization policy for primary goods. Trade in agriculture goods. Trade in services.

Recommended Bookss

1. Christopher Bliss, Economics Theory and policy for trading Blocks, Manchester University press, New York.
2. Peter Robson, The Economics of International Integration, psychology press

ECONOMICS OF SERVICES

BUE 7081 **3-0-0=3**

Structure and transformation of economies and the role of service sector. Evidences on structural transformation of leading economies and regions in the world. Contribution of service sector in GDP, exports and employment. Service sector and 'Excess Growth' hypothesis. Type of services—Commercial Services and Public Services. Financial services. Knowledge. India's trade in commercial services. WTO and GATS. Services under different Mode and India's advantage. Outsourcing of services. BPOs - Problems and prospects.

Recommended Bookss:

1. Kumar, V.A. "Services Sector in India, Recent Policy Initiatives", New Century (Latest Edition).
2. Uppal, R.K. "Service Sector of India- Emerging Challenges", New Century Publications (Latest Edition).

RURAL ECONOMICS

BUE 7181 **3-0-0=3**

Farm and Non Farm Sector, Land rights and revenue system; Zamindars and peasants; Rural Panchayat, agricultural production; crop patterns, role of Agricultural in Indian Economy, Problems of low productivity - Land Reforms - need and scope. The food problem and Green Revolution, Employment, Unemployment and Underemployment of Rural area, Barter System, Non-farm activities, Commercialization of Rural activities, Rural Markets, Globalization and rural Economy, Rural credit system, rural banks, Rural development programmes.

Recommended Bookss

1.Thomas Nixon Carver, Principles of Rural Economics
2. Chatterton, Alfred, Rural Economics In India, Oxford University Press
3. Wu JunJie, Paul W Barkley, Bruce A Weber, Routledge, Frontiers in Resource and Rural Economics: "Human-Nature, Rural-Urban Interdependencies". PFF Press book.

ECONOMICS OF HILLY REGION

BUE 7133 **3-0-0=3**

Standard of Living of Hill People, sources of livelihood, Problems of Hilly Habitations, Demographic Structure, Migration from Hills, Economic potential of Hilly Region, Economic Activities-agricultural production of Hilly Region, Animal Husbandry and Dairy Development, Horticulture , Trade, Hill Industries, Hill Lands, Rural and urban hills, Hill stations and Tourism, Hill labour force, Sustainability & Economic Development Strategies, Hill Areas Development Programmes, Patterns of Economic Growth in hills.

Recommended Bookss

1. Gursharan Singh Kainth,Developing Hill Agriculture, Regencu Publication
2. Bhaskar Majumder Housing on the Hills in India, Concept Publishing Company
3. J. B. Ganguly, Sustainable Human Development in the North-eastern Region of India

TRANSPORTATION ECONOMICS

BUE 7142 **3-0-0=3**

Nature and scope of transport economics, functions and economic interest of transport, modal characteristics, demand for transport, supply of transport, cost of transport, pricing of transport services, transport and economic development. Structure of Indian road transport. Taxation of commercial motor transport, Administration and financing of road construction, extension maintenance. Current problems of road transport. The role and characteristics of road freight transport, supply and demand in road freight transport, legislation relating to road freight transport, management information systems and information technology in road freight transport.

Analysis of the Indian railway market, legal requirements and policy, railway characteristics, railway ownership, containerization, regional rail cooperation, international railway trends, railway pricing, Railway budget and finance, Railway administration, classification of goods railways rate tribunal and current problems of road transport Characteristics and scope of air transport, the cost of providing air transport services, the pricing of

air transport services, airline management and control and airport planning and management, Civil aviation in India. International organization and law relating to aviation. Shipping economics, Shipping Rates, Liners and Tramps, competition and shipping conferences. Development of Indian shipping, economics of port and Port Procedure, current problems, shipping policy and five years plans, chartering business, containerization. , Shipping policy and development.

Recommended Bookss

1. André De Palma, Robin Lindsey, Emile Quinet, Roger Vickerman,A Handbook of Transport Economics, Edward Elgar Publishing. Copyright.
2. John Robert Meyer, José A. Gómez-Ibáñez, William B. Tye, Clifford Winston, Essays in Transportation Economics and Policy, Brookings Institution Press
3. K. Button, Transport Economics, Edward Elgar Publishing.

HEALTH ECONOMICS

BUE 7082 **3-0-0=3**

Introduction: the relevance of economics in health and medical care, The Supply and Demand for Health and Medical Care, Health Insurance Industry, Decision-making under uncertainty, Insurance markets, Causes and consequences of employer-based private health insurance Managed care, Hospital Service Industry and Long-term Care, Physician Service Industry, Pharmaceuticals, the Government's Role and Policy Analysis, Social insurance Comparative health systems, Health care reforms.

Recommended Books:

1. Briggs, A.H., Claxton, K. and Sculpher M. J. "Decision modelling for health economic evaluation", Oxford: Oxford University Press (Latest Edition).
2. Cleverley, W.O., Cleverley, J.O. and Song, P.H. "Essential of health care finances", Jones & Bartlett Learning (Latest Edition).
3. Cutler, D. "Your money or your life: strong medicine for America's health care system", Oxford University Press (Latest Edition).
4. Culyer, A.J. and Newhouse J.P., "Handbook of Health Economics", Amsterdam, New York: North Holland/Elsevier (Latest Edition).
5. Culyer, A.J. "The dictionary of health economics", Cheltenham, UK: Edward Elgar Publishers (Latest Edition).
6. Feldstein, P.J. "Health care economics", New York: Thomson Delmar Learning (Latest Edition).
7. Feldstein, P.J. "Health policy issues: An economic perspective", Chicago: Health Administration Press (Latest Edition).
8. Folland, S, Goodman A. and Stano, M. "The Economics of health and health care", Upper Saddle River NJ: Prentice Hall (Latest Edition).

ECONOMICS OF TOURISM

BUE 7151 **3-0-0=3**

Basic concepts in Tourism, History of Development of Travel and Tourism, What is "tourism economics, Tourism product, Tourism and the National Economy, definitions and economic measures of tourism products and services, Methods for estimating visits, demand and value of recreation & tourism, Travel cost, Contributions of Tourism to national, regional and local economies as measured by production, income, value added and jobs, Management, planning, policy and marketing decision of tourism, transportation economics, Cost-benefit analysis, Competition among Tourism Industries, global Tourist, Sustainable Tourism Development.

Recommended Bookss

1. James Mak, Tourism and the Economy: Understanding the Economics of Tourism, Versha Press
2. M. Thea Sinclair, Mike Stabler, The Economics of Tourism, Routledge Publisher
3. Kartik Chandra Roy, Clemant Allan, Tisdell Tousiam in Indian and India,s Economic Development, Nova Science Publishers.

Details of Courses Offered by School of Busniess for B.Tech., B.Arch. & M.C.A. Program

Engineering Economics and Management

BUL 1061 **3 – 0 – 0 = 3**

Engineering Economics- Scope & Concept. Applied Operational Economic Issues. Analysis of Demand. Demand Forecasting. Laws of Production. Various Production Functions. Cost Analysis. Economic and Technical Efficiency. Different Market Structure and Price Determination. Net Present Value. Rate of Return. Payback Period. Benefit - Cost Analysis. Preparing and Presenting an Economic Feasibility Study: Project Engineering, Market Study. Macro Business Environment in India. Indian Manufacturing Sector. Economic reforms and Market Mechanism.

Management: Nature & Functions: Development of management thoughts; Principles of Management; Planning, Organizing, Staffing, Directing, And Controlling; Coordination and Cooperation, Techniques for effective coordination. Challenges and Opportunities for OB: OB Model; Foundations of Individual Behaviour: Learning, Attitudes, Personality, Perception, Emotional Intelligence,

Recommended Books

1. Economics by Paul A Samuelson and William D Nordhaus, TMH
2. Managerial Economics by D.N.Dwivedi, Vikas Publications
3. Essentials of Management by Harold Koontz and Heinz Weihrich, TMH

Project Management for Engineers

BUE 4011 **3 – 0 – 0 = 3**

Introduction: Project Management – An Overview, need, goals and form of project management, Generation and screening of ideas, Marketing and demand analysis, Technical Analysis, Financial analysis , economic Analysis, Formulation of Detailed Project Reports. Project planning and scheduling; Planning Time Scales – Network Analysis (PERT and CPM method), Cost estimation and Budgeting, Managing risk in the project. Project evaluation, reporting and termination: Project management information system, project evaluation, Project reporting, Project termination. Project organization: Project organization structure, Role and responsibilities of project manager.

Recommended Books

1. K. Nagarajan, Project Management, New Age international, Publishers, New Delhi.
2. Nicholas, Project Management for Buss. & Tech., Pearson Education Ltd., Delhi
3. Clifford F Gray and Erik W Larson, Project Management , McGraw Hill.
4. Prasanna Chandra -Selection, Financing, Implementation, and Review, Project Planning, Analysis, Tata McGraw-Hill Publishing House, New Delhi.
5. Gido & Celements, Project Management Cenage Publication.
6. A guide to the Project Management Body of Knowledge, Project Management Institute, Newtown Square, Pennsylvania USA

Engineering Economics

BUE 4081 **2-0-0 =2**

Engineering Economics- Scope & Concept. Applied Operational Economic Issues. Analysis of Demand and supply. Demand Forecasting. Various Production Functions. Laws of Production. Cost Analysis. Economic and Technical Efficiency. Different Market Structure and Price Determination. Net Present Value. Rate of Return. Payback Period. Benefit - Cost Analysis. Preparing and Presenting an Economic Feasibility Study: Project Engineering, Market Study. Macro Business Environment in India. Indian Manufacturing Sector. Economic reforms and Market Mechanism.

Recommended Books:

1. Robert S. Pindyck, Daniel L. Rubinfeld, Microeconomics , Publisher: Prentice Hall
2. Dominic Salvatore, Micro Economic Theory and Applications, Oxford University Press
3. Dominick Salvatore : Microeconomics : Theory and Applications',:Oxford University press.
4. Nellis J., and D. Parker – Principles of Business Economics– PearsonEducation, London.
5. Richard T. Frogmen – 'Macro economics', Pearson education.

Marketing Management

BUE 4031 **3-0-0=3**

Marketing –Definition, Nature, scope of marketing. Concepts of Marketing, Value Chain Delivery Network, Role & functions of Marketing Manager

Marketing Environment Marketing Information System & Marketing Research Product mix and differentiation, Product life cycle, New Product Development, Pricing, Marketing Channels, Promotion Mix

Buyer Behaviour and Market Segmentation, Targeting and Positioning, Concept of Brands, Packaging and Labelling. Concept of Online Marketing

Recommended Books:

1. Kotler, Philip and Gary Armstrong : Principles of Marketing, Prentice Hall, New Delhi
2. Ramaswamy, V.S. and Namakumari, S : Marketing Management, Macmillan India, New Delhi
3. Srinivasan, R : Case Studies in Marekting : The Indian Context, Prentice Hall, New Delhi.
4. Majumdar, Ramanuj : Product Management in India, Prentice Hall, New Delhi.

Industrial Economics

BUE 3081 **3-0-0=3**

Industrial Economics: Concept and scope, Industrial and Market structure, Industrial concentration, Expansion of the firms through merger, acquisition and diversification, Role of Government in the process of industrialization and collaborative business ventures, Economic aspects of industrial efficiency, Measurement of capacity utilization, Partial and total factor productivity.

Evolution of Industrial economy: Industrial Classification, International standard industrial classification, National industrial classification, Industrial growth indicators, Index of Industrial Production, Annual Industry survey, Foreign Direct Investment (FDI): Origin and evolution of FDI, definition of FDI, FDIVs FII, measurement, theories and effect.

Formation of business plans, Small and medium scale business in India, Rural industries, Auxiliary industrial problems of small scale business, Industrial Sickness and Industrial innovation Problems, Industrial financing of small and medium enterprises, New and emerging business opportunities in the Global dynamic environment, Corporate venturing, Networking and franchising.

Reforms in industrial sector and their impact since 1991, WTO and the new international trading regime and its implications for India, Environmental and related issues in Global trade, Self-Help group, SEZ,FEMA,MTTP, Competition Act, Intellectual property rights & Indian Industry, Industrial labor disputes and trade unions.

Recommended Books:-

1. Ahuluwalia, I.J.: Industrial Growth in India, Oxford University Press
2. Kuchal, S.C.:- Industrial Economy of India, Chaitanya Publishing House
3. Barethwal, R.R. : Industrial Economics, New Age International Publishers
4. Desai, S.S.M. & Bhalerao:- Industrial economy of India, Himalaya Publishing House

Bio-Business Planning & Management

BUL 4011 **3 – 0 – 0 = 3**

Concept of Business: psychological & social factors, theories; qualities of a prospective entrepreneur; Characteristics of entrepreneur; Bio-entrepreneurs. Trends & Support activities of Government for Bio Industries.

Business plan: Design & Evaluation; Internal & External Environment Scanning & Opportunities Assessment: Types of Environment, Competition Analysis, Concept of SBU, PEST and SWOT Analysis.

Procedure for establishing a unit - The start up process, Project identification, Selection of the product, Project Formulation, Assessment of Project Feasibility, Market Survey, Investment / Risk Analysis, Preparation of project report, Selection of site, Legal Considerations

Forms of Ownership; Financing These Units - Estimation of Finance Requirement, Type of Requirements, Sources of Finance and role of financial institutions; Lease Financing and Hire Purchase; Working Capital Management; Purchasing and Inventory Management; Production and Operation Management; Profit Planning and Budgeting; Growth Strategies for Businesses.

Recommended Books:

1. Entrepreneurial Development by S. S. Khanka, S. Chand & Co
2. Handbook on business plans, Mittal Sanjiv, Arora Soma, Gupta Akanksha, Excel books.
3. Environment Management, Satpathy Ipseeta, Excel Books
4. Marketing Management, Ramaswamy, Namakumari, Macmillan

Introduction to Economics

BUL 2083 **3-1-0=4**

Current economics problems. Alternative economics systems. An overview of the economy. The market mechanism. National product and income. Consumption, saving and investment. Determination of national income, aggregate demands and supply. Fiscal policies. The nature of money and monitory policy. Inflation and unemployment .Basic concepts of price theory .Elasticity of demand and supply. Theory of production .theory of cost. Pricing in competitive and monopoly markets. International trade. Theory of exchange rates .Balance of payments. Economic growth and developments. inequality and poverty.

Recommended Books

1. Robert S. Pindyck, Daniel L. Rubinfeld, Microeconomics , Publisher: Prentice Hall
2. Dominic Salvatore, Micro Economic Theory and Applications, Oxford University Press
3. Dominick Salvatore : Microeconomics : Theory and Applications',:Oxford University press.
4. Nellis J., and D. Parker – Principles of Business Economics– PearsonEducation, London.
5. Griffith A. and S. Wall, Economics for Business and Management – PearsonEducation, London

6. Keat P.G. and P.K.Y. Young – Managerial Economics – Tools for Today's Decisionmatters – Pearson Education New Delhi
7. Richard T. Frogmen – 'Macro economics', Pearson education.
8. Eugene Diutio – Macro economic Theory, Shaum's Outline series. Tata McGraw Hill
9. D'Souza – 'Macro Economics' – Pearson Education 2008.

Industrial Psychology

BUL 4021 **3-0-0=3**

Industrial Psychology, Role of psychologist in Industry, Growth & development of industrial psychology in India, human factors and Industry problems, employee's job performance and psychographic factors, Conceptual framework of attitudes: factors influencing development of attitudes, implications for organizations, employee morale, practical implications of motivational theories, applications of leadership theories, emotional and spiritual management; work environment management: various types of environments and related patterns of behavior. Accidents at work stress management interventions.

Recommended Books:

1. Schultz & Schultz, Psychology & Work Today, Pearson Ed.
2. Muchinsky, Psychology Applied to Work, Thomson Wadsworth
3. Coon & Mitterer, Introduction to Psychology: Gateways to Mind & Behavior, Thomson Wadsworth.
4. Kaplan & Saccuzzo, Psychological Testing- Principles, Applications & Issues, Thomson Wadsworth.

Organization Behaviour & Management Practices

BUL 7021 **3-0-0=3**

Introduction to Management; Development of management thoughts; Functions of Management: Planning, Organizing, Staffing, Directing, and Controlling; Techniques for effective coordination, Decision Making.
Introduction to Organization Behaviour; Understanding Individual Behaviour: Learning Attitudes, Personality, Perception; Transactional analysis; Johari Window
Foundations of Group Behaviour; Conflict Management.
Organization as a system: Organizational Change; Organizational Culture; Organizational Development.

Recommended Books:

1. Koontz & Weihrich, Essentials of Management, TMH
2. L.M.Parsad, Principles & Practices of Management, Himalaya
3. Mullins, Management & OB, , Pearson
4. Robbins, Judge, Sanghi, Organizational Behaviour, Pearson
5. Greenberg et al., Managing Organsitional Behaviour , Phi
6. Fred Luthans, Organizational Behaviour, TMH

Human Resource Management in Practice

BUL 8021 **3-0-0=3**

HRM-concept, Need, scope, Emerging Trends in HRM. Human Resource Information System: Setting up HRIS and its usage; Design of HRIS.
Job Analysis. Human Resource Planning; E-HR Planning.
E-Job Design; Recruitment and Selection, Induction and Socialisation, E-Recruitment & Selection.
Manpower training and development-need analysis, process, techniques, E-Training and its evaluation.
E-Performance Management; Performance Appraisal, 360-degree Feedback, Potential Appraisal. Career and Succession Planning.
Job Evaluation. An overview of incentives. E-Compensation Management; Human Resource Development. Conceptual framework of Industrial relations in India. E-HR Records.

Recommended Books:

1. Dessler, Human Resource Management ,PHI
2. Mondy, Human Resource Management, PHI
3. Gomez et al., Managing Human Resources, Pearson
4. Aswathappa, Human Resource and Personnel Management , TMH
5. V.S.P.Rao, Human Resource Management , Excel Publisher

Business Economics

BUL 6061 **3-0-0=3**

Nature and scope of Business economics; role and responsibility of business economist; Demand and supply; factors determining demand and supply; law of demand and supply;; market equilibrium; application of equilibrium price in business and pricing decision.
Demand functions: linear and non-linear; elasticity of demand; demand forecasting. Firm and industry; firm and its goals; time elements; production function; long run and short run, fixed and variable inputs; law of production; expansion path of output. Cost analysis: concepts, short and long run cost output relationship; economies and diseconomies of scale. Price output decision under perfact competition, monopoly, discriminating monopoly, monopolistic competition, oligopoly. Managerial Approaches (Baumol, Marris and Williamson), Behavioral Approach (Cyert and March), Business Cycles.

Recommended Books:

1. A.Koutsoyiannis ,Modern Micro Economics ,Macmillian Press Limited

2. Yogesh Maheshwari ,Managerial Economics ,Prentice Hall
3. H.L Ahuja ,Managerial Economics ,S Chand
4. Thueses & Fabrycky ,Engineering Economy,Prentice Hall
5. D.M Mathani ,Managerial Economics, Himalaya Publishing House

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Physics

Master of Sciences in Physics

Study & development of physics is important as it plays a key role in the future progress of humankind. Physics is an exciting intellectual adventure that inspires young people and expands the frontiers of our knowledge about Nature. Physics generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world. It contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries. Physics is an important element in the education of chemists, engineers and computer scientists, as well as practitioners of the other physical and biomedical sciences. It extends and enhances our understanding of other disciplines, such as the earth, agricultural, chemical, biological, and environmental sciences which happen to be the subjects of substantial importance to all peoples of the world. Physics improves our quality of life by providing the basic understanding necessary for developing new materials, instrumentation and techniques for various applications.

Considering above the programme has been designed with two elements namely core and specialization and initially the school shall offer Electronics and Condensed Matter Physics as the specializations. Subsequently based on the availability of infrastructure and faculty other specializations can be added without any need to modify the core component.

Features:

- The programme has been designed broadly on the basis of UGC model curriculum, syllabus for NET and GATE examinations.
- Syllabus of various lading institutions has also been used as a reference while framing the curriculum.
- The programme has an excellent blend of the core and applied components.
- The programme has been designed on core and specialization pattern and initially two specializations namely electronics (Microcomputers and Interfacing) and Condensed Matter Physics shall be offered with 10 students for each specialization.
- Based on the expertise of the faculty more specializations can be added in future

Name of the Degree: Master of Science in Physics (M. Sc. Physics).

Course Structure of M.Sc(Physics)

Semester I **First Year**

Course Code	Course Title	L-T-P	Credits
PHL 6021	Classical Mechanics	4-0-0	4
PHL 6031	Mathematical Physics	4-0-0	4
PHL 6041	Quantum Mechanics-1	4-0-0	4
PHL 6051	Electronics	4-0-0	4
PHP 6121	General Laboratory-I	0-0-12	6
Total Credits		**16-0-12=28**	**22**

Semester II **First Year**

Course Code	Course Title	L-T-P	Credits
PHL 6061	Statistical Mechanics	4-0-0	4
PHL 6042	Quantum Mechanics-II	4-0-0	4
PHL 6071	Electrodynamics & Plasma Physics	4-0-0	4
PHL 6081	Atomic & Molecular Physics	4-0-0	4
PHP 6122	General Laboratory-II	0-0-12	6
Total Credits		**16-0-12=28**	**22**

Semester III **Second Year**

Course Code	Course Title	L-T-P	Credits
PHL 7091	Nuclear & Particle Physics	4-0-0	4
PHL 7101	Condensed Matter Physics	4-0-0	4
PHL 7XP2	Special Paper I	4-0-0	4
PHL 7XP3	Special Paper II	4-0-0	4
PHP 7XP6	Special Paper Lab	0-0-12	6
Total Credits		**16-0-12=28**	**22**

Semester IV **Second Year**

Course Code	Course Title	L-T-P	Credits
PHL 7111	Computational Methods & Programming	2-0-4	4
PHL 7043	Relativistic Quantum Mechanics	4-0-0	4
PHL 7XP4	Special Paper III	4-0-0	4
PHL 7XP5	Special Paper IV	4-0-0	4
PHD 7131	Project	0-0-16	8
Total Credits		**16-0-16=32**	**24**

SEMESTER I

Classical Mechanics

PHL 6021 **4-0-0=4**

Unit I: Introduction to Mechanics and the Lagrangian Formulation: [10]
Mechanics of a system of particles in vector form. Conservation of linear momentum, energy and angular momentum, Degrees of freedom, Constraints, and generalized coordinates and velocities. Elementary idea of general dynamical systems: conservative versus dissipative systems. Lagrangian, action principle, external action, Euler-Lagrange equations. Generalised momenta and the conservation laws. Applications of the Lagrangian formalism.

Unit II: Two-Body Central Force Problem: [10]
Central force problem, Kepler problem, bound and scattering motions. Scattering in a central potential, Rutherford formula, and the Scattering cross section.

Unit III: Hamiltonian Formulation of Mechanics: [12]
Hamiltonian, Hamilton's equations of motion. Legendre transforms relation to Lagrangian formalism. Phase space, Phase trajectories. Applications to systems with one and two degrees of freedom. Hamiltonian systems and Liouville's theorem. Canonical transformations, Poisson brackets. Action-angle variables. Non- integrable systems and elements of chaotic motion.

Unit IV: Rigid Bodies and the Small Oscillations: [08]
Noninertial frames of reference and pseudoforces: centrifugal Coriolis and Euler forces. Elements of rigid-body dynamics, Euler angles, and the symmetric top. Small Oscillations: Normal mode analysis, and Normal modes of a harmonic chain.

Unit V: Special Theory of Relativity: [10]
Inertial frames. Principle and postulate of relativity. Lorentz transformations. Length contraction, time dilation and the Doppler effect. Velocity addition formula. Four- vector notation. Energy-momentum four-vector for a particle. Relativistic invariance of physical laws.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books
1. Classical Mechanics: H Goldstein.
2. Classical Mechanics: N C Rana and P S Joag
3. Mechanics: L. D. Landau and E. M. Lifshitz
4. Introduction to Classical Mechanics: R. G. Takwale and Puranik.

Mathematical Physics

PHL 6031 **4-0-0=4**

Unit-I. Vector and Tensor: [10]
Scalar and vector fields, Vector differential operators: gradient, curl. Divergence and Laplacian. Vector operators in curvilinear coordinates. Gauss's theorem. Green's theorem and Stoke's theorem: applications to physical problems. Tensors.

Unit-II. Boundary value problems: [15]
Partial differential equations: applications in electrostatics, Laplace and Poisson equations: heat conduction, diffusion, elastic and electromagnetic waves. Schrodinger wave equation. Solutions in rectangular, spherical polar and cylindrical polar coordinates. Boundary conditions.

Unit-III. Complex Variables: [10]
Elements of complex variables. Cauchy–Reimann eqn. Taylor and Maclaurine Expansion, Residue theorem and contour integration.

Unit-IV.Special Functions: [12]
Special functions: Bessel, Hermite, Legendre, Laugerre polynomials: generating functions and orthonormality. Addition theorem for spherical harmonics, application in heat conduction, diffusion, wave equations etc., Dirac delta function and its representations.

Unit-V. Fourier and Laplace Transformations: [08]
Fourier analysis. Fourier transforms, Laplace transforms and applications in physics.

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Recommended Books
1. Mathematical Methods for Physicists: George B. Arfken and Hans-Jurgen Weber.
2. Mathematics for Physicists and Engineers: Louis A. Pipes.
3. Mathematical Method of Physics: A.K. Ghatak.
4. Analytical Mathematics in Physics: C. Harper, 1st Edition Prentice Hall
5. Mathematical Physics: B S Rajput
6. Mathematical Method- Potter and Goldberg (Prentice hall of India)
7. Vector Analysis (Schaum Series) (McGraw Hill)

Quantum Mechanics-I

PHL 6041 **4-0-0=4**

Unit-I [10]
The principle of Superposition, One and three dimensional wave packets, Motion of wave packets, Differential equation satisfied by wave packets, Interpretation of wavefunction, Probability current density, equation of continuity, wave packet in momentum space, Ehrenfest's theorem, wavepackets and uncertainty relations and spread of wave packet.

Unit-II Application of Schrödinger equation: [10]
One dimensional finite square well potential, particle in one and three dimensional box, solution of free particle Schrödinger equation in spherical polar coordinates, solution of one and three dimensional harmonic oscillator in spherical polar co-ordinate, degeneracy of harmonic oscillator states. Rectangular potential barrier, application of barrier penetration.

Unit-III General Formalism: [10]
Fundamental postulates of wave mechanics, operator representation of dynamical variables, commutation of operators, Adjoint and hermitian operators, unitary operators, eigen value problem for operators, properties of eigen functions and eigen values of hermitian operators, simultaneous eigen functions, Dirac Delta function and box normalization of free particle wave function, uncertainity principle in operator approach. Bra and ket notations, matrix representationof wave function and operator, energy spectrum of of one dimensional harmonic oscillator using matrix mechanics.

Unit-IV Theory of Angular momentum-I: [10]
Definition of generalized angular momentum, operators for J_+, J_- and J_Z, Commutation relation of angular momentum operator. Spectrum of eigen values of J^2 and J_Z, operators for angular momentum L in spherical polar co-ordinates, Eigen values and eigen functions of L^2 and L_Z. Spin angular momentum, Eigen values and eigen functions of S^2 and S_Z.

Unit-V Theory of Angular momentum-II: [10]
Matrix representation of J^2, J_Z, J_+, J_-, J_x, J_y for j=1/2 and 1. Pauli's spin matrices and their properties, Addition of two angular momenta, coupled and uncoupled representation, Clebsch Gordon coefficients, Spectrum of eigen values of total angular momentum. Calculations of C. G. coefficients when (i) $j_1 = ½$, $j_2 = ½$ (ii) $j_1 = ½$, $j_2 = 1$.

Recommended Books

1. Quantum Mechanics, L. I. Schiff, 3rd Edition, McGraw-Hill (1968).
2. Quantum Mechanics, Ghatak& Loknathan, 1st Edition, MacMillan India
3. Quantum Mechanics, Thankapan, 2nd Edition, New Age Int. Ltd (2004).
4. Introductory Quantum Mechamics, Richard L. Liboff.
5. Introduction to Quantum Mechanics: C.J. Joachain and B.H. Bransden.
6. Introduction of Quantum Mechanics: D.J. Griffiths.
7. Quantum Mechanics: Suresh Chandra

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Electronics

PHL 6051 **4-0-0=4**

UNIT-I Amplifiers:
BJT and FET Amplifiers; Frequency response of amplifiers; Operational Amplifiers: Differential amplifiers, Principles of Operational Amplifiers, Transfer Characteristics, Offset parameters, Differential gain, CMRR, applications of operational amplifiers, linear circuits.

UNIT-II Digital Systems:
Combinational Systems: Binary Adder/Subtractor, Multiplexers, Demultiplexers, Encoders, Decoders, Parity checker/generators
Sequential Systems: Flip-Flops, Shift registers, Asynchronous (Ripple) and Synchronous counter, Applications of Counters
D/A and A/D Systems: Digital-to-Analog converters, Analog-to-Digital converters

UNIT-III Memories:
ROM, PROM, EPROM, RAM, Static and dynamic random access memory devices: SRAM and DRAM, CMOS and NMOS, non-volatile – NMOS, Magnetic, Optical and Ferromagnetic memories, Charge Couple Devices (CCDs).

UNIT-IV Microprocessor:
8085 Microprocessor Architecture, Instruction set - Addressing modes - Illustrative programmes - writing assembly language programmes, looping, counting and indexing - Counters and Timing delays - Stack and Subroutines

UNIT-V Interfacing Peripheral Devices:
Memory and I/O interfacing, Data transfer schemes, Interfacing Devices and I/O devices, programmable peripheral interface 8255A, 8279A programmable keyboard/display interface, direct memory access (DMA) and 8237 programmable DMA controller, Interrupts of intel 8085, programmable interrupt controller (PIC) intel 8259A.
Note for Paper Setting: Major examination paper will consists of 20% of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60% of total marks from the portion covered after minor II.

Recommended Books

1. "Electronic Devices and circuit theory" by Robert Boylested and Louis Nashelsky PHI, Eighth Edition New Delhi -110001, 2002
2. "Electronics Principles", 7th Edition TMH by A.P. Malvino, 2007
3. "Principles of Electronics" (7th Edition) S. Chand, V.K. Mehta
4. "Integrated Electronics" by Millman and Halkias, TMH Publishers
5. "OP-Amps & Linear integrated circuits," by Ramakant A. Gayakwad PHI, Fourth Edition, 2010
6. "Digital principles and Applications" by A.P. Malvino and Donald P. Leach, Tata Mcgraw - Hill company, Sixth Edition, New Delhi,
7. "Introduction to semiconductor devices, M.S. Tyagi", John Wiley & Sons
8. "Digital Systems: Principles and Applications" by Ronald J. Tocci, Neal S. Widmer Publisher: Prentice Hall, Eighth Edition, 2010
9. "Linear Integrated Circuits" by D.R. Choudhury and S.B. Jain, New Age International, 2003, Second

Edition.
10. "Memory Mass Storage", by G. Campardo, F Tiziani, M. Iaculo, Springer, 2011
11. "Solid State Electronic Devices" by Ben G. Streetman, Prentice Hall, Fourth Edition, 1995.
12. "Douglas V. Hall, "Microprocessors and Interfacing, Programming and Hardware", second edition, McGraw Hill International Edition, 1992.
13. "Principles of microprocessor systems" by A.P. Godse, Technical Publications Pune, 2009
14. "Microprocessor Architecture, programming and Applications with 8085/8086" by Ramesh S. Gaonkar, Wiley – Eastern Ltd., Fifth Edition
15. "Fundamentals of Microprocessor and Microcomputers" by B. Ram, Dhanpat Rai Publications (p) Ltd.-new Delhi (2010)

Electronics Devices*

SPHL 114P **4-0-0=4**

Unit I
JFET, BJT, MOSFET, MESFET; structure, working, derivation of equations for IV characteristics under different conditions. Frequency effects in amplifiers, differential amplifiers using transistors, Operational amplifiers. Linear circuit applications

Unit II
Static and dynamic random access memory devices; SRAM & DRAM, CMOS and NMOS, non-volatile – NMOS, Magnetic, optical and ferroelectric memories, charge coupled devices.

Unit III
Programming the 8085, Introduction to 8085 instruction sets, programming techniques with additional instructions, counters and time delays, stack and sub-routines. Counter and time delays, stack and subroutines, advanced subroutine concepts – Review only. The 8085 interrupts, 8085 vectored interrupt. Restart as software instructions.

Unit IV
Additional I/O concepts and processes, interfacing data converters. Programmable interface devices: 8085 I/O and Timer: 8279 Keyboard/ Display interface. Programmable peripheral interface 8255A with its applications in bi-directional data transfer between two microcomputers, programmable interval timer 8254. Programmable interrupt controller 8259A, direct memory access (DMA) and 8237 DMA controller, Basic concepts in serial I/O, software controlled asynchronous serial I/O; the 8085 serial I/O lines: SOD and SID, hardware controlled serial I/O using programmable chips. Interfacing case studies

Unit V
Industrial process control- Temp. Control, liquid level control, alarm actuator, ambient light control power switch, Power supply- Linear P.S.; switch mode p.s.(SMPS), Uninterrupted P.S. (UPS). Motor drive- induction motor drive, synchronous motor drive, DC motor drive, universal motor drive, stepper motor drive, servo motor drive, microprocessor based applications- microprocessor based firing circuit for thyristor converters, microprocessor based motor drives, speed control of AC motor, microprocessor based process control system.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Electronic principles (6th Ed.) TMH – A. P. Malvino
2. Principles of Electronics (7th Ed.) S. Chand, V K Mehta
3. Millman and Helkias-Integrated Electronics.
4. "Electronic' Devices and circuit theory by Robert Boylested and Louis Nashdsky PHI, New Delhi. 1100001, 1991 .
5. Power electronics, Jamil Asghar (PHI)
6. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, 4th ed. Penram international.
7. I.Liu, G. A. Gibson, Microcomputer Systems: The 8086/8088 Family, 2nd Ed., Prentice Hall, 1986.
8. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991

* Old Course (discontinued from academic session 2012-2013)

General Laboratory-I

PHP 6121 **0-0-12=6**

Note: Students are required to perform at least 12 to 14 experiments from the below given list.

Group A Experiments

1. Study of He-Ne laser- measurement of divergence and wavelength
2. Verification of Cauchy's relationship.
3. To determine the value of Plank's constant by photocell and solar cell.
4. Normal Zeeman effect in transverse and longitudinal configuration using a LG plate.
5. Determination of wavelength of H_α, H_β, H_γ from the Balmer series of hydrogen.
6. To verify Fresnel's formula.

7. Emission and absorption spectra.

Group B Experiments

8. (a) Half wave, full wave and bridge wave rectifier.
   (b) Zener regulation with fixed input voltage and fixed load.
9. Temperature dependence of avalanche and Zener Breakdown diodes.
10. Barrier capacitance of a junction diode.
11. (a) Transistor characteristics, transistor as a switch.
    (b) Transistor feed back circuit design and verification.
12. Design a ground emitter amplifier and draw dc load line curve and measure the Voltage gain, input impedence and output-impedance.
13. Resistivity by four probe method.
14. DC Hall effect
15. Linear Voltage Differential Transformer
16. Characteristics of OP-AMP (741) i.e. input offset voltage, input bias current, and input off set current.
17. Design non-inverting and inverting voltage feed back circuit and measure voltage gain.
18. To design voltage summing and differential amplifier using 741 IC.
19. To design the Schmitt trigger circuit and measure UTP and LTP (in volt).
20. To design integrator and differentiator using 741 IC and also waveform conversion from sine to rectangular and rectangular to triangular.
21. To design Wien-Bridge oscillator of given frequency.
22. To design phase-shift oscillator of given frequency.

SEMESTER II

Statistical Mechanics

PHL 6061 **4-0-0=4**

Unit I: Classical Equilibrium Statistical Mechanics: [16]
Fundamentals of classical statistical mechanics. Micro canonical ensemble, equilibrium and entropy, classical ideal gas, phase space, ergodic hypothesis, liouville equation and Gibbs density, canonical ensemble and partition function, grand (macro) canonical ensemble and partition function, probabilities, ensemble averages and fluctuations, thermodynamic quantities and equation of state from statistical physics: properties of ideal classical gas, gas of oscillators, van der Waal gas and spin system.

Unit II: Quantum Equilibrium Statistical Mechanics: [16]
Fundamentals of quantum statistical mechanics, density matrices, quantum liouville equation and gibbs density, micro canonical, canonical, grand (macro) canonical ensembles, partition functions, probabilities, ensemble averages and thermodynamic quantities, most probable distributions from entropy principle for quantum ideal gases, partition functions for quantum ideal gases. For Fermi gas: thermodynamic quantities and equation of state, for Bose gas: thermodynamic quantities and equation of state, properties of Bose Einstein condensation, thermal radiation and relativistic gases.

Unit III: Phase Transitions and Critical Phenomena: [7]
Change of phase and first order phase transitions in van der Waal gas. Classification of phase transitions and thermodynamic potentials. Theory of first and second order phase transitions, order parameters, critical exponents. Phase transitions of super fluidity and superconductivity, phase transitions in magnetism.

Unit IV: Ising Model: [5]
Ising and Heisenberg models, partition functions for exactly solvable one and two dimensional systems,

Unit V: Non Equilibrium Statistical Mechanics: [6]
Random walk and Brownian motion, Diffusion and transport, Boltzman kinetic equation, Langevin equation, Fluctuation and dissipation theorem, Fokker Planck and Master equations, Wiener and Khintchine equations, Applications to noise, correlations, and other non equilibrium properties.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Walter Greiner, Ludwig Neise, Horst Stocker "Thermodynamics and Statistical Mechanics" Springer
2. Kerson Huang "Introduction to Statistical Physics" Taylor and Francis, 2001
3. P K Pathria "Statistical Mechanics" 2nd Ed.
4. J K Battacharjee, Statistical Physics; Allied Publishers (India)
5. F Reif, Statistical and Thermal Physics, McGraw Hill
6. C Kittel, Thermal Physics, CBS Indian edition

Quantum Mechanics-II

PHL 6042 **4-0-0=4**

Unit-I: Perturbation Theory [10]

Time independent non-degenerate perturbation theory upto second order. Applications to normal He atom, perturbed harmonic oscillator. Time independent degenerate perturbation theory upto first order. Application of degenerate perturbation theory to stark effect and Zeeman effect. Time dependent perturbation theory, calculation of 1^{st} order transition amplitude, transition probability, and derivation of Fermi Golden rule.

Unit-II: [10]
Semi Classical theory of radiations, Einstein's coefficients of emission and absorption, expression for transition probability for absorption and induced emission using electric dipole approximation. Adiabatic approximation for solving time dependent problems, sudden approximation.

Unit-III: [10]
Variational technique, its application to ground state of He, atom. W.K.B-approximation, classical turning points, connection formulae, Application to WKB to bound state problem and tunneling, α-decay derivation.

Unit-IV: Scattering Theory-I [10]
Differential and total scattering cross sections, scattering amplitude, relation between differential scattering cross section and scattering amplitude, Laboratory and centre of mass reference frames, relations of scattering angles and cross sections in laboratory and centre of mass reference frames. Partial wave analysis, expression for scattering amplitude and total scattering cross section in terms of phase shifts, scattering by perfectly rigid sphere and by square well potential, Deduction of optical theorem for scattering cross section.

Unit-V: Scattering Theory-II [10]
Free particle Green's Function, Green's function method for scattering, derivation of scattering amplitude and Born approximation, Application of Born approximation to square well, Yukawa and screen coulomb potential. Multiparticle wave function, particle exchange operator, collision of identical particles and their scattering amplitudes.

Recommended Books
1. Quantum Mechanics, L. I. Schiff, 3rd Edition, McGraw-Hill (1968).
2. Quantum Mechanics, Ghatak& Loknathan, 1^{st} Edition, MacMillan India
3. Quantum Mechanics, Thankapan, 2nd Edition, New Age Int. Ltd (2004).
4. Introductory Quantum Mechamics, Richard L. Liboff.
5. Introduction to Quantum Mechanics: C.J. Joachain and B.H. Bransden.
6. Introduction of Quantum Mechanics: D.J. Griffiths.
7. Quantum Mechanics: Suresh Chandra

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Electrodynamics & Plasma Physics

PHL 6071 **4-0-0=4**

Unit-I: Electrostatics [7]
Gauss's law and application, Poisson's and Laplace Eqns. Boundary Value Problems, Methods of Images, Green function and applications, Electrostatic field in Matter-Polarization, bound charges, susceptibility

Unit-II: Magnetostatics [8]
Biot- Savart's and Ampere's law, Concept of Vector Potential, Magnetic field in matter, Continuity Equation, Maxwell's Eqns, Vector and scalar Potential and Gauge, Pointings Theorem.

Unit-III: EM waves [15]
Electromagnetic waves –Introduction, Reflection and Refraction, Electromagnetic field tensor and its invariance, Lorentz force eqn.in covariant form, Retarded Potential, Electric dipole radiation, Magnetic dipole radiation, Radiation from arbitrary distribution of charge, Lienard Weichert potentials, Radiated power and angular frequency, The fields of a point charge in motion, The Abraham Lorentz formula, Collinear and perpendicular velocity and acceleration, Thomson scattering, Cherenkov radiation, Inhomogeneous wave Eqn., Multipole expansion of electromagnetic fields, Multipole moments

Unit-IV: Wave Guides [5]
Wave Guides- TE, TM and TEM modes, rectangular and cylindrical wave guides, resonant cavities, Energy dissipation, Q of a cavity

Unit V: Plasma [10]
Motion of charged particles in electromagnetic fields: uniform and nonuniform fields, time varying fields; Elementary concepts: Boltzmann eqn, Plasma oscillations, Debye shielding, Plasma parameters, magneto plasma, Plasma confinement; Hydro dynamical description of plasma, hydro magnetic waves, Alfven waves.

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

Recommended Books
1. D.J. Griffiths- Introduction to Electrodynamics
2. J.D. Jackson- Classical Electrodynamics

3. F.F. Chen- Plasma Physics
4. Bittencourt- Plasma Physics

Atomic & Molecular Physics

PHL 6081 **4-0-0=4**

Unit-I: Atomic Spectra:
Introduction to Spectroscopy and Types of Spectra, Spectrum of Hydrogen Atom, Bohr Model for hydrogen atom, Bohr-Sommerfeld model of Hydrogen Atom, Sommerfeld's Relativistic Correction, Fine Structure of Hydrogen Atom. [10]

Unit-II: One Valence Electron Atoms:
Magnetic Dipole Moments, Electron Spin and Vector Atom Model and Sterrn-Gerlach Experiment, Spectra of one valance electron system, Fine structure of Hydrogen atom spectrum and alkali atoms, Zeeman Effect, Paschen-Back effect, Stark Effect in Hydrogen Atom, Spin-orbit interaction for two valance electron system (LS and JJ Coupling), Pauli's exclusion Principle, Singlet and Triplet States, Selection Rules, Hyperfine Structure of Spectral Lines, Interpretation of Helium Spetrum. [15]

Unit-III: The Breadth of Spectral Lines and X-Ray Spectra:
Breadth of Spectral Lines, Effect of Nuclear Properties on Spectral Lines, X-ray Spectra, Moseley's Law, Regular and Irregular Doublet Law, Photoelectron Spectra. [5]

Unit-IV: Molecular Structure:
Types of Molecular Spectra and Molecular Energy States, Classification of molecules, Rotation Rotational spectrum of a rigid diatomic molecule, Isotope effect in rotational spectra, Intensity of rotational lines, Non-rigid rotator, Rotation-vibration spectra of diatomic molecules. [10]

Unit-V: Various Techniques:
Raman spectroscopy, Nuclear Magnetic Resonance (NMR), and Electron Spin Resonance (ESR). Photoelectron spectroscopy, Mossbauer Spectroscopy, Visible and Ultraviolet Spectroscopy and Different Light Sources, Laser [10]

Recommended Books

1. G. Aruldhas, Molecular Structure and Spectroscopy, Second Edition 2007, Prentice Hall Of India, New Delhi
2. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, Third Edition 1972, McGraw-Hill book company, London
3. S. Chandra, Molecular Spectroscopy, 2009, Narosa Publishing House, New Delhi
4. S. Chandra, Physics of Atoms and Molecules, 2010, Narosa Publishing House, New Delhi
5. W. Demtroder, Molecular Physics, 2005, Wiley-VCH Verlag GmbH & Co., KGaA, Weinheim
6. S.L. Gupta, V. Kumar and R.C. Sharma, 2007, Elements of Spectroscopy, Twentieth Edition, Pragati Prakahsan, Meerut
7. J. M. Hollas, Modern Spectroscopy, 1987, Third Edition, John Wiley & Sons, New York
8. V.K. Jain, Introduction to Atomic and Molecular Spectroscopy, 2007, Narosa Publishing House, New Delhi
9. Sune Svanberg, Atomic and Molecular Spectroscopy, 1992, Second Edition, Springer Verlag, Berlin
10. H.E. White, Introduction to Atomic Spectra, 1934, McGraw-Hill Kogakusha Ltd., Tokyo

General Laboratory-II

PHP 6122 **0-0-12=6**

Note: Students are required to perform atleast 12 experiments from the list

General Physics Experiments

1. Determination of e/m ratio: (Millikan oil drop method)
2. To plot the current voltage characteristic of a Cds photo resistor at constant irradiance and to measure the photo current as a function of irradiance at constant voltage.
3. To verify Biot-Savart's Law.
4. To measure the wavelength using a millimeter scale as a grating (with Diode laser).
5. To study the polarization of Sugar solution at different concentration.
6. Febry-parot interferometer.
7. Determination of Planck's constant.
8. Determination of Rydberg constant

Digital Electronics experiments

9. Temperature on-off controller using IC.
10. Waveform generator using IC's.
11. Study of 8-bit DAC
12. 16 channel digital multiplexer and demultiplexer.
13. Design and verify the truth table for half adder and full adder logic circuits.
14. Active filter circuits (second order)
15. Delayed linear sweep using IC 555.
16. Constant current source using IC 741 and LM 317.
17. Regulated power supply using IC LM 317.
18. Design serial in –serial out and parallel in- parallel out shift registers.
19. Study of presettable counters 74190 and 74193.
20. Design of MOD-5 counter using 16-bit counter.
21. To design D/A and A/D converters IC.

22. Study of 8085 microprocessor and execution of simple programs.
23. SID and SOD using 8085.

SEMESTER III

Nuclear & Particle Physics

PHL 7091 **4-0-0=4**

Unit-I: Fundamentals [10]

Proton-electron theory of nucleus, proton-neutron theory of nucleus, nomenclatures of nuclei, Size, density and charge distribution for a nucleus, atomic mass unit, packing fraction, binding energy, Semi-empirical mass formula, nuclear forces, Yukawa theory, exchange force, neutron-neutron scattering, deuteron, ground and excited states of deuteron.

Unit-II: Nuclear Models & Nuclear Reactions: [15]

Nuclear fission, liquid drop model for fission, Bohr-Wheeler theory of nuclear fission, nuclear fusion, source of stellar energy, collective nuclear model , nuclear shell model, magic numbers

Kinds of nuclear reactions, various conservation laws, nuclear reaction kinematics, endothermic and exothermic reactions, Compound nucleus model, Breit-Wigner formula, optical model, nuclear transmutation

Unit-III: Detectors, Accelerators and Reactors [8]

Sensitivity of detector, response of detector, energy resolution of detector, efficiency of detector, dead time detector, ionization chamber, proportional counter, Geiger-Muller counter, scintillation detector, Van de Graaff generator, Cyclotron, Synchro-cyclotron, linear accelerator, nuclear chain reaction, general aspects of reactor design, classification of reactors,

Unit-IV : Decay Processes [7]

Displacement laws for alpha and beta decays, law of radioactive disintegration, law of successive disintegration, theory of alpha decay, theory of beta decay

Unit-V: Elementary Particles: [10]

Fundamental forces, discovery of elementary particles, classification of elementary particles, various conservation laws for elementary particles, CP violation in neutral K-decay, Gell-Mann-Nishijima formula, Gell-Mann-Okuba mass formula, Quarks model for elementary particles.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Abhyankar K.D. and Joshi A.W., An Overview of Basic Theoretical Physics,2009, University Press (India) Private Limited, Hyderabad
2. Cohen, B.L., Concepts of Nuclear Physics, 2005, Tata McGraw-Hill, New
3. Devanathan, V., Nuclear Physics, 2006, Narosa Publishing House, New Delhi
4. Ghosh, S., An Introduction to the Engineering Asoects of Nuclear Physics, 2009, I.K. International, Publishing House Pvt. Ltd., New Delhi
5. Griffiths, D., Introduction to Elementary Particles, 1987, John Wiley & Sons,
6. Heyde, K., Basic Ideas and Concepts in Nuclear Physics, 2005, Overseas Press, India
7. Kaplan, I., Nuclear Physics, 1998, Narosa Publishing House, New Delhi
8. Kulkarni V.W., Atomic and Nuclear Physics, 2004, Himalaya Publishing
9. Tayal D.C., Nuclear Physics, 2009, Himalaya Publishing House, Delhi
10. Wong, S.S.M., Introductory Nuclear Physics, 2005, Prentice-Hall, India

Condensed Matter Physics

PHL 7101 **4-0-0=4**

Unit I : Crystal Physics and X-ray Crystallography [10]

Crystalline solids, unit cells and direct lattice, two and three dimensional Bravais lattices, crystal systems, crystal planes and Miller indices, closed packed structures, symmetry elements in crystals, point groups and space groups, quasicrystals.

Unit II: Reciprocal Lattice and Experimental X-ray Diffraction Techniques [10]

Diffraction of X-rays, Laue equations, Bragg's law, Reciprocal lattice and its application to diffraction techniques, Ewald sphere, absorption of X-rays, Experimental diffraction techniques-Laue's diffraction technique, powder X-ray diffraction technique, application of powder method, general concept of scattering factor and structure factor.

Unit III: Disorder in Solids [10]

Point defects(Frenkel and Schottky), line defects (slip, plastic deformation, edge and screw dislocation, Burger's vector, concentration of line defects, estimation of dislocation density), Frank Reid mechanism of dislocation multiplication(dislocation reaction), surface (planar) defects, grain boundaries and stacking faults.

Unit IV: Electronic properties of solids [10]

Electrons in periodic lattice, Bloch theorem, Kronnig –Penny model, classification of solids on the basis of band theory, effective mass, tight bonding, cellular and pseudopotential methods, Fermi surface, De Hass Von alfen effect, Quantum Hall effect.

Unit V: Magnetic Properties of Solids [10]

Classification and general properties of magnetic materials, Weiss theory of ferromagnetism, temperature dependence of spontaneous magnetization, Heisenberg's model and molecular field theory, Curie and Curie Weiss law, Domains and hysteresis, spin waves and magnons, the Bloch $T^{3/2}$ law, Neel model of antiferromagnetism and ferrimagnetism. Soft and Hard magnetic materials, Superconductivity, type I and type II superconductors, Meissner effect, London equations, concept of coherence length.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Introduction to Solid State Theory: O. Madelung.
2. Solid State Physics: Neil W. Ashcroft and N. David Mermin.
3. Principles of Condensed Matter Physics: P.M. Chaikin and T.C. Lubensky.
4. Solid State Physics – An Introduction to Theory and Experiment: H. Ibach and H. Lüth.
5. Crystallography Applied to Solid State Physics: A.R. Verma and O.N. Srivastava.
6. Solid State Physics: A. J. Dekker
7. Introduction to Solid State Physics, 7th ed., John Wiley: C. Kittel.

SPECIAL PAPERS

Electronics Option (IIIrd Semester)

Special Paper I (Electronics)

PHL 7052 **4-0-0=4**

Unit I

Register organization of 8086, architecture, signal description of 8086, physical memory organization, general bus operation, I/O addressing capability, special processor activities, maximum mode 8086 system and timings.

Unit II

Machine language instruction formats. Addressing modes of 8086, instruction set of 8086, assembler directives and operators.

Unit III

A few machine level programs, machine coding of the programs, programming with an assembler, assembly level sample programs.

Unit IV

Review introduction to Microcontrollers and Microprocessors, Embedded vs external memory, Devices, 8-bit and 16 bit Microcontrollers, CISC and RISC processors. Harvard and Van Neumann Architectures, Commercial Microcontroller Devices. The architecture of the 8051 microcontroller- The plan of 8051 microcontroller, the registers in 8051 microcontroller, the data memory in 8051, the multiplexed port system, the internal and the external memory use

Unit V

The interrupt and the interrupt flags, the interrupt system- what is interrupt? Why do we use interrupts? The interrupt system of the 8051, setting up an interrupt jump table, servicing the interrupt, enabling and disabling the interrupts, interrupt from within the microcontroller, external hardware interrupt, how are the interrupts handled. Addressing Modes. Instruction Set, Instructions and simple programs. Using stack pointer, Assembly language programming, Development systems and tools, software simulations of 8051. microcontroller based applications.

Note: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Microprocessor Architecture, Programming , and Applications with 8085, R S Goankar, 5th Ed. Penram International
2. Advanced microprocessors and peripherals, architecture, programming and interfacing, A K Ray and K M Bhurchandi, TMH, 2001
3. Microcontrollers, Ajay V Deshmukh, TMH, 2005
4. Jan Axelson, Penram International
5. Microprocessors and Interfacing, programming and hardware, D V Hall, TMH
6. The 8051 microcontroller and Embedded systems, Rajiv Kapadia, Jaico Publishing House
7. 8086 Microprocessor, programming and interfacing, K J Ayla, Penram International
8. 8051 Microcontroller, K J ayla, Penram International
9. Programming and customizing the 8051 microcontroller, Mike Predko, TMH

Special Paper II (Electronics)

PHL 7053 **4-0-0=4**

Unit I:
PIC Microcontrollers: Overview and features, PIC 16C6X/7X. FSR (File Selection Register) [Indirect Memory Address Pointer]. PIC reset actions. PIC Oscillator connections. PIC memory organization, PIC 16C6X/7X instructions. Addressing modes. I/O ports, Interrupts in PIC 16C61/71.

Unit II
PIC 16C61/71 timers. PIC 16C71 analog to digital converter (ADC). Capture/ Compare/ PWM (CCP) Modules in PIC 16F877. Master synchronous serial port (MSSP) module. Universal synchronous asynchronous receiver transmitter (USART). Analog-to-digital converter (ADC).

Unit III
PIC 16F8XX flash Microcontrollers:- Introduction, Pin diagram, STATUS register, power control register (PCON) and OPTION REG register, program memory, data memory.
Design with Atmel Microcontrollers (89 CXX and 89C20XX):

Unit IV
PC parallel ports for interfacing- Study of PC parallel port: Essentials. Accessing ports (Data, status and control registers, bidirectional ports). Programming issues, Programming tools, Experiments, Interfacing.

Unit V
Interfacing and Microcontroller Applications- Light emitting diodes (LED's); push buttons, relays and latch connections, keyboard interfacing, interfacing 7-segment displays; LCD interfacing, ADC and DAC interfacing with 89C51 Microcontrollers.
Industrial applications of Microcontrollers- Introduction to measurement applications

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Microprocessor Architecture, Programming, and applications with 8085 – R.S. Gaonkar (5^{th} edition, penram international)
2. Advanced microprocessors and peripherals, architecture, programming and interfacing A.K. Ray and K. M. Bhurchandi, TMH (2001)
3. Microcontrollers, Ajay V. Deshmukh (TMH, 2005)
4. Design with PIC microcontrollers John B Peatman, Pearson Education
5. Jan Axelson (Penram International Publications, India)

Special Paper Lab (Electronics)

PHP 7056 **0-0-12=6**

A1. Microprocessor based Experiments:
(Minimum two experiments from 1 to 4, and 5 (compulsory))

1. Study of 8085 interrupts
2. Complex waveform generation using microprocessor kit and 8 bit DAC
3. Simple I/O (mode 0) and I/O with handshake (mode 1) using DIP switches as the I/P and :LED's as the O/P devices
4. Study of operation of PTC 8253/8254; Mode 0,1,2,3,4
5. 8086 assembly language programming:-
   a) Simple data manipulation programs
   b) Simple programs to handle I/O ports
   (PC parallel port or I/O ports on a PC add-on card)
   (Assembly language programming of 8086 may be done by operating PC in a real mode by using 'Debug' program. Separate 8086 study kit is not needed)

A2: Microcontroller 8031/ 8051 based experiments: (Minimum 5)

1. Study of 8051 microcontroller kit
2. Study of IN and OUT port of 8051 (Interfacing switches, LED's and Relays)
3. Study of external interrupts of 8051
4. Study of Internal timer and counter in 8051
5. Study of serial communication with 8051
6. Interfacing 8 bit DAC with 8051 to generate complex waveforms.
7. Advanced programming and mathematical calculations using microcontroller

A3: PC Interfacing experiments: (Minimum four experiments)

1. Interfacing switches, LED's to PC printer parallel port
2. Interfacing DC motor, steeper motor, solenoid using PC printer parallel port
3. Interfacing 8 bit DAC to PC printer parallel port
4. Interfacing 8 bit ADC to PC printer parallel port
5. Study of multifunction I/O card
6. ON/OFF temperature control using PC and multifunction I/O card
7. Study of event counter using multifunction I/o card with PTC 8253/8254

Condensed Matter Physics Option (IIIrd Semester)

Special Paper I (Condensed Matter Physics)

PHL 7102 **4-0-0=4**

UNIT I: Introduction to materials and their classification; Crystalline and non-crystalline materials; Atomic structure and interatomic bonding in solids.

UNIT II: Mechanical properties of materials – elastic and plastic deformations, property variability and design/safety factors; Dislocations and strengthening mechanisms – dislocations and plastic deformation, mechanisms of strengthening in metals, recovery, re-crystallization, and grain growth; Failure – fracture, fatigue, and creep.

UNIT III: Phase diagrams – basic concepts (solubility limit, phases, microstructure, phase equilibria, one-component phase diagram), binary phase diagrams, the iron–carbon system, phase transformations in metals and metal alloys, fabrication and processing of metals, bulk and surface properties of metals.

UNIT IV: Optical properties of metals and nonmetals, applications of optical phenomena – luminescence and photoconductivity, laser, optical fibre.

UNIT V: Criterion for selection of materials, process and cost optimization. Engineering applications of materials. Economic, environmental, and societal issues in Materials science and Engineering.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Material Science and Engineering: An introduction, by William D. Jr., Callister Wiley Text Books
2. Element of Material Science and Engineering by Lawrence H. Van Vlack, Pearson Education India.
3. Science of Engineering Materials by C.M. Srivastava and C. Srivastava, New Age International Publishers.
4. Applied Physics of Solids by Rajnikant, Wiley International.
5. Material Science and Engineering- A first course by V.Raghavan, Prentice Hall India.

Special Paper II (Condensed Matter Physics)

PHL 7103 **4-0-0=4**

UNIT I : Polymer structures, classification; Characteristics, applications, and processing of polymers; mechanical behavior of polymers, mechanisms of deformation, degradation and strengthening of polymers, crystallization, melting, and glass transition phenomena in polymers, Polymer types, Polymer synthesis and processing; Degradation of Polymers; Electrical properties of polymers.

UNIT II: Composites – particle-reinforced composites, fiber-reinforced composites, and structural composites; corrosion and degradation of composites.

UNIT III: Ceramic Structures and mechanical properties of ceramics; types and applications of ceramics; fabrication and processing of ceramics; Electrical conduction in ionic ceramics.

UNIT IV: Dielectric behavior, and other electrical characteristics – ferro- and piezoelectric materials, thermal and magnetic properties of materials. Fabrication and processing of materials for semiconductors.

UNIT V: Materials for biomedical applications; Property requirements of biomaterials; Concept of biocompatibility; cell-material interactions; Important biomaterials; Design concept of developing new materials for bio-implant applications, bio-MEMS and bio-NEMS.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Material Science and Engineering: An introduction, by William D. Jr., Callister Wiley Text Books
2. Material Science and Engineering- A first course by V.Raghavan, Prentice Hall India.
3. Material Science by S.L.Kakani and Amit Kakani, New Age International Publishers.
4. Applied Physics of Solids by Rajnikant, Wiley International
5. Material Science by M.S.Vijaya and G. Rangaranjan, Tata Mc Graw Hill Publishing Company limited.
6. Material and Process in manufacturing by Garmo J.T., Nold A.Kohsor.

Special Paper Lab (Condensed Matter Physics)

PHP 7106 **0-0-12=6**

Students will be required to perform at least 10-12 experiments from the list below:

1. To Study the Curie Temperature of Ferro(/Ferri) – electric/magnetic Materials.
2. Study of Cooling Curve for Alloy Mixture (lead-tin/Pb-Sn) using Equilibrium Diagram by direct cooling.

3. Materials internal structure investigation by employing X-ray diffraction technique (Laue, Single Oscillation, Double Oscillation, Rotation, Weissenberg).
4. To measure the Susceptibility of a Paramagnetic solution by Quinck's Tube Method.
5. To study the mono atomic and diatomic lattice dynamics through
   (a) Dispersion relation for "Mono-atomic Lattice" and comparison with theory.
   (b) Determination of the Cut-off frequency of the mono-atomic lattice
   (c) Dispersion relation for the di-atomic lattice, acoustical mode and energy gap.
6. To study the ultrasonic velocity and compressibility of liquids with Ultrasonic Interferometer.
7. To study the Young s modulus and elastic constant in solids by Piezoelectric Technique.
8. Electron Spin Resonance (ESR) in DPPH – Determining the magnetic field as a function of the resonance frequency.
9. To Study the solar cell Characteristics.
10. To Study the B-H curves of given specimen and estimate the Hysteresis loss.
11. To Study the Hall effect in semiconducting crystal and estimate its Hall's coefficient and carrier concentration.
12. To determine the resistivity of given semiconductor crystal and hence the energy band gap using Four probe Method.
13. Any one of the following:
   (a) To determine the thickness of mica sheet using Michelson Interferometer.
   (b) To determine the thickness of given wire using He-Ne laser.
14. To study the dielectric constant of given materials (polystyrene, glass and PCB sheet etc.).
15. To determine the thermal conductivity of given material using Lee's Disc Method.
16. Demostration experiment based on PEM (proton exchange membrane) fule cells and electrolysis.
17. To determine theresistance of thermister at different temperatures and hence estimate its energy band gap.
18. To determine the numerical aperture of an optical fiber.
19. To measure the temperature dpendent viscosity of viscous liquids (e.g. glycerol).
20. To determine the the specific heat of given metals (copper, brass and aluminum etc.)

Note: Apart from above, course instructor can also pick few experiments from the UGC-Physics Model Curriculam and any other experiments meant for demonstration of concept and traning in condensed matter physics and nanotechnology, in general.

SEMESTER IV

Computational Methods & Programming

PHL 7111 **2-0-4=4**

FORTRAN Language [10]

Compiler, Interpreter and Flow charts. Characters used in Fortran. **Keywords.** Constants and variables. Data type declarations. Expression and statements. Input-output statements, READ, WRITE, OPEN, CLOSE, FORMAT, STOP, END statements, IMPLICIT declaration. COMMON statement. Labeled COMMON statement. SAVE statement, EQUIVALENCE statement. DATA statements. Logical IF and GO TO statements. Nested logical IF and Arithmetic IF statements. Computed GO TO statements. IF-THEN-ELSE. IF-ELSE and GO-TO structures. Loop statements - Indexed DO statements. DO loop continue statements. Nested DO loops and DO-IF structures. Array and Subscripted Variables. Function and Subroutines**.**

Interpolation: [8]

Graphical method, Linear interpolation, least square fitting, Cubic spline fitting, Lagrange's interpolation, Newton's divided difference interpolation, Gregory-Newton difference interpolation

Integration: [8]

Graphical method, integration with Lagrange's interpolation, Newton-cotes expression, trapezoidal rule, Simpson rule, Newton's three-eight rule, Gauss quadrature method, Monte Carlo method.

Solution of differential equations: [6]

Taylor series method, Euler method, Henn method, Runge-Kutta method, Predictor-Corrector method, Runge-Kutta method for second order first degree.

Roots of equations: [6]

Graphical method**,** limits for roots of polynomial equation, Bisectional method, false position method, Newton-Raphson method, Bairstow's method for complex roots.

Solutions of simultaneous equations: [6]

Elimination method, Gauss elimination method, Pivotal Condensation method, Gauss-Jordan method, Matrix inversion method

Eigen values and Eigen vectors: [6]

Determinant of a matrix, Characteristic equation of a matrix, Eigen values and Eigen vectors of a square matrix, power methods, Random numbers

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Suresh Chandra, Computer Applications in Physics with FORTRAN, BASIC and C, (2006) Narosa Publishing House, New Delhi
2. Suresh Chandra, Applications of Numerical Techniques with C, (2006) Narosa Publishing House, New Delhi
3. M.K. Jain, S.R.K.Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 2nd Edition, (1985), Wiley Eastern Limited, New Delhi
4. P.B. Patil and U.P. Verma, Numerical Computational Methods, (2006) Narosa Publishing House, New Delhi
5. K. Shankara Rao, Numerical Methods for Scientists and Engineers, 2nd Edition, (2004), Prentice-Hall of India, New Delhi

Relativistic Quantum Mechanics

PHL 7043 **4-0-0=4**

Unit-I: Second Quantization

Creation and annihilation operators for Bosonic and Ferionic states, Field operators, second quantized operators, (one –particle density operator and kinetic energy operator), pair correlation function (pauli's exclusion principle and Boson consideration).

Unit-II: Klein-Gordon Equation

Klein-Gordon Equation, Plain wave solution, probability current density and equation of continuity, difficulties due to the existence of negative energy states, Correct non on relativistic expression for probability current density, Klein-Gordon equation in electromagnetic field, solution of Klein-Gordon equation for a particle with coulomb potential V_0 (hydrogen atom problem), first order Klein-Gordon equation and its solution.

Unit-III: Dirac Equation:

Derivation of Dirac equation, β-matrices and their anti-commutation relations and their representations, plane wave solutions of Dirac equation (positive and negative energy solutions), Dirac equation with central potential and hydrogen atom problem, existence of electron spin for a Dirac particle.

Unit-IV: Covariance of Dirac Equation:

Covariant form of Dirac Equation, γ-matrices and their properties, γ_5-matrix and properties, Covariance of Dirac Equation under Lorentz transformationsand rotrations, Construction of plane wave solutions of Dirac equation by Lorentz Boost of particle at rest, Bilinear covariants.

Unit-V: Heisenberg Representation in Dirac Theory:

Dirac operator in the Heisenberg representation, Heisenberg equation of motion, constant of motion and spin of Dirac particle, velocity in Dirac theory, Zitterbewegung and negative energy solutions, Presence of negative energy components, Hole theory and charge conjugation.

Recommended Books

1. Quantum Mechanics, L. I. Schiff, 3rd Edition, McGraw-Hill (1968).
2. Quantum Mechanics, Ghatak& Loknathan, 1st Edition, MacMillan India Ltd
3. Quantum Mechanics, Thankapan, 2nd Edition, New Age Int. Ltd (2004).
4. Introductory Quantum Mechanics, Richard L. Liboff.
5. Introduction to Quantum Mechanics: C.J. Joachain and B.H. Bransden.
6. Introduction of Quantum Mechanics: D.J. Griffiths.
7. Relativistic Quantum mechanics, J. J. Sakurai

Note for paper setting: major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II

SPECIAL PAPERS

Electronics Option (IVth Semester)

Special Paper III (Electronics)

PHL 7054 **4-0-0=4**

Unit I

Programming concepts and embedded programming in C and C++ - Review of C++, Software programming in assembly language (ALP) and in High level language 'C', 'C' program elements: Header and source files and preprocessor directives.

Unit II

Program elements: Macros and functions, program elements; Data types, data structures, modifiers, statements, Loops & pointers, Queues, stacks, lists and ordered lists, embedded programming in C++, 'C' program compiler and cross compiler, source code engineering tools for embedded C/C++, optimization of memory needs.

Unit III

Embedded systems: Introduction to embedded systems, an embedded system, processor in the system, other hardware units, software embedded into a system. Exemplary embedded systems, embedded system-on-chip (SOC) and in VLSI circuit.

Processor and Memory Organization: Structural units in a processor, processor selection for a embedded system, memory devices, memory selection for an embedded system, allocation of memory to program segments and blocks, and memory map of a system, direct memory access, interfacing processor, memories and I/O devices.

Unit IV

Devices and Busses for Device networks: I/O devices, timer and counting devices, serial communication using the '12C', 'CAN' and advanced I/O buses between the networked multiple devices. Host system or computer, parallel communication between the networked I/O multiple devices using the ISA, PCI, PCI-X and advanced buses.

Device Drivers and interrupts servicing mechanism: Device drivers, parallel port device drivers in a system, serial port device drivers in a system. Device drivers for internal programmable timing devices, interrupt servicing (handling) mechanism, context & the periods for the context switching. Deadline and interrupt latency.

Unit V

Real time operating system services - I/O subsystems, network operating systems, real time and embedded system operating system, interrupt routines in RTOS environment, handling of interrupt source call by the RTOS's. RTOS task scheduling models, interrupt latency and response times of the tasks as performance metrics, performance metric in scheduling models for periodic, sporadic and aperiodic tasks. List of basic actions in a preemptive scheduler and expected times taken at the processor. Fifteen-point strategy for synchronization between the processes. ISRs OS functions and tasks and for resource management, OS security issues, Mobile OS.

Real Time Operating System Programming tools: Micro C/OS-II and VxWoks:

a) Need of a well tested and debugged real-time operating system (RTOS).
b) Use of uC/OS-II
c) Use of VxWorks

Case studies of programming with RTOS:

a) Case study of coding for automatic chocolate vending machine using MUCOS, RTOS
b) Case study of coding for sending application layer byte streams on a TCP/IP network using RTOS Vx Works.
c) Case study of an embedded system for an adaptive cruise control system in a car 488.
d) Case study of an embedded system for a smart Card 502

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Starting out with C++, Tony Gladdis (3rd ed.) Dreamtech press
2. Embedded Systems, Architecture, programming and design, TMH, 2005
3. Embedded Microcomputer Systems: real time interfacing, Jonathan W Valvano, Thomson Learning
4. Object oriented programming with C++, E Balagurusamy, 2nd Ed, TMH
5. OOPS with C++ from the foundation, N R Parsa, Dream Tech Press India Ltd
6. Assembly language programming in IBM PC, Peter Norton & John Socha, PHI

Special Paper IV (Electronics)

PHL 7055 **4-0-0=4**

Unit I

Introduction to VHDL - VHDL terms, describing hardware in VHDL, entity, architectures, concurrent signal assignment, event scheduling, statement concurrency, structural designs, sequential behavior, process statements, process declarative region, process segment part.

Unit II

Process execution. Sequential statements, power of configurations. Behaviour modeling: Introduction to behaviour modeling, transport versus internal delay, internal delay, transport delay, internal delay model, transport delay model, simulation deltas, drivers, driver creation, bad multiple driver model, generics, block statements, guarded blocks.

Unit III

Sequential processing: Process statement, sensitivity list, process example, signal assignment versus variable assignment, incorrect Mux example, correct Mux example, sequential statements, IF statements, CASE statements, Loop statements, NEXT statement, EXIT statement, ASSERT statement, Assertion BNF, WAIT statements. WAIT ON signal, WAIT UNTIL expression, WAIT for time-expression, multiple WAIT conditions. WAIT time-out. Sensitivity list versus WAIT statement, concurrent assignment problem, passive processes.

Unit IV

Networking: Overview of data communication and networking: Introduction, data communication, networks, the internet, protocols and standards, network models, layered tasks. Internet model. OSI model.

Physical layer: Signals, analog and digital, analog signals, digital signals, analog vs digital, data rate limits, transmission impairment, more about signals, digital transmission, line coding block coding, sampling, Transmission mode.

Unit V
Multiplexing, frequency division multiplexing (FDM), Wave division multiplexing, time division multiplexing (TDM), transmission media, guided media, unguided media- wireless, high speed digital access, DSL technology, cable modem, SONET
Wireless LAN's, IEEE 802.11, Bluetooth.

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books
1. Starting out with C++, by Tony Gladdus (3rd ed.) Dreamtech press
2. Embedded systems, architecture programming and design, TMH 2005
3. VHDL: Programming by example, TMH 4th ed. 2005
4. Data communications and networking by B. A. Forouzan (3rd ed. TMH)

Condensed Matter Physics Option (IVth Semester)

Special Paper III (Condensed Matter Physics)

PHL 7104 **4-0-0=4**

UNIT I: Crystal Growth techniques: Theories of crystal growth, Epitaxy, Thin films and coatings; Thin Film deposition, Vacuum evaporation, Chemical Vapour deposition, Thermal oxidation, Plasma deposition, and Sputtering, Homogeneous and heterogeneous nucleation

UNIT II: Surface and Bulk Characterization techniques for materials, Rheology, Differential scanning calorimetry (DSC), Thermal gravimetric analysis (TGA).

UNIT III: X-ray diffraction: X-ray spectrum, x-ray generating equipments, powder and single crystal diffractometer.

UNIT IV: Basic properties and uses of ESCA, FTIR and RBS, Raman Spectroscopy, UV-Visible Spectroscopy, Applications of laser and neutrons in material characterization.

UNIT V: Qualitative description of Atomic force microscopy, Scanning probe microscopy, and Optical Microscopy. Introduction to electron microscopy, electron diffraction. Transmission electron microscopy (TEM), and Scanning electron microscopy (SEM)

Note for paper setting: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books
1. Fundamental of Renewable Energy Process by Aldo V. DA ROSA.
2. Environmental and Natural Resource economics by Tom Tietenberg.
3. Applied Physics of Solids by Rajnikant, Wiley International
4. Fundamental of Renewable Energy Sources by G.N.Tiwari, M.K.Ghosal.

Special Paper IV (Condensed Matter Physics)

PHL 7105 **4-0-0=4**

UNIT I: Effects of confinement and finite size zero, one and two dimensional nanostructures.

UNIT II: Concepts of surface and interfacial energies, intermolecular and interfacial forces in organic, polymeric, biological and aqueous systems-Vander Waals, electrostatic, double layer, acid base, depletion interactions, hydrophobic force.

UNIT III: Mesoscale thermodynamics, Gibbs treatment of interfaces, mesoscale fluid dynamics, thin soft films, mesoscale phenomena in soft matter and applications: adhesion, wetting, nucleation.

UNIT IV: Nanofabrication: pattering of soft materials by self organization and other techniques, chemical self assembly, artificial multilayers, cluster fabrication, Langmuir-Blodget growth, nanolithography, scanning probe lithography, microcontact printing, intercalation, attrition, ion implantation gas phase condensation, chemical vapour deposition.

UNIT V: Nanosuspensions- ferrofluids, compaction of nanocrystalline materials, carbon nanotubes, short and long term applications and perspectives, demonstration of some techniques in preparation and characterization of nanomaterials.

<u>Note for paper setting</u>: Major examination paper will consist of 20 % of total marks from the portion covered in Minor I, 20% of total marks from the portion covered till Minor II and 60 % of total marks from the portion covered after minor II.

Recommended Books

1. Introduction to Nanotechnology, C.P. Poole Jr., F.J. Owens,Wiley (2003).
2. Nanosystems, K.E. Drexler, Wiley (1992).
3. The Physics of Low-Dimensional Semiconductors, John H. Davies, Cambridge University Press, 1998.
4. S. Datta, Electronic Transport in Mesoscopic Systems: Cambridge University Press, 1995.
5. K. L. Chopra, Thin Film Phenomena, Mcgraw Hill, 1968.
6. Applied Physics of Solids by Rajnikant, Wiley International
7. Jackie Ying, Nanostructured Materials, Academic Press, 2001.
8. M.Ohring, Materials science of Thin Films, Academic Press, 1992.
9. Surface Science, K.W. Kolasinski, John Wiley, 2002.
10. J.H. Fendler, Nanoparticles and Nanostructured Films, Springer, 2000.
11. D.L. Smith, Thin Film Deposition, Mcgraw Hill, 1995.

Details of Courses Offered by School of Physics for B.Tech Program

Fundamentals of Physics

PHL 1011 **3 – 0 – 0 = 3**

UNIT I: Force and electric field due to continuous charge distribution, Field lines–Flux–Gauss's Law (differential and integral forms) and its applications, Electric potential, Work done in assembling a charge distribution. [8]

UNIT II: Force Law–line current, surface current and volume current densities (Equation of Continuity), Biot-Savart law, Properties of B, Magnetic flux–Div B, Curl B, Magnetic vector potential A, Ampere's law (differential and integral forms), Faraday's laws of electromagnetic induction, displacement current, Modified Ampere's law, Four Maxwell's equations in differential and integral forms. [10]

UNIT III: Electromagnetic Spectrum, Brief introduction to black body radiation, Photo-electric Effect and Compton Effect, Wave particle duality (de–Broglie waves), Davisson-Germer Experiment, Concept of wave function and its physical significance, Phase and Group velocities, Uncertainty Principle. [10]

UNIT IV: Bohr Theory of atom (with finite and infinite nuclear mass), Derivation of time dependent and time independent Schrödinger wave equations, Expectation values and operators (momentum, energy and angular momentum operators) and commutators, Particle in a box of infinite height (One dimensional). [10]

UNIT V: Free electron theory–Free electron gas, Energy levels and density of states in one dimension, Band theory of solids, Classification of metals, semiconductors and insulators on the basis of band theory. [7]

Recommended Books

1. Introduction to Electrodynamics, D. J. Griffiths, Pearson.
2. Electromagnetics, B. B. Laud, New Age International Publisher.
3. Perspectives of Modern Physics , Arthur Beiser, Tata McGraw Hills
4. Introduction to Solid State Physics, Charles Kittel, Wiley
5. Solid State Physics, S.O. Pillai, Wiley
6. Fundamentals of Physics, Resnick Halliday, Wiley

Physics Laboratory

PHP 1011 **0 – 0 – 2 = 1**

The laboratory begins with a hands-on (pre-laboratory) training to learn the use of measuring instruments like vernier callipers, screw gauge and spherometer. The list of experiments include

1. (a) To find the angle of prism by rotating the telescope method.
   (b) To find the refractive index of the material of the given prism using a spectrometer.
2. To determine the refractive index of given liquid (water) using a hollow prism and spectrometer.
3. To study the Newton's interference rings and determine the wavelength of sodium light.
4. To determine the wavelength of sodium light using a plane diffraction grating.
5. To study the dependence of Refractive Index (μ) of the material of the prism on the Wavelength (λ) of light; and hence
   (a) to determine the Dispersive Power of the material of prism
   (b) to verify the Cauchy Relationship $\mu=a+b/\lambda 2$,and to estimate the values of 'a' and 'b'.
   (c) to plot a graph of $d\mu/d\lambda$ versus λ.
6. To determine the frequency of A.C. mains with a Sonometer using non-magnetic wire.
7. To draw the characteristics curves of a Semiconductor Diodes (Si or Ge)
8. To study the V-I characteristics of a Zener Diode.
9. To study the performance of a Half-wave, Full-wave & Bridge wave rectifiers without filters.
10. To determine the band gap by measuring the resistance of a Thermistor at different temperatures.

11. To determine the energy band gap of a semiconductor diode (Ge) using Four Probe Method.

12. To verify Stefan's law by estimating the temperature of a torch bulb filament from resistance measurement.

13. To study the Hall Effect and calculate the Hall Coefficient and Charge Carrier Concentration of a given sample.

14. To find the wavelength of He-Ne laser using transmission diffraction grating.

Note: Apart from above listed experiments, course coordinator can also pick any other experiments meant for demonstrating proof-of-concept and to impart training and help the students learn the subject matter of "fundamentals of physics", in general.

Electrodynamics*

SPHL 101B **3 – 1 – 0 = 4**

ELECTROSTATICS:
Force and electric field due to continuous charge distribution
Field lines-Flux-Gauss's Law and its applications
Electric potential
Work done in assembling a charge distribution
Electric dipole-field lines-force and torque on a dipole due to external static electric field
Interaction energy between two dipoles
Multipole expansion
Conductors and capacitors
Boundary conditions for conductors

ELECTROSTATICS FIELDS IN MATTER
Polarization-restricting to linear, isotropic and homogenious medium
Surface and bound charge density
Electric displacement vector
Gauss's law in materials
Work done in assembling free charges in the vicinity of dielectric materials
Boundary conditions

MAGNETOSTATICS
Force Law-line current, surface current and volume current densities (continuity Eqn.)
Biot-Savart law-properties of B
Magnetic flux-Div**B**-Magnetic vector potential **A**
Curl **B** Ampere's law
Multipole expansion –magnetic dipole moment Force and torque on a magnetic dipole due to external static magnetic field.

MAGNETOSTATICS FIELDS IN MATTER
Magnetization- bound and surface charge densities
Auxillary field **H**
Boundary conditions
Force on a charged particle under electric and magnetic fields.

TIME DEPENDENT ELECTRIC AND MAGNETIC FIELDS
Electromotive forces-Faraday's law of electromagnetic induction
Self and mutual inductance
Displacement current density
Maxwell's equations for electromagnetic field
Wave equation-plane wave solution poyting vector **S**
Reflection and transmission of electromagnetic radiations at boundary

Recommended Books

1. Introduction to Electrodynamics, D. J. Griffiths, Pearson.
2. Electromagnetics, B. B. Laud, New Age International Publisher.
3. Elements of Electromagnetics, Methew N. O. Sadiku.
4. Electromagnetism, I. S. Grant and W. R. Phillips

Modern Physics*

SPHL 103B **3 – 1 – 0 = 4**

Electromagnetic Spectrum, Brief introduction to Black body radiation, Photo-electric Effect and Compton Effect, Wave particle duality (de-Broglie waves), Physical significance of wave function, Phase and Group velocities, Uncertainty Principle, Bohr Theory of atom (with finite and infinite nuclear mass), Normalized, orthogonal and well behaved wavefunctions, Derivation of time dependent and time independent Schrödinger wave equations, Expectation values and operators (momentum, energy and angular momentum operators and commutators), Particle in a box (infinite) and Harmonic oscillator, Hydrogen atom (introduction to 3 quantum numbers

(*nml*)and their significance, ground state wave functions, exception values, probability density and radial probability density).

Crystal structure: Unit cell, basis, coordination numbers, Packing fraction (SC, BCC, FCC, HCP, diamond and Nacl structures). Miller Indices, Bragg's Law, Crystal X-ray diffraction (3 experimental methods). Free electron theory. Band theory of solids. Classification of metals, semiconductors and insulators on the basis of band theory.
Semiconductor: Dopping intrinsic and extrinsic semiconductors, Hall Effect. Semiconductor devices: P-N Junction and its applications Super conductivity: Type I (Meissner effect) Type 2 superconductors.

Introduction: stimulated absorption and emission, Spontaneous emission, Einstein Coefficients Types of Lasers: Ruby laser, He-Ne, Co_2 laser, Semiconductor laser

Recommended Books

1. Introduction to Quantum Mechanics, Ajoy Ghatak, Macmillan
2. Quantum Mechanics: An Introduction , Schiff
3. Perspectives of Modern Physics , Arther Beiser, TMH
4. Introduction to Solid State Physics Charles Kittel, Wiley
5. Solid State Physics , Pillai Wiley
6. Semiconductor Physics & Devices, Islam Oxford
7. Fundamentals of Physics, Resnick Halladay, Wiley

Electrodynamics Lab*

SPHP 101B **0 – 0 – 3 = 1.5**

1. Least count of measuring instruments.
2. Determination of frequency of ac mains.
3. Study of optical fibers.
4. Measurement of wavelength of light using Newton's Rings.
5. Measurement of wavelength of light using Diffraction Grating.
6. Prism based experiments (Angle of prism, Angle of Minimum Deviation, Refractive Index).
7. Resolving power of a Prism & Diffraction Grating.
8. Dispersive Power of a given prism using Mercury Source.
9. Experiments related to Cauchy's constants A & B using Mercury Source.
10. To draw the calibration curve (D-λ) of a spectrometer with a given prism and hence to find the wavelengths of some unknown lines.
11. Experiments on Double slit diffraction.
12. Thermistor Characteristics.
13. Thermocouple Characteristics.
14. Demonstration Experiment on Michelson Interferometer.
15. Demonstration Experiment on Sound Detection System.
16. Demonstration Experiment on optical fibers.

Modern Physics Lab*

SPHP 102B **0 – 0 - 3 = 1.5**

1. Diffraction of light using He-Ne lasers.
2. Study of Stefan's Radiation Constant.
3. Determination of Characteristics of pn junction (Energy Band-gap / Reverse Saturation / Material Constant / Diffusion Capacitance).
4. Study of Semiconductor Diode as a Temperature Sensor.
5. Study of Hall Effect.
6. Study of Diode characteristics & applications
7. Study of Diode Rectifier circuits (Half wave / Full wave (Centre-tapped/Bridge type)).
8. Study of zener diode characteristics & applications
9. Study of Resistivity & Band-gap of a Semiconductor crystal using Four Probe Method.
10. Study of optoelectronic devices
11. Velocity of sound in air using CRO
12. Conduction of heat through poor conductor Lee's method.
13. Demonstration Experiments on B-H Curve (Hystersis loop).
14. Demonstration Experiment on measurement of Dielectric constant.

* Old Course (discontinued from academic session 2014-2015)

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Mathematics

Introduction

The School of Mathematics initially started as School of Applied Physics & Mathematics and was established in the year 2005-2006. However, in 2008 it evolved as a separate full fledged school. The objective of the School is to pursue research besides offering courses to the Under Graduate and Post Graduate students in Mathematics.

Objectives

- To provide education and training of excellent quality both at undergraduate and postgraduate levels.
- To ensure that the University achieves and maintains an international standing in both teaching and research.
- To promote study and research in new and emerging areas and encourage academic interaction of the faculty and students at national and international levels.
- To encourage close collaboration with industry and facilitate the application of research for commercial use and for the benefit of society.

Master of Science in Mathematics

Introduction

Mathematics continues to grow at a phenomenal rate. There is no end in sight, and the application of mathematics to science becomes greater all the time. In the said programme, an attempt has been made to introduce some courses relating to latest developments in Mathematics, that include Optimization Techniques, Discrete Mathematics, Numerical Methods, Space Mechanics, Game Theory, Decision Theory, Econometrics.

Besides core courses like Algebra, Analysis, Differential Equations, Topology, Differential Geometry, some computer science related courses like Computer programming, Data Structures & Programming Methodology and some electives have been introduced to make the programme inter disciplinary.

Some courses like Queuing Theory, Financial Mathematics, Modeling and Simulation, Time Series and Stochastic Process etc. have been introduced keeping in view the demand of the hour.

The programme has been designed keeping in view various competitive examinations, such as NET, GATE etc. Moreover, the courses have been designed in the light of the courses of some other universities also.

Program Structure of
Master of Science in Mathematics

Semester I **First Year**

Course Code	Course Title	L-T-P	Credit
MTL 6051	Abstract Algebra	4-0-0	4
MTL 6052	Real Analysis	4-0-0	4
MTL 6061	Discrete Mathematics	4-0-0	4
MTL 6062	Computer Programming	4-0-0	4
MTL 6063	Advanced Calculus	4-0-0	4
MTP 6061	Programming Lab	0-0-2	1
	Total Credits	**20-0-2**	**21**

Semester II **First Year**

Course Code	Course Title	L-T-P	Credit
MTL 6053	Linear Algebra	4-0-0	4
MTL 6054	Complex Analysis	4-0-0	4
MTL 6065	Differential Equations	4-0-0	4
MTL 6071	Probability & Statistics	3-1-0	4
MTL 6066	Numerical Methods	3-1-0	4
MTP 6062	Numerical Methods Lab	0-0-2	1
	Total Credits	**18-2-2**	**21**

Second Year **Third Semester**

Course Code	Course Title	L-T-P	Credit
MTL 7081	Optimization Techniques	3-1-0	4
MTL 7051	Topology	4-0-0	4
MTL 7061	Space Mechanics	4-0-0	4
MTE 70XX	Elective -I	*4-1-0 or 4-0-2	5
MTE 70XX	Elective –II	*4-1-0 or 4-0-2	5
	Open Elective-I	3-0-0	3
	Total Credits	**22-3-0 Or 22-1-4 Or 22-2-2**	**25**

Second Year **Fourth Semester**

Course Code	Course Title	L-T-P	Credit
MTL 7062	Differential Geometry	4-0-0	4
MTL 7063	Modern Applied Algebra	4-0-0	4
MTL 7052	Functional Analysis	4-0-0	4
MTD 7091	Minor Project / Survey Article / Research Article / Book Review		6+2**
	Open Elective-II	3-0-0	3
	Total Credits	***18-0-6**	**23**

* Depends on the choice of the electives
** Credit to be earned from seminar presentations on the project during the semester
# Contact hours with the project supervisor

List of Electives:

Course Code	Course Title	L-T-P	Credit
MTE 7012	Partial Differential Equations and Special Functions	4-1-0	5
MTE 7013	Measure Theory and Advanced Probability	4-1-0	5
MTE 7014	Non Linear Analysis	4-1-0	5
MTE 7015	Advanced Topics in Algebra	4-1-0	5
MTE 7011	Algebra-IV	4-1-0	5
MTE 7021	Information Theory	4-1-0	5
MTE 7022	Digital Signal Processing	4-0-2	5
MTE 7023	Real Time Systems	4-0-2	5
MTE 7024	Parallel Processing	4-0-2	5
MTE 7025	Distributed Computing	4-0-2	5
MTE 7026	Coding Theory	4-1-0	5
MTE 7027	Graph Theory	4-1-0	5
MTE 7028	Galois Theory	4-1-0	5
MTE 7029	Biomathematics	4-0-2	5
MTE 7031	Time Series and Stochastic Process	4-1-0	5
MTE 7032	Decision Theory	4-1-0	5
MTE 7033	Econometrics	4-1-0	5
MTE 7041	Queuing Theory	4-1-0	5
MTE 7042	Theory of Reliability	4-1-0	5
MTE 7043	Inventory Theory	4-1-0	5
MTE 7044	Modeling and Simulation	4-0-2	5
MTE7045	Theory of Games	4-1-0	5
MTE 7231	Financial Mathematics	4-1-0	5
MTE 7232	Marketing Management	4-1-0	5

List of Open Electives:

Course Code	Course Title	L-T-P	Credit
MTE 7141	Complex dynamics	3-0-0	3
MTE 7151	Techniques in numerical analysis	3-0-0	3
MTE 7152	Tensor Calculus	3-0-0	3
MTE 7153	Mathematical Modeling in Science, Engineering and Mangement	3-0-0	3
MTE 7161	Statistical techniques	3-0-0	3
MTE 7171	Introductory Operation research	3-0-0	3

Abstract Algebra

MTL 6051 **4-0-0=4**

SECTION – A

Group, Subgroup, Normal subgroup, Homomorphisms and Isomorphisms of groups, Cyclic group, Symmetric and alternating groups, Simplicity of Alternating group A_n for n>5, Commutators, conjugates, centralizer, series of subgroups, Jordan Holder theorem, solvable groups.

SECTION – B

Rings, Integral Domains, Fields, Ideals, Residue class Rings. Theorems on Homomorphisms, Division Rings, Prime and Maximal Ideals, Polynomial Rings, Divisibility, Eulclidean and Principal Ideal Domains, Unique Factorization Domains, Gauss Theorem.

SECTION - C

Prime fields, Field Extensions, Algebraic element, Algebraic Extensions, Separable Extensions, Perfect Fields and Splitting Field.

Recommended Books:

1. Herstein I.N., Topics in Algebra, Wiley
2. Jacobson, N., Lectures in Abstract Algebra Vol. I
3. Jacobson, N., Basic Algebra-I
4. Fraleight, J.B., A First Course in Abstract Algebra

5. Bhattacharya, Jain & Nagpal, Abstract Algebra
6. Shanti Narayan, Modern Algebra

Real Analysis

MTL 6052 **4-0-0=4**

SECTION - A

Countable & Uncountable sets, Statements of axiom of choice, well ordering principle, Zorn's Lemma, Transfinite induction. Field of real numbers as a complete ordered field, Metric space, compact set, Heine-Borel Theorem, Bolzano Weierstras theorem, Taylor's Theorem.

SECTION - B

Construction & properties of Lebesgue measure, Borel sets, Measurable sets, Measurable functions, Lebsegue integration & its properties, Dominated & Monotone convergence Theorems, Fatou's Lemma.

SECTION - C

Fourier series of integrable functions, Discussion of pointwise & uniform convergence of Fouries series, Fejer's Theorem for continuous periodic functions, Parseval's Theorem, Riesz Fisher theorem, Fourier Transforms of integrable functions, convolutions & their Fourier Transforms.

Recommended Books:

1. Rudin, W., Principles of Mathematical Analysis
2. Royden, H.L., Real Analysis
3. Apostol, T.M., Real Analysis
4. Tichmarch, E.C., Theory of Functions
5. Hewitt & Stromberg, Abstract Analysis
6. Goldberg, R.R., Fourier Transforms
7. Das & Pattanaik, Fundamentals of Mathematical Analysis
8. Barra, G.D., Measure Theory & Integration

Discrete Mathematics

MTL 6061 **4-0-0=4**

SECTION – A

Unary and Binary operations, partial order relation, chains and anti chains, structure theorem, Lattices, Boolean algebra, order relation in Boolean algebra, Boolean polynomials, Block diagrams for gating network, connections with logic. Boolean subalgebra, Disjunctive Normal form, Direct products and Boolean morphisms

SECTION –B

Basic concepts of graph theory: vertices, edges, degree, paths, circuits, cycles, complete graphs and trees. Multi-graphs, weighted graphs and directed graphs, Adjacency matrix of a graph. Connected and disconnected graphs. K-connected and K-edge connected graphs. Shortest path in weighted graphs, Eulerian path and circuits, Hamiltonian path and circuits, Planar graphs, chromatic number, edge colouring of graphs, Vizing's theorem. Trees and cut sets: Trees, spanning tree and cut set, minimum spanning tree.

SECTION –C

Pigeon hole Principle, Inclusion - Exclusion principle, Generating functions and Discrete numeric functions, manipulation of numeric functions, Asymptotic behaviour of numeric function, Recurrence relations, Linear recurrence relation with constant coefficients and their solutions, Homogeneous solution, particular solution & total solutions. Solution by the method of generating functions.

Recommended Books:

1. C.L. Liu, Elements of Discrete Mathematics, Mc Graw Hill International editions, 1985
2. Bernard Kolman & Robert C. Busby, Discrete Mathematical Structures for Computer Science, Prentice Hall of India, 1988
3. J.P Tremblay & R. Manohar, Discrete Mathematical Structures with applications to Computer Science, Tata Mc Graw Hill Book Co. 1988
4. Richard Johnson Baugh, Discrete Mathematics, Macmillan Publishing Co. 1989.
5. Narsingh Deo, Graph Theory, Prentice Hall of India, 1986
6. K.D. Joshi, Foundations of Discrete Mathematics, Wiely Eastern Ltd., 1989

Computer Programming

MTL 6062 **4-0-0=4**

SECTION –A

Simple model of a computer system : CPU, Memory, Input/Output devices. Hardware and software. Booting process and DOS commands. The steps involved in computer programming, problem analysis, algorithms flow charts. Computer Programming: various data types (simple and structured) and their representation (BCD, ASCII and EBCDIC), constants and variables, arithmetic and logical expressions, data assignments, input and output statements, Program header & declarations. High level and low level programming languages.

SECTION -B

Further Computer programming: Control statements -sequencing, conditional and unconditional branching and looping. Single and multi-dimensional arrays. Searching (linear, binary), sorting (exchange, bubble, selection and insertion) and merging. User defined data types.

SECTION -C

Stepwise refinement. Subroutines: Functions and Procedures. Parameter passing, call by value & call by reference. Functions and procedures as parameters, recursion. Further data structures: Records (simple, hierarchical and variant), sets, files (text and binary files).

Programming Lab

MTP 6061 **0-0-2=1**

Practical: (Programming in C)

1. Write a program to find the factorial of any number.
2. Write a program to find x^y where x and y are entered by the keyboard.
3. Write a program to find the roots of a quadratic equation.
4. Write a program to display ten digit Fibonacci series and its sum.
5. Write a program to find out all Armstrong numbers between 1 and 500.
6. Write a program to find out whether a number is Prime or not.
7. Write a program to find the sum of prime numbers between 1 and 500.
8. Write a program to add and multiply the two arrays of 3×3.
9. Write a program to find a given number in a array of 3× 3.
10. Write a program to display the sequence in the following order

```
1                    1
1 2                  2 2
1 2 3                3 3 3
1 2 3 4              4 4 4 4
1 2 3 4 5            5 5 5 5 5
```

Recommended Books:

1. Yashwant Kanetkar, Programming in C, BPB Publications, New Delhi.
2. Introduction to Computer Science, ITL/ESL.
2. Dale, Orshalick, Introduction to Pascal & Structural Design, Tata Mc-Graw
3. D.E.Knuth, Fundamental Algorithms

Advaced Calculus

MTL 6063 **4-0-0=4**

SECTION- A

Limit of function of two variable, continuity, partial differentiation. Partial derivatives of higher order, Schwartz theorem, Young's Theorem Homogeneous functions of three variables.

SECTION- B

Maxima and Minima, Restricted maxima and minima, Lagranges multipliers, Jacobian. Legendre polynomials $P_n(x)$, $Q_n(x)$; Rodrigues formulae, Orthogonality of Legendre Polynomials, Recurrance formulae.

SECTION -C

Bessels equation, Bessels function, Recurrance formula, Orthogonality, generating function, Trigonometric expansion involving Bessel's function Bessel's integrals.

Recommended Books:

1. E. Kreyszig, Advanced Engineering Mathematics
2. W. Rudin, Mathematical Analysis
3. R. Goldberg, Methods of Real Analysis

Linear Algebra

MTL 6053 **4-0-0=4**

SECTION - A

Linear spaces, Subspaces, Linear combinations, Linear spans, Row space of a Matrix, Sums and direct sums, Linear Dependence, Basis & Dimension, Dimension and subsapaces, Rank of a Matrix, Linear mappings, Kernel and Image of linear mapping, Singular and nonsingular mappings, Linear mappings and systems of linear equations, operations with linear mappings.

SECTION - B

Algebra of Linear operators, Invertible operators, Matrix representation of a Linear operator, change of basis, Similar Matrices and linear mapping, Determinant function, properties of determinants. Applications to linear equations. Determinant of a linear operator. Eigen values and Eigen vectors, characteristic polynomial, Cayley-Hamilton theorem. Minimum polynomial, Characteristic and minimum polynomials of linear operators.

SECTION - C

Linear functionals and the dual space. Dual basis, second dual space, Annihilators, Transpose of a Linear mapping, Bilinear forms and matrices. Quadratic forms, Hermiltian forms. Inner product spaces, Cauchy-schwarz inequality, orthogonality, orthonormal sets, Gram-schmidt orthogonalization process. Linear functional and adjoint operators, orthogonal and unitary operators and matrices. Normal operator. Canonical forms, Invariant direct sum decomposition, Nilpotent operators, Jordan and rational canonical forms

Recommended Books:

1. S. Lang, Linear Algebra
2. Hoffman & Kunze, Linear Algebra
3. W Rudin, Principles of Mathematical Analysis
4. P. Halmos, Finite Dimensional Vector Space
5. Seymour Lipschutz, Theory and Problems of Linear Algeb

Complex Analysis

MTL 6054 **4-0-0=4**

SECTION - A

Analytic (Holomorphic) functions, Cauchy-Riemann equations, Polar form of Cauchy-Rieman equations, Harmonic functions, Exponential and Trigonometric functions, conformal transformation, Bilinear transformation.

SECTION - B

Integral along a path, Cauchy's Theorem, Cauchy Integral Formula, Taylor's and Laurent's expansions, Cauchy inequalities, Liouville's Theorem' Fundamental Theorem of Algebra, Morera's Theorem, Maximum modulus and minimum modulus Theorems, Argument Principle, Rouche's Theorem, Schwarz Lemma.

SECTION - C

Singularities, Different Types of singularities, Residue at a singularity, Cauchy's Residue theorem. Residue and Contour integration, Analytic continuation, Uniqueness of analytic continuation.

Recommended Books:

1. S. Lang, Complex Analysis
2. J.B. Conway, Functions of one Complex Variable
3. Ahlfors, Complex Analysis
4. J.C. Chaturvedi & S.S. Seth, Functions of a Complex Variable
5. Walter Rudin , Real and Complex Analysis

Differential Equations

MTL 6065 **4-0-0=4**

SECTION -A

Simultaneous Differential Equations- Methods of solving Simultaneous Differential Equation, Simultaneous Equations of the First Order, Linear Differential Equations of Second Order, Complete Solution of the differential equations when one integral of the Complementary function is known, Reduction to Normal form, Solution by change of the independent variable, Solution by means of operational factors, Method of variation of parameters, methods of undetermined coefficient.

SECTION -B

Exact Linear Differential Equations of nth order-Condition of exactness for a linear equation of order n, Integrating factors, Non-linear differential equation of particular forms-Exact non-linear differential equations, Riccati's Equation, Homogeneous equations.

SECTION - C

Total differential Equation-Necessary & Sufficient condition for the total Differential Equations, Solutions of a Total Equation involving four variables.

Series Solutions of Second order Linear Differential Equations. Method of differentiation Cauchy, Euler equation, method of Frobenius, The Hyper Geometric Series, Solution of Gauss-Hypergeometric Equation.

Recommended Books:

1. E.L. Ince, Ordinary Differential Equations, Dover Publication Inc. 1956
2. G. Birkhoff & G.C. Rot, Ordinary Differential Equation, John Willey.
3. M. Braun, Differential Equations & their Applications, Springer Verlag.
4. E.A. Coddington, An Introduction to ordinary differential equations, PHI
5. M. Roy, Chaturvedi, Differential Equations, Students Friends.

Probability and Statistics

MTL 6071 **3-1-0=4**

SECTION-A

Review of probability- Random variable and Distribution function, Marginal and joint probability distribution Mathematical expectation of sum and product of random variables. Moments, Cumulates and their interrelationship, Moment generating function and cumulate generating function, Binomial, Normal and Poisson with their properties.

SECTION - B

Correlation and Regression, Karl Pearson and Spearsman Rank, Correlation coefficient, Regression coefficient and lines of regression. Partial and multiple correlation. Sampling distribution, Standard error, Simple, Random sampling and stratified random sampling with their role.

SECTION-C

Test of significance for mean, variance, proportion and correlation coefficient, Test of goodness of fit and Independence of attributes, Analysis of variance for one way and two way classified data, concept of estimation, Definition of unbiasedness, consistency and efficiency, Statistical Decision making: Risk function, Loss function. Baye's rule and Baye's approach.

ReferenceBooks:

1. A.M. Goon, M.K. Gupta and B. Das Gupta, Fundamental of Statistics, Vol. I & Vol. II, World Press.
2. A.M. Goon, M.K. Gupta, B.Das Gupta, A Dublin of Statistical Theory-Vol. I & II, World Press.
3. S.C. Gupta , V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
4. An Introduction to probability theory and mathematical statistics: V.K. Tohatgi (Wiley Eastern Publisher Ltd., New Delhi).
5. S.P.Gupta, Statistical Methods, Sultan Chand and Sons

Numerical Methods

MTL 6066 **3-1-0=4**

SECTION - A

Differences: Error in interpolation, Detection of error by use of difference tables, Differences of a Polynomial, Newton's formula for Forward and Backward interpolation, Gauss Central difference Interpolation formula, Striling's formula, Bessel's formula, Interpolation with unequal intervals; Lagrange's formula, Divided differences and their properties, Newton's general Interpolation formula, Inverse interpolation.

SECTION - B

Errors in Numerical Calculations, Number and their accuracy, Errors and their analysis errors in a series approximation, Numerical solutions of algebraic and transcedental equations: Bisection Method, Iterative Method, Method of false-position, Newton-Raphson method, Secant method, curve fitting and approximation; fitting of a straight line. Approximation of functions, Chebyshev polynomials. Taylor's series approximation. Solution of linear systems of equations: Direct method, Elimination method, Gauss-seidel method, Jacobi method.

SECTION - C

Numerical Differentiation: Maximum and minimum value of a tabulted function, Numerical Integration: Trapezoidal Rule. Simpon's 1/3 and 3/8 Rule. Newton-cotes integration formula. Gaussian quardrature formula. Numerical evaluation of singular integrals. Numerical solution of ordinary differential equations: Solution by Taylor's series. Euler's method, Picard's method. Runge Kutta method. Predictor Corrector Method: Miline's method and Adams-Moulton's method.

Numerical Methods Lab

MTP 6062 **0-0-2=1**

Practical: (Programming in C based on numerical methods)

1. Write a program to find the roots of a given equation by bisection method.
2. Write a program to find the roots of a given equation by regula-falsi method.
3. Write a program to find the roots of a given equation by Secant method.
4. Write a program to find the value of the polynomial x^3+x^2+3x+5 correctr up to three decimal places by Newton Raphson method.
5. Write a program to find a solution of system of equations by Guass elimination method.
6. Write a program to solve a given system of equations by Gauss-Seidel method.

Recommended Books:

1. Rajaraman V., Computer Oriented Numerical Methods, PHI
2. Foroberg, Introduction of Numerical Analysis. Addison Wesely.
3. Conte, C.D. & Boor, C.D., Elementary Numerical Analysis, An algorithmic approach, McGraw
4. Kendall, N.A. & Atkinson, K.E., An Introduction to Numerical Analysis, John Willey.
5. Krishnamurthy V., Computer based Numerical Algorithms, East West
6. Shastri S.S., Introductory methods of Numerical Analysis
7. Jain M.K. et. al., Numerical Methods.

Optimization Techniques

MTL 7081 **3-1-0=4**

SECTION - A

Introduction to Operations research. Linear Programming: Principles of simplex Method. Simplex method in tabular form. Duality and Dual simplex Method. Degeneracy and cycling.

SECTION -B

Special cases of assignment and transportation problems. Matrix game and its relation with linear programming. Fundamental theorem of matrix games theory, game with mixed strategies.

SECTION -C

Queuing theory: Probability description of arrivals and service times, objectives and different characteristics of a queuing system. Determine queuing system. Discrete time queuing system, steady state behavior of Markovian and Erlangian Models (MM/1,MM/C,M/EK/1).

Recommended Books:

1. V.K. Kapoor, Operations Research, Sultan Chand and Sons.
2. Taha, Operations Research, MacMillan & Co.
3. Kanti Swaroop, Operations Research.
4. Sharma S.D., Operations Research, Kedar Nath Ram Nath and Co.
5. Gillet B.E., Introduction of Operations research, Tata Mc-Graw Hill.
6. Murthy, G.K., Linear Programming; john willey & Sons.

Topology

MTL 7051 **4-0-0=4**

SECTION -A

Infinite sets and axiom of choice, Well ordered sets, the maximum principle; Topological spaces, Bases for a Topology, The order Topology, The Product Topology, The Subspace Topology, Closed sets and Limit points, Continuous function.

Homeomorphism, Construction of continuous functions, Metric Topology. The quotient Topology (Introduction only).

SECTION -B

Connectedness and Compactness: Connected Spaces, Connected sets in the Real line, Components and Path components, Local Connectedness, Compact spaces, Compact sets in the Real line, locally compact and Limit point Compactness.

SECTION- C

Urysohn's lemma, The Tietze extension Theorem, The Urysohn's Metrization Theorem. The Tychnoff Theorem, The completely regular spaces, The Stone-cech compactification (Statement only), Complete Metric Spaces and Function spaces, Complete Metric Spaces, Compactness in Metric spaces, Pointwise and Uniform convergences, the Compact Open Topology, Baire Spaces.

Recommended Books:

1. Munkers, J. R., Topology- A First Course: Prentice Hall of India.
2. Joshi, K. D., General Topology
3. Murdeshwar, M. G., General Topology
4. Simmons, G. F., Introduction to Topology & Modern Analysis
5. Kelley, J. L., General Topology
6. Willard, S., General Topology, Addison-Wesley Publishing company.

Space Mechanics

MTL 7061 **4-0-0=4**

SECTION-A

Statics in Space: General Force Systems, Equilibrium of System of particles, reduction of force system, Equilibrium of a rigid body.Generalized co-ordinates and constraints, Work and potential energy.

SECTION-B

Kinematics, Kinetic energy and angular momentum, Kinematics of a particle of rigid body, moments of the product of inertia, Kinetic energy and angular momentum

Methods of dynamics in space, motion of particle and system of particles, moving frame of reference. Motion of rigid body, impulsive action.

SECTION-C

Introduction to equations of Lagrange and Hamilton, the classification of Dynamic System. Lagrange equations for non homomorphic system with moving constraints, Applications of Lagrange Equations, The Hamilton and canonical equations of motion and conservative system.

Recommended Books:

1. J.L.Synge, B.A.Griffith, Principles of Mechanics, Mcgraw Hill.
2. R.G.Takewale and P.S.Puranik, Introduction to classical Mechanics,TMH
3. Sankara Rao, Classical Mechanics, Prentice Hall India.

Differential Geometry

MTL 7062 **4-0-0=4**

SECTION – A

Curves and vector fields in IR^3, Differentiable curve and its parametric representation. Tangent vectors and vector fields, Directional derivatives, arc-length and tangent vector. Osculating plane and the circle. Curvature vector. Principal normal vector. Torsion and Frenet Formula, approximation of curve C & its projections, Frenet formulae for an arbitrary curve.

SECTION – B

Translation, rotation and isometrics in IR^n, Fundamental Theorem on curves in IR^3, Congruent curves, Surfaces & Differentiable manifolds, Surface- An Introduction, Differentiable manifold. Differentiable function on a manifold, Differentiable mapping between two manifolds.

SECTION – C

Parametric curves & Tangent plane, Normal and Vector fields, Length of a curve & Tangent plane, Normal & vector fields, length of a curve & first fundamental from, Surface of revolution and ruled surfaces, Envelopes, Characteristic lines, 1-Forms on IR^3 (only introduction).

Recommended Books:

1. Prakash Nirmla, Differential Geometry An Integrated Approach. TMH.
2. Will more, T.J., Introduction to Differential Geometry.
3. Spivak, Michael, Differential Geometry Vol. I & II.

Modern Applied Algebra

MTL 7063 **4-0-0=4**

SECTION-A

Binary Group Codes, Communication system and its problems, Binary Symmetric Channel, Encoding and Decoding, Error detecting and correcting codes, Block codes, Distance between words, Matrix Encoding Technique, Groups codes, Construction of Decoding Table, Hamming codes.

SECTION-B

Polynomial Rings, Polynomial Rings over field,Polynimal codes, Shift Register and its use in polynomial multiplication, Unique Factorization Theorem for polynomials,Complex Roots of unity, Formal Derivatives.

SECTION-C

Extension of fields, Simple Extensions, Computation in R[x]/[m(x)], Existence Theorem, Finite fields, Computation in GF (2^n). Root fields of Polynomials.

Recommended Books:

1.Birkhoff.G. , Barte, Thomas C., Modern Applied Algebra.
2. Herstein, I.N., Topics in Algebra
3.Gill,Arthar, Applied Algebra for computer science, Prentice Hall of India.
4.Dornhoff, Larry L., Applied Modern Algebra , MacMillan & Co. & Franz E.

Funcational Analysis

MTL 7052 **4-0-0=4**

SECTION - A

Normed spaces, Banach spaces, Further properties of Normed spaces, Subspaces, Linear operators, linear functionals, bounded and continuous linear operators, normed spaces of operators, dual spaces.

SECTION - B

Hahn-Banach theorem (Extension of linear functionals) for nomed spaces, application to bounded linear functionals on C[a,b], adjoint operators, reflexive spaces, uniform boundedness theorem, convergence of sequence of operators and functionals, Open mapping theorem, closed linear operator, Closed Graph Theorem.

SECTION - C

Inner product spaces, Hilbert spaces, further properties of inner product spaces, orthogonal complements and direct sums, orthonormal sets and sequences, total orthonormal sets and sequences, representation of functionals on Hilbert spaces, Hilbert adjoint operators, Self adjoint, unitary and normal operators.

Recommended Books:

12. Kreyszig Erwin, Introductory functional Analysis with application, John Willey and Sons.
13. Bachman and Naricel, Functional Analysis
14. Simmons, G.F., Introduction to Topology and Modern Analysis - TMH
15. P.K. Jain, O.P. Ahuja and Khalil Ahmed, Functional Analysis

Electives

Partial Differential Equations & Special Functions

MTE 7012 **4-1-0=5**

SECTION -A

Partial Differential equation of the first order-formulation and Classification of partial differential equations, Lagrange's linear equation, particular forms of non-linear partial differential equations, Charpit's method. Linear partial differential equations with constant coefficients. Homogeneous equations Non homogeneous equation.

SECTION - B

Partial Differential equations of second order with variable coefficients, Monge's Methods, Separation of variables' canonical forms, Cauchy's problem, Legendra polynomials- Solution of Legendre's Equation, Generation function, Rodrigue's formula, orthogonal Properties. Integrals involving Legnedre polynmials, Fourier-Legendre expansion, Rescurrence relations, Legendre's function of second kind Qn(x). Christoffel's summation formula.

SECTION - C

Bessel functions, solutions of Bessel's equations, Generating functions, Integral expressions. Recurrence relations, Orthogonal properties, Fourier- Bessel expansion. Hermite and Laguerre Polynomials- Differential equations, Generating functions, Recurrence relations and orthogonal properties:

ReferenceBooks:

1. F. John, Partial Differential equations, Narosa Publication
2. N. Sneddon, Elements of Partial Differential Equations, Mc-Graw Hill
3. H.F. Weinberger, A First Course in Partial Differential equations, John Willey & Sons
4. Prasad & R. Ravindran, Partial Differential equations, Willey Eastern Ltd.,
5. W.E. William, Partial Differential equations, Clarendan Press, Oxford.

Measure Theory & Advanced Probability

MTE 7013 **4-1-0=5**

SECTION – A

Lebesgue-Stieltjes measure, Product measures, Fubini's theorem, Jordan-Hahn decomposition theorem, Radon-Nikodym theorem and derivative, conditional expectation using Radon-Nikodym derivative, Cauchy-Schwartz inequality, Holder inequality, Minkowski inequality, Jensen inequality, Lyapunov inequality, Kolmogorov inequality, Hajek-Renyki inequality, Sequences of distribution functions, Helly-bray theorem.

SECTION – B

Almost everywhere convergence, convergence in mean square, distribution function of random vectors, weak and strong law of large numbers, Khintchine, Boreal and Kolmogorov theorems, Borel-Cantelli lemmas and Zero-one law, Characteristic function: Inversion theorem and continuity theorem, One-dimensional central limit problem: Lindbergh-Levy, Lyapunov, Lindeberg-Feller theorems.

SECTION – C

Properties of distribution and characteristic functions, continuity theorem, inversion formula, Representation of distribution function as a mixture of discrete and continuous distribution function; Convolutions, marginal and conditional distributions of Bivariate discrete and continuous distributions.

Recommended Books:

1. W.Feller, An introduction to probability theory and its applications: Vol. I & Vol. II.
2. K.L.Chung, A course in probability theory
3. B.R.Bhat, Modern Probability theory.
4. V.K.Rohatgi, An Introduction to Probability theory and its applications
5. P.R.Halmos, Measure Theory
6. H. Baver, Probability Theory and element of measure theory

Non Linear Analysis

MTE 7014 **4-1-0=5**

SECTION –A

Laplace Transform. Laplace Transform of some elementary functions. Laplace Transform of derivatives. Laplace Transform of Bessel function. Inverse Laplace Transform of derivatives and integrals. Convolution of two functions. Convolution Theorem.

SECTION -B

Application of Laplace Transform to solve Differential equations. Solution of ordinary differential equations with constant co-efficient and with variable co-efficient. Application of Laplace Transform in initial and boundary value problem. Heat equation and Wave equation.

SECTION - C

Fourier Transforms. Fourier Sine and Cosine transforms. Convolution integral, Relationship between Fourier and Laplace Transform, Finite Fourier Sine and Cosine transforms, Inversion formula, Application of Fourier Transform in initial and boundary value problem.

Recommended Books:

1. Sneddon, I.N., The use of integral transforms.
2. Vashishtha, A.R. and Gupta, R.K., Integral Transforms.
3. Davies, B, Integral Transforms and their applications

Advanced Topics in Algebra

MTE 7015 **4-1-0=5**

SECTION –A

Rings, Matrix rings, Polynomial rings, Skew Polynomial rings, Laurant rings, Boolean rings. Opposite ring, Characteristic of a ring. Direct Products.

Ideals, homomorphism of rings, Endomorphism rings. Field of fractions, Prime fields, PIDS and UFDS.

SECTION –B

Modules Direct product, Direct sum of modules, Free modules, homomorphisms Maxima submodule, Minimal Submodule, Simple modules, Schurs lemma, Annihilator of a Subset of a module.

Modules over PID's, Torsion modules, torsion free modules,

SECTION –C

Chain conditions, Artinian modules, Northerian modules, Composition series, Modules of finite length, Jordan Holder Theorem.

Artinian rings, Noetherian rings, Hilbert Basis Theorem, I.S.Cohen's Theorem, Introduction of Nil radical and Jacobson radical.

Recommended Books:

1. C. Musili, Introduction to rings and modules, Narosa.
2. K.R. Gooderal and R.B. Warfield, Introduction to Non-commutative rings,
3. N. McCoy, Ring Theory.

Algebra- IV

MTE 7011 **Credits: 4-0-0**

Section A

Modules, Submodules, Annhilator, Direct product and direct sum of modules, Quotient modules, Homomorphism, Homeomorphism and Isomorphism theorems of modules Finitely generated Module, Cyclic module, Simple modules, Schur's Lemma, free modules, modules over a PID, Torsion modules, Torsion free modules, fundamental Theorem of Abelian groups.

Section B

Chain conditions, Artinian ring and modules, Noetherian rings & Noetherian modules, Hilbert's basis theorem, Cohen's theorem, integral extensions, Hilbert zero theorem, localization, discrete valuation fields, Introduction to nil redicals and Jacobson redical.

Section C

Skew Polynomial Rings, Primary Decomposition, Primary Decomposition of Skew Polynomial Rings , Applications of Skew Polynomial Rings, associated prime ideals, primary decomposition.

References:

1. Artin, Michael , Algebra, PHI Learning Pvt. Ltd., New Delhi, 2011.
2. Bhat, V. K., Modern Algebra and Applications, Alpha Science Intl. Ltd, 2013, 1st Edition.
3. Dummit, D.S. and Foote ,R.M., Abstract Algebra, Wiley India, 2011, 3rd Edition.
4. Gopalakrishnan, N.S., University Algebra, New Age International, 1986, 2nd Edition.
5. Herstein, I.N., Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975, 2nd Edition.
6. Jacobson, N., Basic Algebra, Vol-1, Freeman, 1985, 2nd Edition.
7. Musli, C., Introduction to rings and modules, Narosa, 2nd Edition.

Information Theory

MTE 7021 **4-1-0=5**

SECTION –A

Measure of Information – Axioms for a measure of uncertainty, The Shannon entropy and its properties. Joint and conditional entropies, Transformation and its properties, Noiseless coding - Ingredients of noiseless coding problem, Uniquely decipherable codes, Necessary and sufficient condition for the existence of instantaneous codes, Construction of optimal codes.

SECTION- B

Discrete Memoryless Channel - Classification of channels, Information processed by a channel, Calculation of channel capacity, Decoding schemes, The ideal observer, The fundamental theorem of Information Theory and its strong and weak converses

Continuous Channels - The time-discrete Gaussian channel, Uncertainty of an absolutely continuous random variable, The converse to the coding theorem for time-discrete Gaussian channel, The time-continuous Gaussian channel, Band-limited channels.

SECTION-C

Some intuitive properties of a measure of entropy –Symmetry, normalization, expansibility, boundedness, recursivity, maximality, stability, additivity, subadditivity, nonnegativity, continuity, branching, etc. and interconnections among them, Axiomatic characterization of the Shannon entropy due to Shannon and Fadeev, Information functions, the fundamental equation of information.

References:

1. Ash, R., Information Theory, Inderscience Publishers, New York, 1965.
2. Reza, F.M., An Introduction to Information Theory, MacGraw-Hill Book Company Inc., 1961.
3. Aczela, J. and Daroczy, Z., On Measures of Information and their Characterizations, Academic Press, New York

Digital Signal Processing

MTE 7022 **4-0-2=5**

SECTION-A

Introduction of Signals, Systems and Signal Processing, Classification of Signals and Systems, Advantages of Digital over Analog Singnal processing, Signal Models - Continuous Time versus Discrete time signals, Periodic and Aperiodic Signals, Phasor Signals and Spectra, Energy and Power Signals, System Modeling Concepts, The superposition integral for Fixed and Linear Systems, Impulse Response of a Fixed and Linear System - Fourier Series - Trigonometric Series- Exponential Fourier Series-Symmetry Properties of the Fourier Coefficients.

Fourier Integral, Energy Spectral Density, Fourier Transforms in the Limit, Fourier Transform Theorems and Pairs, System Analysis with Fourier Transform, Laplace Transform Theorems, Network Analysis using the Laplace Transform.

SECTION-B

Discrete Time Signals and Systems - Review of Sampled Data Systems, Time Domain Representations of Discrete Time Signals, Frequency Domain Representation of Discrete Time Signals, Discrete Time Signals obtained by sampling, Discrete Fourier Transform. Z-Transform - Definition and Examples, Inverse Z-Transform, Properties of the Z-Transform,Introduction to Realization of Digital Systems - Block Diagrams and Signal Flow Graphs. Introduction to Realization of an IIR and FIR systems, Discrete Fourier Transforms (DFT) and Fast Fourier Transform (FFT)

SECTION-C

Design of Digital Filters : Introduction to Filters, A comparision of IIR and FIR Digital Filters.Design of IIR Digital Filters - Impulse Invariant Transformation, Bilinear Transformation, Design of Digital Butterworth and Chebyshev Filters.Design of FIR Digital Filters - Windowing and Rectangular Window, Filter Designs using Windows, Frequency Sampling Technique. DSP tools and DSP techniques in various applications.

Recommended Books:

1. Alan. V. Oppenheim, Ronald W. Schafer, Digital Signal Processing Prentice Hall of India
2. J. Defatta, Digital Signal Processing, John Willey & Sons
3. Prokians, Digital Signal Processing, PHI

Real Time Systems

MTE 7023 **4-0-2=5**

SECTION - A

Introduction to Real-time computing: Characterizing Real-time system & tasks; Performance measures of real time systems, estimation of program run time, Real-time system design: Hardware requirement, system-development cycle, data transfer techniques, synchronous & asynchronous data communication, standard interfaces.

SECTION - B

Task Assignment and Scheduling: Priority scheduling, scheduling with fixed priority dynamic priority scheduling, Real-time programming languages & Tool: desired language characteristics, data typing, control structure, run time error handling, overloading & generics, run time support, Real-time databases.

SECTION - C

Real time communication algorithms, Fault tolerence techniques: Causes of failure, fault types, fault detection, redundancy, integrated failure handling Reliability Evaluation techniques: Parameter values, reliability model for hardware redundancy, software error model, Clock synchronization.

Recommended Books:

1. C.M. Krishna & K.G. Shen, Real Time Systems, Mc. Graw Hill, 1997.
2. P.D. Lawrence & K. Mauch, Real Time Microcomputer Design: An Introduction, McGraw Hill, 1988.
3. Mathai Joseph, Real Time systems: Specification, verification & analysis, Prentice Hall Inc., 1996.
4. Stuart Bennet, Real Time computer control, Prentice Hall Inc., 1988.
5. S. J. Young, Real time languages, John Willey & sons, 1982.

Parallel Processing

MTE 7024 **4-0-2=5**

SECTION - A

Introduction to parallel computing, advantages of parallel computing. Solving problems in parallel: Temporal parallelism, Data parallelism and their comparison. Intertask dependency and task graphs. Structures of parallel computers: Pipelined parallel computers, Array processors, Shared memory multi-processor, message passing multiprocesors, MMC systems. Integer Arithmetic: Carry look-ahead addition and carry-save addition on binary tree, integer multiplication and convolution on a linear array. Elementary sorting algorithm.

SECTION - B

Matrix Algorithms : Matrix-Vector multiplication and solving lower triangular system of equations on a linear array, matrix multiplication, LU decomposition, matrix inversion, Guassian elimination on a mesh. Graph Algorithms : Mesh algorithm for tranisitive closure, connected component, shortest path, breadth first search and minimum spanning tree. Mesh of trees and its applications such as Matrix-Vector multiplication, Convolution and integer multiplication.

SECTION - C

More fancier networks : r-dimensional mesh of trees, shuffle trees, shuffle-exchange network, hypercube, De-bruijn network and butterfly. Some examples on these networks, sorting and FFT on butterfly.
Introduction to dataflow computers. Parallelism in logic programming. Programming parallel computers.

Recommended Books:

1. V. Rajaraman, Elements of Parallel Processing, Prentice-Hall of India, 1990.
2. Designing Efficient Algorithms on Parallel Computers, Mc-Graw Hill International, NewYork, 1987.
3. Parallel Algorithms, Dhall et. al., Mc-Graw Hill Int.

Distributed Computing

MTE 7025 **4-0-2=5**

SECTION-A

Distributed Operating System : Distributed Computing system models, Issues in design of distributed operating system, message passing, Remote Procedure Calls, synchronization, process management, resource management, distributed file systems. Introduction to distributed data-bases.

SECTION-B

Distributed Algorithms : Introduction to distributed algorithms, synchronous and partial synchronous models, Algorithms in general synchronous leader election, Breadth first search, shortest path, randomized algorithms. Distributed concensus with link and process failures. Asynchronous system model, I/O automata, operation of automata, complexity measures, randomizations,

SECTION-C

Asynchronous shared memory model, mutual exclusion, resource allocation, concensus, Asynchronous network model, basic asynchronous network algorithms, shared memory Vs Networks. Introduction to parallel distributed processing: general framework, methods of learning.

Recommended Books:

1. PK Sinha, Distributed Operating System, PHI, 1997.
2. AS Tanenbaum, Modern Operating Systems, PHI.
3. Nancy A Lynch, Distributed Algorithms, Morgan Kaufmann Pub. Inc.,

4. DF Rumelhart, JI Mc Clelland & PDP group, Parallel Distributed Processing vol I&II, MIT Press, 1995.
5. Simon Haykin, Neural Networks, IEEE Press.

Coding Theory

MTE 7026 **Credits: 4-1-0=5**

Section A

Divisibility and Euclidean algorithm, congruences, Finite fields, Legendre symbol and quadratic reciprocity, Jacobi symbol.

Section B

Binary Group Codes: Communication system and its problems, Binary Symmetric Channel, Encoding and Decoding, Error detecting and correcting codes, Block codes, Distance between words, Matrix Encoding Technique, Groups codes, Construction of Decoding Table, Hamming codes.

Section C

Introduction to algebraic structures, Field extensions, Quadratic Residues, Krawtchouk Polynomials, Combinatorial Theory, Probability Theory, Shannon's Theorem, Coding Gain, Problems.Linear and Good Codes

Recommended Books:

1. Neal Koblitz, A Course in Number Theory and Cryptology, Graduate Texts in Mathematics, Springer (1987).
2. Rosen M. and Ireland K., A Classical Introduction to Number Theory, Graduate Texts in Mathematics, Springer (1982).
3. David Bressoud: Factorization and Primality Testing, Undergraduate Texts in Mathematics, Springer (1989).
4. Birkhoff.G. , Barte, Thomas C., Modern Applied Algebra

Graph Theory

MTE 7027 **4-1-0=5**

SECTION – A

Basic concepts of graph theory: vertices, edges, degree, paths, circuits, cycles, complete graphs and trees. Multi-graphs, weighted graphs and directed graphs. Adjacency matrix of a graph. Connected and disconnected graphs. K-connected and K-edge connected graphs.

SECTION – B

Paths and Circuits: Euler graphs, Hamiltonian paths and circuits. Trees: rooted and binary trees, spanning trees, fundamental circuits, spanning trees in a weighted graph. Cut-sets: fundamental circuits and cut-sets, network flows, 1-isomorphism, 2-isomorphism.

SECTION – C

Planar Graphs, Matrix representation of graphs, Colouring and Covering: chromatic number, four colour problem. Directed graphs, Algorithms on Graphs: Minimum cost spanning trees, depth first search, strong connectivity, path finding
problems, transtive closure algorithm, shortest path algorithm and path problems.

Recommended Books:

1. Elements of Discrete Mathematics, C. L. Liu, Mc Graw Hill International Editions, 1985
2. Graph Theory, Narsingh Deo, Prentice Hall of India, 1986
3. Foundations of Discrete Mathematics, K.D. Joshi, Wiely Eastern Ltd., 1989.

Galois Theory

MTE 7028 **Credits: 4-1-0=5**

Section A

Field theory and Compass constructions: Algebraic, Complex algebraic numbers, Number fields; transcendental, separable, normal purely inseparable extensions; finite fields; the Frobenius of a field of positive characteristic; Perfect fields; theorem of the primitive element; Ruler and Compass constructions; constructing regular polygons.

Section B

Galois theory and applications: Group of automorphisms of fields; fundamental theorem of finite Galois Theory; cyclic extensions; solvability by radicals; Kummer theory; Determining the Galois group of a Polynomial.

Section C

Transcendental extensions: Transcendence basis theorem; Luroth's theorem; ranscendence of e. Algebraically closed fields: Existence and uniqueness of an algbebraic closure.

Recommended Books:

1. Garling D.J.H., Galois Theory (Cambridge Univ. Press)
2. Stewart I.N., Galois Theory (Chapman Publ. Co.)
3. Jacobson N., Basic Algebra (Hindustan Publ. Corpn., Delhi) Vol. 1 (Chap. 4), Vol. 2 (Chap. 8)
4. Jacobson N., Lectures on Abstract Algebra Vol.3
5. Lang S., Algebra (Adison Wiley)

Biomathematics

SMTE 228P **3-1-2=5**

SECTION – A

Pre-requisites: Basic knowledge of mathematics such as calculus, matrices and probability is required.

Dynamic Modeling with Difference equations: The Malthusian Model, Non-linear models, Analyzing non-linear models, Variations on the Logistic Model.

Linear Models of Structured Populations: Linear models and Matrix algebra, Projection matrices for structured models, Eigenvectors and Eigenvalues.

Curve Fitting and Biological Modeling: Fitting curves to data, The method of least squares, Polynomial curve fitting.

SECTION-B

Modeling Molecular Evolution: Background on DNA, An introduction to Probability, Conditional Probabilities, Matrix Models of Base Substitution.

Genetics: Mendelian Genetics, Probability distributions in genetics, Linkage, Gene frequency in populations.

Applications of stochastic processes in biology, Markov processes, Markov chains, Chapman-Kolmogorov Equations, Limiting distribution of Markov chain.

SECTION-C

Introduction of a Field K and an Algebra A over K, Examples, Types of Algebras, Basis and Dimensions of an Algebra, Gametic Algebra for Simple Mendalian Inheritance, Zygotic Algebra, Communicative Duplication of Algebras. Non associativity of Inheritance.

Baric Algebra and Weight Function, Idempotents and Train Algebras, Genetic Algebra, Application of the Genetic Algebra in theory to genetics (Self fertilization, autopolyploidy and Sex linked Inheritance).

Practicals: (Using MATLAB)

1. Find out inverse and determinant of a matrix.
2. Compute eigenvalue of a given matrix.
3. Compare two sequences of data and produce a frequency array.
4. Curve fitting.
5. Computation of higher transition probabilities of Markov chains.
6. Numerical computation of the models discussed in Section C.

Recommended Books:

1. Allman, Elizabeth S. and Rhodes, John A., Mathematical Models in Biology, Cambridge University Press (2004).
2. Keshet, E. L., Mathematical models in biology, Mc Graw-Hill, New York (1988).
3. Rubinow, S. I., Introduction to Mathematical Biology, John Wiley, New York (1975).
4. W-Busekros, A., Algebras in genetics, Lecture notes in biomathematics, Vol.-36, Springer-Verlag, New York(2006).
5. Medhi, J., Stochastic processes, New Age International (2010).

Time Series And Stochastic Process

MTE 7031 **4-1-0=5**

SECTION – A

Time series as a stationary or non stationary stochastic process, time domain analysis based on currelogram, sample autocovariance function and autocorrelation function at log K, log correlation.

Measurement of cyclic fluctuations: Periodogram and its relation with acvf, Harmonic analysis. Measurement of irregular component: Variant difference method.
AR(p) process, MA(q) process, mited ARMA(p,q) process, Stationarity and inevitability conditions, ARIMA (p,d,q) model, estimation of parameters, tests for stationarity Stochastic – Process.

SECTION – B

Markov Chain having two states, n-step transition probabilities, Classification of states, recurrent and transient states, Chapman-Kolmogorov equations, Stationary probability theorems and limit theorem for ergodic chains, martingales.

SECTION- C

Poisson process, birth and death process, Random walk and Gambler's Ruin problem, Wiener process, Renewal theory and its application, Branching chains: Discrete Process (Galton-Watson), Continuous process (Markov Branching), Fundamental theorem of Extinction.

Recommended Books:

1. P.G.Hoel, S.C. Port, C.J. Stone, Introduction to stochastic processes, Universal Book Store, New Delhi.
2. S.K. Srinivasan, K.M. Mehata, Stochastic Processes, Tata McGraw-Hill Publishing Company limited, New Delhi.
3. J. Medhi, Stochastic Processes.
4. G.E.P. Box and G.M. Jenkins, Time series Analysis: Forecasting and control.

5.C. Chatfield, The Analysis of Time Series: Theory and Practice

Decision Theory

MTE 7032 **4-1-0=5**

SECTION - A

Concepts of process, Bayesian Procedure, Decision Functions, Different Decision Criterion for Decision Problems under risk and Uncertainty. Regret versus Loss Function, Expected Value of perfect Information, Utility and its Application in Decision Problems.

SECTION -B

Multilevel (Multi-Stage) Decision problem, Principles of Diagramming and Locating of Optimal Strategy. Decision Analysis with Continuous Distribution for the Events.

Decision Process with Sampling Information: Simple Sampling and Binomial Sampling and with Updating the Prior Distribution of the Events (Use of Posterior Distribution). Decision Process and Normal Distribution of Event.

SECTION- C

Basic Concepts of the Sampling time Markov Decision process Examples, Stationary Policies, Average Cost Criterion, Policy- Iteration Algorithm, Linear Programming Formulation Procedure and Comparison of Linear Programming Formulation Procedure and Policy Iteration Algorithm for Solving an Infinite Stage Markov Decision Problem. Simple Concept of Semi Markov Decision Process. Application of Markov Decision Process to Inventory Management, Maintenance, Manufacturing Process, Telecommunication and Queuing theory.

Recommended Books:

1. Baird, Bruce F., Managerial decision under uncertainty – An introduction to the analysis of ecision making (chapters- 7,8,10,12), John Wiley, 1989.
2. Buchanan, J. T., Discrete and dynamic decision analysis, 1982.
3. Bunn, D. W., Applied decision analysis, McGraw Hill book co., 1986.
4. Mogran Johns, Introduction to decision theory.
5. Tijms, H. C., Stochastic model – An algorithmic approach, John Wiley

Econometrics

MTE 7033 **4-1-0=5**

SECTION - A

Two-variable linear model: Linear model and underlying assumptions, ordinary least squares estimators, linear hypothesis, Testing a single coefficient, Testing the significance of the complete regression, Testing the significance of a subset of coefficients confidence estimation, R^2 and adjusted R^2, Use of extraneous information in terms of exact and stochastic linear restrictions, restricted restrictions, Prediction in the least squares model, point and interval predictors.

SECTION -B

Tests for structural change, use of dummy variables, problem of multicollinearity and its remedies, estimation of parameters by generalised least squares in models with non spherical disturbances, heterosceldasticity of disturbances, estimation under autocorrelated disturbances.

SECTION- C

Bayesian analysis of linear models, Simultaneous equation model, concept of structural and reduced forms, problem of identification, rank and order conditions of identifiability, indirect least squares, Two stage least square and limited information maximum, likelihood estimation.

Recommended Books:

1. J. Johnston, Econometric methods
2. Judge, Griffiths, Hill, Hitkepohl, The theory and practice of econometrics.
3. D.N. Gujrati, Basic Econometrics (McGraw-Hill).

Queuing Theory

MTE 7041 **4-1-0=5**

SECTION - A

Concept of stochastic processes. Markov Chains discrete and Continuous time parameter. Objectives and different characteristics of a Queuing system. Performance measures. Steady State solution of Markovian Models (M/M1, M/M/C, M/E_k/1, E_k/M/1).

SECTION - B

Analytical method and use of randomization technique to find the transient solution of M/M/ and M/M/∞ Queuing models including busy period distribution.

SECTION- C

Imbedded markov chain technique and its use to the Queuing models: M/G/1, G1/M/1 and M/D/C, Bulk Queuing models. Different design and control policies ((O, N) and vacation policies) for Markovian Queuing models. Introduction to discrete time Queuing system.
Simulation procedures: Data generation and Book- keeping aspects.

Recommended Books:
1.Cooper, R.B., Introduction to Queuing Theory, 2nd Ed, North Holland,
2.Cox, D.R. and Smith W.L., Queues, Mathuen, 1961
3.Gross, D. and Harris C.M., Fundamentals of Queuing Theory, 2nd Ed., John
4.Kleinrock, L., Queuing Systems, Vol. I, John Wiley, 1975.
5.Medhi, J., Stochastic Model in Queuing theory, Academic Press, 1991.
6.Satty, T.L., Elements of Queuing Theory with Applications, Mc-Graw Hill,

Theory of Reliability

MTE 7042 **4-1-0=5**

SECTION - A

Basics of Reliability, Classes of life Distributions. Series, Parallel, stand by configuration, (k, n) systems, Bridge structure. Reliability Models of Maintained and non– maintained systems. Availability Theory and its Modeling for various configurations.

SECTION - B

Reliability Allocation problems. Discrete Replacement Policies Age, Block, Preventive and Corrective Maintenance policies, concept of minimal repair, notions of aging.

SECTION - C

Renewal theory and its applications, Solution of Renewal type equations, Algorithms by Min Xie. Optimisation problems with respect to systems Reliability. Overhaul and repair decision and other related problems. Introduction to Software Reliability.

Recommended Books:
1. Barlow, R.E. and Proschan, F., Mathematical theory of Reliability, John Wiley and Sons, New York 1965.
2. Cox., D.R., Renewal Theory, Matheun London, 1962
3. Jardine, A.K.S., Maintenance, Replacement and Reliability, Pitman
4. Morse, P.M., Queues, Inventories and Maintenance, John Wiley and Sons,
5. Rau, John, G., Optimization and Probability in systems engineering, Van Nostrand Reinhold Company, 1970.
6. Roy, Billinton and Ronald, W. Allan, Reliability Evaluation of Engineering Systems, Pitman Publication, 1983.
7. Tillman, F.A. Hwang, Optimisation of systems Reliability Marcel Dekker inc.
8. Musa, J.D. Jannino Antony, Software Reliability Measurement, Prediction and Applications, McGraw Hill, 1987.
9. Lewis, E.E., Introduction to Reliability Engineering, 2nd edition, John Wiley & Sons, 1994.
10. Villemeur, A., Reliability, Availability, Maintainability and Safety Assessment, John Wiley,

Inventory Theory

MTE 7043 **4-1-0=5**

SECTION – A

Analytical structure of Production and Inventory problems, Inventory related costs, Properties of Inventory system, Factors influencing inventories.
Deterministic inventory models and extensions without and with lead time, Inventory models with partial backlogging and sales, Models with continuous production and non-constant demand with known production capacity, Inventory models with constraints, Quantity discounts; All units and incremental. Sensitivity of the lot size system, N-products and M-Machines model.

SECTION – B

Stochastic Inventory Models and Extension without and with lead time, Use of transformation from time-dependent for continuous and discrete demand, Power demand pattern Inventory Model, Safety stock and Buffer stock.

SECTION – C

Simulation in Inventory system, Production scheduling, Classification of items viz; BAC, VED, FNS, Two-way analysis of ABC & FNS, Case studies.

Recommended Books:
1. Koenigsber, Buchan J. E., Scientific Inventory Management, prentice Hall,1963
2. Hadley, G., Whitin, T. M., Analysis of Inventory Systems, prentice Hall,1963.
3. Hansman, Fred, Operations Research in Production and Inventory Control, John Wiley, 1968.
4. Naddor, E., Inventory System, John Wiley, 1966.
5. Johnson, L. A., Montgomery, D. C., Operations Research in Production planning, Scheduling and Inventory Control, John Wiley, 1974.
6. Stephen, L., Inventory Control, McGraw Hill, 1979.
7. Silver, E. and Perterson, R., Decision System for Inventory Management and Production Control, Wiley, NY, 1985.

Modelling & Simulation

MTE 7044 **4-0-2=5**

SECTION-A

Modelling : Definition of a SYSTEM, System concepts, types of system, continuous & discrete systems, modelling process, verification & validation.
Simulation : Introduction, classification of simulation models, advantages and disadvantages of simulation, Discrete system simulation : Monte Carlo method, Random Number Generation.

SECTION-B

Queuing Theory : Introduction, Notation and assumption, Queuing model with poisson input, exponential service and arbitrary service times. Simulation of queuing system, Simulation of a single-server queue, Simulation of two-server queue.
Inventory Control : Elements of inventory theory, more complex inventory models, finite and infinite delivery rate model with and without back ordering. Simulation of inventory systems.

SECTION-C

Evaluation of simulation, length of simulation runs, variance reduction techniques.
Project management : PERT/CPM techniques, simulation of PERT networks. Model as components of information systems, modelling for decision support.
Virtual reality : the ultimate interactive model.

Recommended Books:

1. Gorden, G., System Simulation, Prentice Hall of India.
2. Narsing Deo, System Simulation, Mcgraw Hill.
3. Payne, J.A., Introduction to Simulation, Mc-Graw Hill 1982.

Theory of Games

MTE 7045 **4-1-0=5**

SECTION – A

Fundamental theorem of Rectangular Zero-sum games, Properties of Strategies, Relation of Dominance, Methods of solving Rectangular Zero-sum games.

SECTION – B

Games with infinitely many strategies. The fundamental theorem of continuous games, differential Games, Separable games with convex pay-off function.

SECTION – C

Solution of n-persons games with and without zero-sun restriction. Lanchester's equations and their application to games of strategy. Stochastic Games.

Recommended Books:

1. Meyerson, R., Game theory: Analysis of conflict, Harvard University Press, Cambridge Mass, 1991.
2. Levin R. L. and Desjardin R. B., Theory of games and strategies, International Textbook Co., NY, 1970.
3. Luce R. and Raiffa H., Games and Decision, Wiley, NY, 1957.
4. McKinsey J. C. C., Introduction to Theory of Games, McGraw Hill Book Co., NY, 1952.
5. William J. D., The complete strategist, McGraw Hill, NY, 1966.

Financial Mathematics

MTE 7231 **4-1-0=5**

SECTION -A

Role of Financial Management. Financial Analysis and planning. Working Capital Management. Cost of Capital, Capital Structure and Dividend Policies, Short term and Long term Financial Planning.

SECTION- B

Analytical Approach to Finance. Technique of Goal Programming and its Application to Profit Planning and Financial Budgeting. Capital Expenditure Decision under Risk.

SECTION- C

Financing Decision: Problem of determining optimal capital structure, Leasing, Debt Management, Analysis of commitment of funds and risk of cash insolvency; Receivables and Inventory Management Approaches, Simulation Approach to Working Capital Management.

Recommended Books:

1. Van Horne J.C., Fundamentals of Financial Management, Prentice Hall
2. Brigham E.F., Gapenski L.C., Financial Management: Theory and Practice, The Dryden Press, 9th edi., 1998.
3. Khan M.Y. and Jain P.K., Financial Management, Tata McGraw Hill Pub. Co.,
4. Clark J.J. Hendland T.J. and Pritchard R.E, Capital Budgeting Planning and Control of Capital Expenditures, Prentice Hall, Englewood Cliffs, NJ, 1986.
5. Donaldson G. and Bertrand F., Corporate Debt Capacity: A Study of Corporate Debt Policy and the Determination of Corporate Debt Capacity, Beard Books, 2000.
6. Fogler, R.H. and Ganpathy, S., Financial Econometrics, Prentice Hall,
7. Levy H. and Sarnat M., Capital Investment and Financial Decisions, Prentice Hall, Englewood Cliffs, NJ, 1982.
8. Mao J.C.T., Quantitative Decision of Financial Decisions, Macmillan, NY,

Marketing Management

MTE 7232 **4-1-0=5**

SECTION – A

Concept of Marketing and its role in Business and Public Organization, Marketing Decisions, Need for Scientific Marketing Analysis, uses and Limitations of Mathematical models in Marketing, Classification of Marketing Structure depending upon the nature of competitive conditions, Consumer behavior.
Demand elasticity's, Elasticity theorems, Joint optimization of price, quality and promotional effort Purchasing under Fluctuating prices.

SECTION- B

Factors affecting Pricing decision, Pricing methods. Promotional decisions in the presence of competition, Game theory Models for Promotional Effort, Spatial Allocation of Promotional effort, media Allocation of advertisement, Brand Switching Analysis.

SECTION – C

Sales response to Advertising in Presence of Competition. Channels of distribution, Transportation decision, Locating company's wholesale dealers and warehouses. Case studies relating to marketing decisions.

Recommended Books:

1. King, W.R., Quantitative Analysis for Marketing Management, McGraw Hill,
2. Bass, B., Mathematical models and methods in Marketing, Irwin series,
3. Murty, S., Lilien, G.L., Marketing Models, Prentice Hall of India, 1998.
4. Border, N.H. and Marshal W. V., Advertising Management – Text and Cases, Richard D. Irwin Inc., 1967.
5. Howard, J., Consumer behaviour in Marketing Strategies, Prentice Hall, 1989.

Open Electives

Complex Dynamics

MTE 7141 **3-0-0**

Rational Maps, Fixed points, Critical points, Formal definition of Fatou and Julia sets, Completely invariant sets, Normal families and equicontinuity, Properties of the Julia set and Fatou sets, Examples, Quadratic polynomials, Mandelbrot Set.

Completely Invariant Components of the Fatou Set, Maps Between Components of the Fatou Set, Components of the Julia Set, Periodic Points, The Existence of Periodic Points, Super Attracting Cycles, Repelling Cycles, The Julia Set and Periodic Points.

References:

1. Alan F. Beardon, Iteration of Rational Functions: Complex Analytic Dynamical Systems, *Volume 132 of Graduate Texts in Mathematics*, Springer, 2000.
2. Lennart Carleson, Theodore W. Gamelin, Complex Dynamics, Springer, 1993.

Techniques in Numerical Analysis

MTE 7151 **3-0-0=3**

Errors in numerical calculations, numbers and their accuracy. Numerical solution of algebraic and transcendental equations, bisection method, iterative method, false position method, Newton-Raphson method, secant method, curve fitting. Solution of system of equations, direct method, elimination method, Gauss seidel method, Jacobi method.

Differences, Errors in interpolation, differences of polynomials, Newton's formula for forward and backward interpolation, Interpolation with unequal intervals; Lagrange's method, divided difference and their properties. Numerical differentiation, Numerical integration: trapezoidal rule, Simpson's 1/3 and 3/8 rule. Newton-Cotes integration formula. Numerical solution of differential equations, Taylor series method, Picard's method, Runge-Kutta method.

Recommended Books:

1. Sankara Rao K. ,Numerical Methods For Scientists And Engineers, Princtice Hall of India Private, New Delhi, 2007.
2. Gerald, C.F, and Wheatley, P.O, Applied Numerical Analysis , Sixth Edition, Pearson Education Asia, New Delhi, 2002.
3. Balagurusamy, E., Numerical Methods, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.
4. RajaRaman V. Computer Oriented Numerical Methods, Princtice Hall of India Private, New Delhi.
5. Burden, R.L and Faires, T.D., Numerical Analysis , Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
6. Conte S.D. & Boor C.D., Elementary Numerical Analysis, An algorithmic approach, Mc Graw Hill.

Tensor Calculus

MTE 7152 **3-0-0=3**

Contravariant and covariant vector, transformation of contravariant and covariant vector, definition of a tensor, tensor field, addition and subtraction of tensors, multiplication of tensors, inner product of tensors, contraction of tensors.

Symmetric tensors, anti symmetric tensor, quotient law, reciprocal symmetric tensor, invariant of tensor, relative tensor, relative vector, relative scaler.

References:

1.Gupta,P.P. Tensors and differential geometry,Pragati Prakashan, Meerut

2.Nayak,Prasun Kumar,Textbook of Tensor calculus and differential geometry,PHI learning,2012

Mathematical Modeling in Science, Engineering and Management

MTE 7153 **3-0-0=3**

Mathematical Modeling: Introduction, needs, scope, limitations, types of models, Elementary ideas of dynamical systems. Mathematical Models in Biology: Modeling blood flow, viscosity, Poiseuille law, Oxygen transfer in red cells, diffusion, Single species population models: Basic concepts, Exponential growth model, Logistic growth model, Gompertz growth model , Mathematical modeling of epidemics: Basic concepts, Simple epidemic model, General epidemic model.

Models on the spread of scientific and technological innovations: Atomic waste disposal,electrical networks, image model, graph theoretic models, communication system model, ordinary and partial differential equation models.

Optimization models: One variable optimization, multi-variable optimization, programming models, game theoretic models, reliability models, queuing models. Statistical Models: Probability models and regression models with applications. Mathematical models in economics and management: Production and supply functions, price-elasticities, utility of consumption and consumer surplus.

References:

1. Bailey, N., The Mathematical Theory of Infectious Diseases, Haftier Press, New York, 1975
2. Beltrami, E., Mathematics for Dynamic Modeling, Academic Press, Orlando, Florida, 1987.
3. Mathematical Modeling in the Biological Environment, MTE-14, Indira Gandhi National Open University, New Delhi, 1998.
4. Braun, M., Differential Equations and their Applications, Springer, New York, 1978.
5. Kapur, J. N., Insight into Mathematical Modeling, Indian National Science Academy, New Delhi, 1983.
6. Meyer, W., Concepts of Mathematical Modeling, McGraw Hill, New York, 1994.
7. Barnes B. and Fulford, Robert G., Mathematical Modelling with Case Studies, CRC Press, First Indian Reprint, New York 2011.
8. Ross, S. M., Probability Models, Academic Press, New York, 2001.
9. Taha, H. A., Operations Research and Introduction, 7th edition, Pearson education, New Delhi, 2005.

Statistical Techniques

MTE 7161 **3-0-0=3**

Probability and distributions: Definition of Probability, independent events, Addition and multiplication rules, conditional probability, examples, Bernoulli, Binomial, Poisson and Normal distributions. Mean and variance of these distributions and their applications.

Hypothesis testing: Hypothesis, critical region, and error probabilities. Tests for means, proportion, equality of proportions. Chi-square test for independence. Methods of sampling: Use of random numbers to generate simple random samples with replacement and without replacement. Stratified sampling.

Recommended Books:

1. Miller Irwin and Miller Maryless, John E. Freund's Mathematical Statistics with Applications, Pearson Education.
2. Hogg V. Robert, Deceased Allen Craig, and McKean Joseph W., Introduction to Mathematical Statistics, Pearson Education.
3. Kapur J.N. and Saxena H.C., Mathematical Statistics, S. Chand.
4. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
5. Gupta S.P., Statistical Methods, Sultan Chand and Sons.

Introductory Operations Research

MTE 7171 **3-0-0=3**

Meaning and nature of Operations Research (OR); History and development of OR, Applications of OR; Models in OR and Methodology of OR.

Linear Programming Problem (LPP): Introduction, Formulation of LPP, Graphical Solution to LP problems, Special cases in graphical method.

General Formulation of LPP, Assumptions, Limitations and Applications of LPP; Computational procedure of Simplex Method; Artificial Variables, Big-M method; Special cases in Simplex procedure; Degeneracy in LPP.

Transportation Problem, Initial Basic Feasible Solution by North West Corner Rule, Least Cost Method and Vogel's Approximation method; Assignment problem, Hungarian Algorithm; Applications of transportation and assignment problems.

Introduction to Game Theory, Maximin-Minimax principle, Saddle point, Games with and without saddle point, Applications of game theory.

References:

1. Swarup, K, Gupta, M. and Manmohan, Operations Research, Sultan Chand and Sons,15th edition.
2. Sharma, S. D., Operations Research, Kedar Nath Ram Nath-Meerut, 10th edition.
3. Taha, H A., Operations Research, Pearson Education, 8th edition.
4. Hadley, G., Linear Programming, Narosa Publishing House, 8th edition.

Details of Courses Offered by School of Mathematics for B.Tech Program

Calculus & Linear Algebra

MTL 1012 **3 – 0 – 0 = 3**

Differential Calculus: Functions of real variable, concavity, convexity, point of inflexion, curvature, radius of curvature, Leibnitz theorem, partial differentiation, asymptotes, curve tracing, envelopes and evolutes, change of variables, Jacobian, expansion of functions of several variables, chain rule, mean value theorem, Taylor series with remainder term, maxima & minima, saddle point.
Integral Calculus: Fundamental theorem of Integral calculus, reduction formulae, properties of definite integral, applications to length, area, volume, surface of revolution. Moments, centre of gravity, improper integrals, β-γ functions.
Matrices: Elementary row and column transformation, linear dependence, rank of a matrix, consistency of system of linear equations, solution of linear system of equations, characteristic equations, Cayley Hamilton theorem, eigen values and eigen vectors, diagonalization, complex matrices.

Recommended Books:
Advanced Engineering Mathematics, Kreysig, Wiley
Engineering Mathematics- A . K. Gupta , Macmillan
Mathematical Methods by Scientists & Engineers, McQuarri, Macmillan
Differential Calculus, Shanti Narayan, S. Chand

Differential Equations & Vector Calculus

MTL 1022 **3 – 0 – 0 = 4**

Vector Calculus: Beta & Gamma functions. Differentiation of vector functions of scalar variables. Gradient of a scalar field, Divergence & Curl of a vector field and their properties. Line & surface integrals. Green's theorem, Stokes' theorem & Gauss' theorem both in vector & Cartesian forms (statement only) with simple applications.

Ordinary Differential Equation: Formation of ODE's, definition of order, degree and solution, ODE's of first order, method of separation of variables, homogenous and non-homogenous equations and their solution, exactness and integrating factor, Bernoulli's general linear ODE's of n^{th} order, operator method, method of undetermined coefficients, method variation of parameters, solution of simple simultaneous ODE's.

Partial Differential Equation: Formation of partial differential equations (PDE), Solution of PDE by direct integration. Lagrange's linear equation . Non-linear PDE of first order. Method of separation of variables. Heat, Wave & Laplace's equations (Two dimensional Polar & Cartesian Co-ordinates).

Recommended Books:
Advanced Engineering Mathematics, Kreysig, Wiley
Vector Analysis, Frank Ayres , Mc Graw Hills
Vector Calclus, Marsden T., Freeman
Differential Equations with Applications, Simons, George, TMH
Differential Equations , Ross, Wiley
A Course in Ordinary and PDEs, Zalman R., Academic Press

Differential Equations & Linear Algebra

MTL 1023 **3 – 0 – 0 = 3**

Taylor's theorems and infinite series. Application of definite integral to area, arc length, surface area and volume. Differential calculus of function of several variables with applications. Maxima and minima. Ordinary differential equation of first and high orders. Series solution for Legendre and Bessel equation. Laplace transforms. Matrix algebra.
Recommended Books:
1. Engineering Mathematics, A.C Srivastava & P.K Srivastava, Vol. I & III, PHI

Complex Analysis & Statistics

MTL 1024 **3 – 0 – 0 = 3**

Vector calculus, arc length, directional derivatives, gradient, curl, divergence, line and double integral. Gauss and stokes theorem with applications. Real and complex analysis. Basic probability and statistical methods.
Recommended Books:
1. Engineering Mathematics, A.C Srivastava & P.K Srivastava, Vol. I & III, PHI

Integral Transforms & complex analysis

MTL 2022 **3 – 1 – 0 = 4**

Fourier Analysis: Periodic functions, trigonometric series, fourier series for functions with period 2Π, complex form of the series, functions with arbitrary period, even and odd functions, half range series, approximation by trigonometric polynomials, square error, Bessel's inequality, Parseval's identity, Fourier integral.

Laplace Transforms: Function of bounded variation, laplace transform of I, t^n, e^{at}, sin(at), cos(at), sinh(at), cosh(at), erf(t), shifting properties, expressions with proofs for:
1. L{t^n f(t)} 2. L{f(t)/t} 3. L{∫f(u) du}
Unit step functions, Heaviside, direct functions and their Laplace transformation, Laplace transform of periodic function.
Evaluation of inverse Laplace transform, partial fraction method, Heaviside development, convolution theorem. Application to solve initial and boundary value problems involving the ordinary differential equation with one dependent variable

Complex Analysis: Curves and regions in complex plane, complex functions, analytic functions, Cauchy-Riemann equations, Laplace equations. Rational, exponential, trigonometric, hyperbolic functions, derivatives of analytic functions, Power series, Taylor series, Laurent series, zero and singularity behaviour of f(z) at infinity.

Recommended Books:

1. Advanced Engineering Mathematics, Kreysig, Wiley
2. Advanced Mathematical Analysis, Malik & Arrora , S. Chand & Co.
3. Advanced Differential Equations, M.D.Rai Singhaniya S. Chand & Co.
4. Complex Analysis., M.R.Spiegel, Schuam's out line Series
5. Higher Engineering Mathematics , B.S. Grewal , Khanna Publisher
6. Advanced Engineering Mathematics E. Kreyszig, New Age International

Discrete Structures

MTL 2023 **3 – 0 – 0 = 3**

Modern Algebra: Sets, Binary relation, equivalence relation. Functions, Injective, Surjective & Bijective mappings. Partial order relations, PO-set, Lattice & Boolean algebra. Algebraic structures, Semi group, Monoid, Group, Cyclic group, Subgroup, Normal subgroup, Quotient group, Homomorphism of groups. Ring, Integral domain, Field. Vector space , Linear dependence & independence . Basis & Dimension. Combinatorics, Recurrence relations & Generating functions.

Mathematical Logic: Statement Calculus- sentential connectives, Truth tables, Logical equivalence, Deduction theorem. Predicate Calculus- Symbolizing everyday language, validity and consequence. First order theories.

Metric space: Definition & examples of Metric space. Open & Closed spheres. Open & Closed sets.

Recommended Books:

1. Set Theory and Logic , R.R Stoll.,S. Chand.& Co.
2. Mathematical Logic, Mendelson, D. Van Nostrand Co.
3. Topology and Modern Analysis, Simmons, Mc Graw Hill
4. Modern Algebra, Herstein, New age International

Engineering Computational Methods

MTL 2024 **3 – 0 – 0 = 3**

SECTION - A

Differences, Error in interpolation, Detection of error by use of difference tables, Differences of a Polynomial, Newton's formula for Forward and Backward interpolation, Gauss Central difference. Interpolation formula, Stirling's formula, Bessesl's formula, Interpolation with unequal intervals; Lagrange's formula, Divided differences and their properties, Newton's general Interpolation formula, Inverse interpolation.

SECTION - B

Errors in Numerical Calculations, Number and their accuracy, Errors and their analysis errors in a series approximation. Numerical solutions of algebraic and transcendental equations: Bisection Method, Iterative Method, Method of false-position, Newton-Raphson method, Secant method, curve fitting and approximation; fitting of a straight line. Approximation of functions, Chebyshev polynimals. Taylor's series approximation. Solution of linear systems of equations: Direct method, Elimination method. Gauss-seidel method, Jacobi method.

SECTION - C

Numerical Differentiation: Maximum and minimum value of a tabulated function, Numerical Integration: Trapezoidal Rule. Simpon's 1/3 and 3/8 Rule. Newton-cotes integration formula.Gaussian quardrature formula. Numerical evaluation of singular integrals. Numerical solution of ordinary differential equations: Solution by Taylor's series, Euler's method, Picard's method, Runga Kutta method. Predictor Corrector Method: Miline's method and Adams-Moulton's method.

Note: (Students should be asked to develop algorithms and Computer programs in C for these methods.)

Recommended Books:

1. Rajaraman V. :Computer Oriented Numerical Methods, PHI
2. Foroberg:Introduction of Numerical Analysis. Addison Wesely.
3. B.S.Grewall: Higher engineering Mathematics, Khanna Publishers
4. Conte, C.D. & Boor, C.D.:Elementary Numerical Analysis An algorithmic approach, Mc-Graw Hill.
5. Kendall, N.A. & Atkinson, K.E. :An Introduction to Numerical Analysis, John Willey & Sons
6. Krishnamurthy V.: Computer based Numerical Algorithms, East West Press
7. Shastri S.S. :Introductory methods of Numerical Analysis, PHI
8. Jain M.K. et.l.: Numerical Methods for scientific and engineering computation, New Age International.

Probability Theory & Statistical Methods

MTL 2032 **3 – 1 – 0 = 4**

Probability: Sample spaces, events, probability axioms, joint probability, conditional probability, total probability, Baye's theorem, multiple events, properties of independent events.
The Random Variable: Definition of random variable, function of a random variable, discrete and continuous random variables, distribution and density function, Binomial, Poisson, uniform and Gaussian random variables, conditional distribution and density functions. Bivariate distributions, joint distribution and density, marginal distribution and density functions, conditional distribution and density, statistical independence, distribution and density of a sum and product of random variables.

Operation on one random variable: Expected value of a random variable, conditional expected value, moments about a point, moment generating function, variance, skewness and Kurtosis, covariance, correlation and regression transformation of random variables.
Stochastic (random) processes: The random process concept, classification of processes, special processes –Poisson process and wiener process, stationarity and independence, distribution and density functions, statistical independence, first order stationary processes, second order and wide sense stationary, time averages and ergodicity, correlation functions, covariance function.

Spectral characteristics of random processes: Power density spectrum and its properties, bandwidth of the power density spectrum, relationship between power spectrum and autocorrelation function, cross power spectral density and its properties.

Recommended Books:
1. Probability Theory and Random Processes, S.P.Eugence Xavier, S. Chand
2. Probability, Random variables & Stochastic Processes. Papoulis, McGraw Hill
3. Probability and Statistics, Murry Spiegel,McGraw Hill
4. Introduction to Probability and Statistics, J.S.Milton,J.C. Arnold

Applied Graph Theory

SMTL 4021 **3 – 0 – 0 = 3**

Introduction to Graph, Finite & Infinite graph, Incidence and Degree; Paths and Circuits, Euler graph, Hamiltonian paths and circuits; Trees and Fundamental Circuits, Distance and Centres.

Spanning Tree,Cut-sets and Cut-vertices, Connectivity and Separability, 1-Isomorphism and 2-Isomorphism; Planar and Dual of graph, Geometric dual, Combinatorial dual; Vector Spaces of Graph, Basis vectors of a graph, Circuit and Cut-set subspaces.

Matrix representation of graph, Incidence matrix, Circuit matrix, Cut-set matrix, Path matrix, Adjacency matrix, Colouring, Chromatic number, Chromatic Polynomial; Covering and Partitioning, Chromatic partitioning, Matching, Covering.
Recommended Books:
1. Algorithm Graph Theory, Gibbons, Cambridge University Press
2. Graphs, Networks and Algorithms, M. N. S. Swamy K. Tulasiraman
3. Graph Theory – with application to Engineering and Computer Science , Narshing Deo, PHI
4. A First Look at Graph Theory, John Clark & D.A. Holt, Allied Publishers Ltd.

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Languages & Literature

Master's Programme in English

Objectives:

M.A. English is designed particularly for those students who wish to pursue English as an all inclusive and multi- disciplinary field of study. The substantive foci of the programme is to familiarize the students with the intellectually stimulating mix of the classical and the modern, the conformist and the reactionary, the central and the peripheral, the inter-disciplinary and the intra-disciplinary , the personal and the political that the field of English studies has become today. English as a language is lingua franca and has evolved into a global phenomenon in both its linguistic and literary 'avatars' and should, therefore, occupy an integral place in any institution envisioning an international standard in teaching and research. It is with this idea that the Facultyof Humanities and Social Sciences in Shri Mata Vaishno Devi University is running the programme leading to a Masters degree in English.

Syllabus:

Language is the most powerful means of communication, a potent instrument of artistic expression, literary creativity and a significant medium for the expression and conservation of culture. Ostensibly, there exists an intrinsic form of relationship between language and literature and this symbiotic co-relation is inter-complementary. English literature today is not confined to the British literature only but also includes American, Canadian, Australian, and Indian literature within its ambit. The present programme aims at the study of the dynamics of both literature and language so as to give a firmer footing to the students of English. It is with these factors in view that the proposed Master's programme in English Literature & Language Studies consists of 16 compulsory courses spread over four semesters and a dissertation. While designing the courses, emphasis has been laid on orienting the students to the study of different genres of literature and exposing them to the wide variety of English literatures which is the current trend in the field. However, the first two semesters includes the courses which introduce to the student concepts, issues, debates and developments in English language and language teaching. An inclusion of these courses increases considerably the already high employability of the English postgraduates.

An important aspect of the syllabus is that considerable care has been taken to keep in mind the requirements of qualifying exams like SLET and NET and other competitive exams in English.

The programme incorporates a dissertation which students will be required to submit in the final semester of the programme. An adequate literary training requires ability to research and write substantial papers. The dissertation, it is expected, will enable students to write their first long and independent thesis under faculty supervision.

The courses of study proposed here will undergo periodical review, and modifications will be effected as and when necessary.

Duration of the Programme: Minimum: 4 Semesters
Maximum: 6 Semesters

Required Credits:

A student must earn at least 80 credits in order to obtain M. A English. Each course carries 4 credits. The dissertation and the seminar carry 12 and 4 credits respectively.

List of Compulsory courses:

1. British Poetry from Chaucer to Gray
2. British Drama from Marlowe to Congreve
3. British Fiction from Aphra Behn to George Eliot
4. British Non-Fiction from Thomas More to Bacon
5. British Poetry from Wordsworth to Heaney
6. British Drama from Shaw to Pinter
7. British Fiction-II from Thomas hardy to Kinsley Amis
8. British Non-Fiction-II from Addison to Russell
9. Introduction to Linguistics & English Language Teaching
10. Applied Linguistics & Second Language Learning
11. Literary Criticism-I
12. Literary Theory

13. American Literature
14. Post Colonial Literature
15. Indian Writing in English
16. Dissertation

Electives

1. Literature in Translation
2. Introduction to Cultural Studies
3. Introduction to Gender Studies

Course Structure for M.A.(English) Program

Semester-I First Yeat

Course Code	Course Title	L-T-P	Credits
LNL6011	British Poetry –I	3-1-0	4
LNL6041	British Drama-I	3-1-0	4
LNL6021	British Fiction-I	3-1-0	4
LNL6031	British Non-Fiction-I	3-1-0	4
LNL6051	Introduction to Linguistics & English Language Teaching	3-1-0	4
	Total	**15-5-0**	**20**

Semester-II First Year

Course Code	Course Title	L-T-P	Credits
LNL6012	British Poetry –II	3-1-0	4
LNL6042	British Drama-II	3-1-0	4
LNL6022	British Fiction-II	3-1-0	4
LNL6032	British Non-Fiction-II	3-1-0	4
LNL6052	Applied Linguistics & Second Language Learning	3-1-0	4
	Total	**15-5-0**	**20**

Semester-III Second Year

Code	Course Title	L-T-P	Credits
LNL7081	American Literature	3-1-0	4
LNL7061	Literary Criticism	3-1-0	4
LNL7091	Post-colonial Literature	3-1-0	4
LNE71X1	Elective-I	3-1-0	4
	Total	**12-4-0**	**16**

Semester-IV Second Year

Code	Course Title	L-T-P	Credits
LNL7062	Literary Theory	3-1-0	4
LNL7071	Seminar	------	4
LNL7101	Indian Writing in English	3-1-0	4
LND7072	Dissertation	------	12
	Total	**-----**	**24**

Total Credits = 80

Elective-I : Three Electives Options exist in the third semester out of which the students have to choose any one.

Code	Course Title	L-T-P	Credits
LNE7111	Literature in Translation	3-1-0	4
LNE7121	Introduction to Gender Studies	3-1-0	4
LNE7131	Introduction to Cultural Studies	3-1-0	4

Semester-I

British Poetry-I

LNL6011 **3-1-0=4**

Unit I: Background & Introduction to the Study of Poetry
Unit II: Geoffrey Chaucer: "General Prologue" to *The Canterbury Tales*
The Preface and The Tale of Wife of Bath
Unit III: Spenser: *Epithalamion,* Shakespeare: Sonnets 18, 30, 63, 130
Unit IV: John Donne: *The Canonization, Hymn to My God, My God in Sickness*
John Milton: *Paradise Lost, Book- I*
Unit V: Alexander Pope: *Essay on Man*
Thomas Gray: *Elegy Written in a Country Churchyard*.

Recommended Books:
A C Bradley: Oxford Lectures on Poetry.
Matheikal: English Poetry from John Donne to Ted Hughes, APD
Paul Baines: The Complete Critical Guide to Alexander Pope, Rouletdge
Geoffrey Tillotsom: On the Poetry of Pope, Clarendon Press
Thomas Gray's Elegy Written in a Country Churchyard: A study guide from Gale's poetry for students, The Gale Group

British Drama- I

LNL6041 **3-1-0=4**

Unit I: Origin & Growth of British Drama & Theatre.
Unit II: Christopher Marlowe: *Doctor Faustus*
Ben Jonson: *The Alchemist*
Unit III: Shakespeare: *Henry IV, Part-I*
Hamlet
Unit IV: Shakespeare: *Twelfth Night*
The Tempest
Unit V: John Webster: *The Duchess of Malfi*
Congreve: *The Way of the World*

Recommended Books:
Brown: The Oxford Illustrated History of Theatre.
Fletcher R: The Concise History of English Literature: Critical Assessment of Literature from Anglo Saxon Period to Modern Times (2 Vols.),
Domin Clapp: A Complete Critical Analysis of Shakespearean Plays
Fredson Bowers: Jacobean and Caroline Dramatists, Gale Cengage
Patrick Cheney: The Cambridge Companion to Christopher Marlowe, CUP

British Fiction –I

LNL6021 **3-1-0=4**

Unit I: Background & Introduction to the study of Fiction
Unit II: Aphra Behn: *Oroonoko*
Daniel Defoe: *Moll Flanders*
Unit III: Henry Fielding: *Joseph Andrews*
Jane Austen: *Emma*
Unit IV: Charles Dickens: *Great Expectations/ Hard Times*
George Eliot: *Middlemarch/ Mill on the Floss*

Recommended Books:
Arnold Kettle: An Introduction to English novel.
Raymond Williams: From Dickens to Lawrence.
Wayne C. Booth: The Rhetoric of Fiction.
Percy Lubbock: The Craft of Fiction.
F.R Leavis: The Great Tradition: George Eliot, Henry James, Joseph Conrad

British Non-Fiction –I

LNL6031 **3-1-0=4**

Unit I: Thomas Moore: *Utopia*
Unit II: Milton's: *Aeropagatica*
Unit III: Swift: *The Battle of Books*
Unit IV: Bacon: Of Studies, Of Truth, Of Death
Unit V: John Stuart Mill: On Liberty

Recommended Books:
Abrams, M.H. (1971) [1953: The Mirror and the Lamp: Romantic Theory and the Critical Tradition*,:* Oxford University Press
Douglas, Charles: John Stuart Mill: A Study of his Philosophy, Edinburgh: Blackwood, 1895
Parker, Joseph: John Stuart Mill on Liberty, A Critique*,* London, 1865.
Irvin Ehrenpreis: Swift: The Man, His Works, and the Age: Mr Swift and his Contemporaries, Harvard University Press.
Fulton Henry Anderson: The Philosophy of Francis Bacon, Octagon Books

Introduction to Linguistics & English Language Teaching

LNL6051 **3-1-0=4**

UNIT-1 The sounds of Language

Phonetics; Voiced and voiceless sounds; Place of articulation; Bilabials; Labiodentals; Dentals; Alveolar; Palatals; Velars; Glottal; Charting consonant sounds; Limitations of the chart; Manner of articulation; Stops; Fricatives; Affricates; Nasals; Liquids; Glides; The glottal stop and the flap; Vowels; Diphthongs; Subtle individual variation

Phonology; Phonemes; Phones and allophones; Minimal pairs and sets; Phonotactics; Syllables and clusters; Co-articulation effects; Assimilation; Elision

UNIT-2 Morphology

Morphology; Morphemes; Free and bound morphemes; Lexical and functional morphemes; Derivational and inflectional morphemes; Morphological description; Problem in morphological description; Morphs and allomorphs; Other languages Etymology; Coinage; Borrowing; Compounding; Blending; Clipping; Backformation; Conversion; Acronyms; Derivation; Prefixes and suffixes; Infixes

UNIT-3 Syntax

Generative grammar; Syntactic structures; Deep and surface structure; Structural ambiguity; Recursion; Symbols used in syntactic description; Tree diagrams; Phrase structure rules; Lexical rules; Back to recursion; Complement phrases; Transformational rules Grammar; Traditional grammar; The parts of speech; Agreement; Grammatical gender; Traditional analysis; The prescriptive approach The descriptive approach; Structural analysis; Immediate constituent analysis; Labeled and bracketed sentences

UNIT-4 Language and Regional Variation

The standard language; Accent and dialect; Dialectology; Regional dialects; Isoglosses and dialect boundaries; The dialect continuum; Bilingualism and diglossia; Language planning; Pidgins and creoles; The post-creole continuum Sociolinguistics; Social dialects; Education and occupation; Social markers; Speech style and style-shifting; Prestige; Speech accommodation; Register and jargon; Slang; Social barriers

UNIT-5 Second language acquisition/learning

Second Language Learning; Acquisition and learning; Acquisition barriers; Affective factors; Focus on method; The grammar–translation method; The audio-lingual method; Communicative approaches; Focus on the learner; Transfer; Inter language; Motivation; Input and output; Communicative competence; Applied linguistics

Recommended Books:

1. Contemporary Linguistics- An Introduction William O' Grady (University of Calgary) St. Martin's Press New York
2. Linguistics: An Introduction Andrew Radford and Others Cambridge University Press
3. Phonology Philip Carr Macmillan
4. A Course in Phonetics Peter Ladefoged Harcourt Brace
5. Writing without Teacher Peter Elbow OUP

Semester-II

British Poetry -II

LNL6012 **3-1-0=4**

Unit I: Wordsworth: *Resolution and Independence, Lucy Poems*
Coleridge: *Rime of the Ancient Mariner*
P.B Shelly: *Ode to West Wind*
Keats: *Ode to Nightingale*

Unit II: Tennyson: *Ulysses, Lotus Eaters*
Browning: *My Last Duchess*
Arnold: *The Dover Beach*

Unit III: G.M Hopkins: *The Wreck of Deutschland*
W.B Yeats: *Sailing to Byzantium*
The Second Coming

Unit IV: T.S Eliot: *The Wasteland*
W.H Auden: *The Shield of Achilles*

Unit V: Philip Larkin: *Church Going*
Ted Hughes: *Hawk Roosting*
Seamus Heaney: *North, Potato Digging*

Recommended Books:

Graham Hough : The Last Romantics
F. Leavis : New Bearings in English Poetry
John Lucas : Modern English poetry from Hardy to Hughes
Graham Martin, & F.H Furbank : The Twentieth Century Poetry: Critical Essays An Documents
Edward Larrisa : Reading Twentieth century Poetry

British Drama-II

LNL6042 **3-1-0=4**

Unit I: G.B Shaw: *Man and Superman*

Unit II: W.B Yeats: *The Countess Cathleen*

Unit III: T. S Eliot: *Murder in the Cathedral*

Unit IV: John Osborne: *Look Back in Anger*
Samuel Beckett: *Waiting For Godot*

Unit V: J.M Synge: *The Playboy of the Western World*

Harold Pinter: *The Birthday Party*

Recommended Books:
Subash Sarkar : T.S Eliot; The Dramatist
Datta Treya P : W. B Yeats; Poet & Dramatist
Asha S : Harold Pinter's Screen Play
Rama Kundu : New Perspectives on British authors from William Shakespeare to Greene
R. Solder : Dictionary of Theatre

British Fiction-II

LNL6022 **3-1-0=4**

Unit I: Thomas Hardy: *Tess of the D'Urbervilles* D.H.Lawrence: *Sons and Lovers*
Unit II: James Joyce: *A Portrait of an Artist as a Young Man* Virginia Woolf: *To the Lighthouse*
Unit III: E.M. Foster: *A Passage to India*
Unit IV: Joseph Conrad: *Lord Jim*
Unit V: Graham Greene: *Power and Glory*

Recommended Books:
Malcom Bradbury : The Modern English Novel.
F.R Karl : A Reader's Guide to Contemporary English Novel.
F.R leavis : The Great Tradition
Borris Ford : Volume 8 of the Pelican Guide to English Literature

British Non-Fiction-II

LNL6032 **3-1-0=4**

Unit I: Addison and Steele: The Coverley Household; Sir Roger at the theatre
Unit II: Charles Lamb: Chimney Sweepers; Christ Hospital
Unit III: Carlyle: Hero as Man of Letters
Unit IV: Ruskin: Unto This Last
Unit V: Huxley: Tragedy and The Whole Truth

Recommended Books:
G. S Fraser : The Modern writer & His world
Patricia Waugh : The Harvest of Sixties
AjSebastian : Literary Terms in Fiction & Prose.
Grenville Kleiser : Studies in Prose

Applied Linguistics & Second Language Learning

LNL6052 **3-1-0=4**

UNIT-1 Discourse analysis
Interpreting discourse; Cohesion; Coherence; Speech events; Conversation analysis; Turn-taking; The co-operative principle; Hedges; Implicatures; Background knowledge; Schemas and scripts

UNIT-2 Language and the brain
Neurolinguistics; Parts of the brain; Broca's area; Wernicke's area; The motor cortex and the arcuate fasciculus; The
localization view; The tip of the tongue phenomenon; Slips of the tongue; Slips of the ear; Aphasia; Broca's aphasia; Wernicke's aphasia; Conduction aphasia; Dichotic listening; The critical period

UNIT-4 Semantics
Conceptual and associative meaning; Semantic features; Semantic roles; Agent and theme; Instrument and experiencer; Location, source and goal; Lexical relations; Synonymy; Antonymy; Hyponymy; Prototypes; Homophones and homonyms; Polysemy ; Word play; Metonymy; Collocation Invisible meaning; Context; Deixis; Reference; Inference; Anaphora; Presupposition; Speech acts; Direct and indirect speech acts; Politeness

UNIT-4 Language and culture
Culture; Categories; Linguistic relativity; The Sapir–Whorf hypothesis; Eskimos and snow; Cognitive categories; Classifiers; Social categories; Address terms; Gender; Gendered words; Gendered speech; Gendered interaction

UNIT-5 Techniques and principles of Language Teaching
Goal of the teacher, Role of the student, Teaching-Learning Process, Student-Teacher Interaction, Student-Student Interaction, Error Analysis GT Method, Direct Method, Audio-Lingual Method, Silent Way, Suggestopedia, Total Physical Response, Communicative Language Learning

Recommended Books
1. Linguistic Semantics John Lyons CUP
2. Teaching and Principles in Language Teaching Diane Larsen-freeman OUP
3. An Introduction to Sociolinguistics Janet Holmes Longman
4. Linguistics: An Introduction to Linguistic Theory Victoria Fromkin
5. Analyzing Sentences: An Introduction to English Syntax Roberts Longman

Semester-III

American Literature

LNL7081 **3-1-0=4**

Unit I: Poetry
Walt Whitman: *Song of Myself, Passage to India*
Emily Dickinson: *Alabaster Chambers, I can wade Grief, Hope is a little thing with Feathers, Just Lost when I was Saved*
Robert Frost: *The Death of the Hired Man, Birches, Stopping by Woods on a Snowy Evening*

Unit II: Drama
Eugene O Neill: *The Hairy Ape*
Tennessee Williams: *The Glass Menagerie*

Unit III: Fiction-I
Herman Melville: *Moby Dick*
Mark Twain: *Adventures of Huckleberry Finn*

Unit IV: Fiction-II
J. D. Salinger: Catcher in the Rye

Unit V: Prose
Edgar Allan Poe: *The Philosophy of Composition*
R.W.Emerson: *The American Scholar*

Suggested Reading
Allan Dower. Fifty Years of American Drama
Malcolm Bradbury. The Modern American Novel
John Campbell. The Hero with a Thousand Faces
Morris Dickstein. Caste of Eden: American Culture in the Sixties

Post Colonial Literature

LNL7091 **3-1-0=4**

Unit I: Theoretical Bases
Stephen Slemon: "The Scramble for Post-Colonialism" from *De-scribing Empire*
Frantz Fanon: "On National Culture" from the *Wretched of the Earth*
Edward Said: Orientalism
Gayatri Spivak: Can the subaltern speak
Homi Bhabha The Location of Culture

Unit II: Fiction-I
Margaret Atwood: Surfacing

Unit III: Fiction II
Patrick White: *TheTree of Man*
Chinua Achebe*: Things Fall Apart*

Unit IV: Poetry
Judith Wright: *Woman to Man*
Isabella Valency Crawford: *The Dark Stag*
Leopold Bloom Singhor: *New York*

Unit V: Drama
George Ryga: *Ecstasy of Rita Joe*
Wole Soyinka: *The Lion and the Jewel*

Suggested Reading
Meenakshi Mukherjee. Realism and Reality: the Novel and Society in India
William Toye. The Oxford Companion to Canadian Literature
Ashcroft Griffiths and Tiffin (ed). The Postcolonial Studies Reader
Harish Trivedi. Colonial Translations
Bill Ashcroft(ed). The Empire Writes Back: Theory and Practice in Postcolonial Literature

Literary Criticism

LNL7061 **3-1-0=4**

Aristotle:	Poetics
Plato:	Selections from the Republic and Ion
Bharatmuni:	On Natya and Rasa: Aesthetics of Dramatic Experience
William Wordsworth:	"Preface" to the Lyrical Ballads
S.T.Coleridge:	Biographia Literaria (Chapters XIII, XVII, XVIII)
Matthew Arnold:	The Study of Poetry
T.S.Eliot:	Tradition and Individual Talent
I.A.Richards:	Principles of Literary Criticism
John Crowe Ransom:	Poetry: A Note on Ontology
Cleanth Brooks:	The Well-Wrought Urn: Studies in Structure of Poetry, Irony as a Principle of Structure
Northrop Frye:	The Archetypes of Literature

Suggested Reading

Wimsatt and Brooks. Literary Criticism: a Short History
J.W.H.Atkins. Ancient Criticism
G.M.H. Graube. The Greco-Roman Critics
Charles S. Baldwin. Renaissance Literary Theory
Allan H. Gilbert. Literary Criticism: Plato to Dryden

Literature in Translation (Elective)

LNE7111 **3-1-0=4**

Unit-I: Translation- Theory and Practice
Sophocles: *Oedipus Rex*

Unit-II: Flaubert: *Madam Bovary*
Brecht: *Mother Courage*

Unit-III: Premchand: *Godan*
Tagore: Selections from *Gitanjali*

Unit-IV: Ramnath Shastri : *Bawa Jitto*
Dinubhai Pant: Who is this Dear Son of his Mother
Jitendra Udhampuri: A Revolution: A Handkerchief
Padma Sachdeva : Questions
Ved Rahi : Jewel

Unit-V: Selected Vakhs of Lal Ded

Introduction to Ladakhi Literature in Translation

Suggested Reading

1. B.K. Das. A Handbook of Translation Studies, Atlantic Publication House
2. Mohit K. Ray. Studies in Translation, Atlantic Publication House
3. Shivnath, Two Decades of Dogri Literature, Sahitya akademi First Published , 1997
4. Shivnath, A Selection of Contemporary Dogri Poetry, Sahitya akademi, 2006
5. Translation of the Vakhs of Lal Ded By B.N. Parimou
6. Translation of the Vakhs of Lal Ded By Bimla Raina
7. Bawa Jitto, Ramnath Shastri, translated by Dr. Vandhana Sharma, Saksham Books International, Pacca Danga, Jammu, 2011
8. Bijay K Das: The Horizon of Translation Studies**Unit-I:** Translation- Theory and Practice

Introduction to Cultural Studies (Elective)

LNE7131 **3-1-0=4**

Unit I: **Introducing Cultural Studies**
a) What it is and what it is not
b) Interdisciplinarity
c) Looking Backwards and Forward at Cultural Studies

Unit II: **Marxism and the Study of Culture**
a) The German Ideology
b) Ideology and Ideological State Apparatus
c) Interpellation

Unit III: **Consumer Culture and Fashion Studies**
a) Fashion, Culture and Construction of Identity
b) Fashion as a Culture Industry
c) Constructing Purity: Bottled Water and the Commodification of Nature

Unit IV: **Culture and Media Studies**
a) Encoding, Decoding
b) The Cultural Politics of News Discourse
c) Heliography: Journalism and the Visualization of Truth

Unit V: **Popular Culture**
a) Introduction to The Study of Popular Cultures
b) Techno-culture
c) Globalization and Culture

Suggested Reading

Chris Baker. Cultural Studies: Theory and Practice. Sage Publications
Richard Johnson. What is Cultural Studies Anyway. Centre for Contemporary Cultural Studies, Univ. of Birmingham.
Ziauddin Sardar. Introducing Cultural Studies. Icon
Simon During(ed). The Cultural Reader. Routeledge

Introduction to Gender Studies (Elective)

LNE7121 **3-1-0=4**

Unit I: a) Gender and Development: Concept, Approaches and Strategies
a) Gender, Development Goals and Praxis

Unit II: a) Gender, Literature and Culture in India
b) Media, ICTs and Gender

Unit III: a) Gender Planning and Development Policies
b) Gender, Law and Human Rights

Unit IV: a) Gender, Organization and Leadership
b) Gender and Entrepreneurship Development

Unit V: Research Methodologies in Gender and Development Studies

Suggested Reading

Baca Zinn, Maxine, Pierrette Hondagneu-Sotelo and Michael A. Messner(eds). Gender Through the Prism of Difference. Boston: Allyn &Bacon.
Kimmel, Michael S. & Michael A. Messner. Men's Lives. Boston: Allyn& Bacon
Gail Dines and Jean M. Humez. Gender, Race and Class In Media. Sage Publications
Simone de Beauvoir. *The Second Sex*

Semester-IV

Literary Theory

LNL7062 **3-1-0=4**

Marxism: Seminal pieces from *The Communist Manifesto, The Formation of Intellectuals, The Historical Novel, Ideology and Ideological State Appartuses*

Structuralism & Deconstruction: *Difference, The Death of The Author*

Post modernism: Seminal Pieces from *The Postmodern Condition, A Poetics of Postmodernism*

New Historicism and Cultural Materialism: *That Shakespearean Rag, Invisible Bullets*

Eco-criticism: *Environmentalism: A Global History*

Suggested Reading

Patricia Waugh(ed). Modern Literary Theory.
George Watson. The English Critics.
Rene Wellek. History of Modern Criticism vol III TO IV
George Saintsbury. A History of Literary Criticism
David Lodge. 20th Century Literary Criticism

Indian Writing in English

LNL7101 **3-1-0=4**

Unit I: Development of Indian Writing in English

Unit II Raja Rao's *Kanthapura*

Unit III:
a) Salman Rushdie's *Midnight's Children*
b) Jhumpa Lahiri's *The Namesake*

Unit IV: Indian Poetry in English

a) Henry Derozio	The Harp of India, To India – My Native Land
b) Nissim Ezekiel	Poet, Lover and Birdwatcher, Background Casually
c) Keki Daruwalla	Boat- ride Along the Ganga
d) Eunice de Souza	Autobiographical, Bequest
e) Imtiaz Dharkar	Purdah I

Unit V: Indian Drama in English

Girish Kannad's	*Tughlaq*
Mahesh Dattani	*Final Solutions*
Manjula Padmanabhan	*Harvest*

Suggested Reading

1. K.R.Srinivasa, Indian Writing in English, Sterling Publishers Pvt. Ltd,2009
2. Meenakshi Mukherjee, Twice Born Fiction, Pencraft International, 2010.
3. Meenakshi Mukherjee, Realism and Reality: the Novel and Society in India, Oxford university press,USA, 1994.

4. Vinayak Krishna Gokak(ed) The Golden Treasury of Indo-Anglian Poetry, Sahitya Akademi, 2006.
5. S. Krishna Bhatta, Indian English Drama: A Critical Study, Sterling House; New Delhi, 1987
6. M.Prabha, Waffle of the Toffs, Oxford & IBH(2008).
7. R.S. Pathak, Indian Fiction in English, Northern Book Centre, Ansari Road, Daryaganj, New Delhi, 1990.

Details of Courses Offered by School of Language & Literature for B.Tech Program

Communication Skills-I

LNL 1141 **3-0-0=3**

Communication: What is communication, components of communication, concepts and problems of communication, basic technical communication skills

Mechanics of Professional Writing: E-mail and formal letter writing, applications, cover letters and CVs, notes Making, Notice, minutes & agenda, claims, adjustments and enquiries.

Word Building: Phrasal verbs, common errors, antonyms & synonyms, one word substitution, words often confused, writing grammar and punctuation

Professional Speaking: The Interview Process, Characteristics of the job interview, pre-interview preparation techniques, Answering strategies, frequently asked interview questions, projecting a positive image, Body Language

Report Writing: Nature & Significance, types of reports, structure of technical report, writing strategies

Group Discussion: Definition, Methodology of group discussion, Techniques for individual contribution, Group Interaction Strategies, helpful expressions & Evaluation Practical Session

Recommended Books:

1. Business correspondence and report Writing. R.C. Sharma & Krishna Mohan, TMH.
2. An Approach to Communication Skills, Indrajit Bhattacharya Dhanpat.
3. English for Engineering Students, Selvam, Vikash Publishers Rai & Co.Delhi

Language Lab-I

LNP 1142 **0-0-2=1**

Unit-I Writing: English Grammar Usage
Unit-II: Listening: Active Listening in English
Unit III: Speaking: Sky Pronunciation Suite
Unit IV: Read Up – Speed Up

Communication Skills-II

LNL6143 **3-0-0=3**

Unit-1
What is communication; components of communication; concepts and problems of communication; basic Technical Communication Skills.
Unit-2
E-mail and formal letter; applications, cover letter and CVs; notes making, Notice, minutes & agenda
Unit-3
Vocabulary Building: Phrasal verbs, common errors words often confused, Idiomatic expressions
Unit-4
Practical sessions: Tense Busters, English Grammar in Use, Active Listening in English, Read-Up Speed-Up.
Unit-5
Reading; Analysis and Discussion of any one selected literary text.

Suggested Readings:
Kumar, Sanjay. Communication Skills. New Delhi: Oxford University Press, 2011. Print.
Mukerjee, Hory S. Business Communication: Connecting at Work. New Delhi: Oxford University Press, 2013. Print.

Language Lab-II

LNP6142 **0-0-2=1**

Unit-I Writing: English Grammar Usage; Advance Grammar in Use
Unit-II: Listening: Active Listening in English; Read-Up Speed-Up
Unit III: Speaking: Sky Pronunciation Suite; Tense Buster
Unit IV: Read Up – Speed Up

Rhetoric & Public Speaking

LNE1143 **3-0-0=3**

Introduction: Rhetoric and Public Speaking, Classical Rhetoric, Contemporary studies of Rhetoric
World Orators: Ancient and Medieval Orators, Modern Orators & their Selected Speeches, Use of Gestures, Control of Voice, Practice sessions.
Public Speaking in the Social Context: Everyday Dialogues.
Debating: Debate & Argumentation Theory, forms of Debate, Debate Competitions.
Presentation Skills: Format, Elements & Essential characteristics, Effective use of Presentation software and overhead, Practical sessions.

Indian Writing in English

LNE1144 **3-0-0=3**

History of Indian writing in English Social, political and Economic factors responsible for its quick coming of age. Review of the formal critical attention paid to the various genre to date. Analysis of the most recurrent themes. In this course, students are required to read, analyze and discuss at least novels of Indian writers writing in English. Selected texts of some of the writers viz. Mulkh Raj Anand, Khushwant Singh, Salman Rushdie, V.S.Naipaul, Kiran Desai will be studied.

Phonetics and Phonology

LNE1145 **3-0-0=3**

Phonetics: The production of speech sounds, Articulators above the larynx, Vowel and Consonant, English short vowels, Long vowels, diphthongs and triphthongs.

Voicing and Consonants: The larynx, Respiration and voicing, plosives, fortis and lenis.
Phoneme, Symbols and transcription, Phonology.
Fricatives and Affricates- their production, fricatives of English, fortis consonants.
Nasals and other consonants
The syllable, structure of English syllable, syllable division, strong and weak syllables, syllabic consonants.
Stress in simple words, levels of stress
Complex word stress: complex words, suffixes, prefixes, compound words.
Phonemics: Phoneme, Phone and allophone, contrast and complementary distribution.

Recommended Books:

1. Roach, Peter, 2000. English Phonetics and Phonology, Cambridge University Press, Cambridge.
2. Balasubramanian, T.1981, A Textbook of English Phonetics for Indian students, MacMillan India Ltd.
3. Mohan Krishna & Singh, N.P. 1995. Speaking English Effectively.
4. Trask, R.L.2004.Key Concepts in Language and Linguistics, Foundation Books, New Delhi.

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Philosophy & Culture

Details of Courses Offered by School of Philosophy & Culture for B. Tech & Integrated M.Sc. (Economics) Programme

Category	Course Code	Course Title	L-T-P	Credits
Core	PCL 2042	Introduction to Logic	3-0-0	3
	PCL 1016	Indian Philosophy	3-0-0	3
	PCL 2047	Advance Logic	3-0-0	3
Elective	PCE 3011	Introduction to Philosophy	3-0-0	3
	PCE 3012	Introduction to Indian Philosophy	3-0-0	3
	PCE 3021	Metaphysics of Human Existence	3-0-0	3
	PCE 3041	Critical Thinking	3-0-0	3
	PCE 3046	Argumentative Methods in Indian Philosophy	3-0-0	3
	PCE 3048	Fallacies in Common Reasoning	3-0-0	3
	PCE 3061	Morality in Indian Tradition	3-0-0	3
	PCE 3071	Introduction to Political Philosophy	3-0-0	3
	PCE 3072	Introduction to Gandhian Thinking	3-0-0	3
	PCE 3073	Introduction to Human Rights & Values	3-0-0	3
	PCE 3131	Meaning of Life	3-0-0	3
	PCE 3132	Professional Ethics	3-0-0	3
	PCE 3141	Foundations to Cognitive Sciences	3-0-0	3
	PCE 3142	Introduction to Philosophy of Science	3-0-0	3
	PCE 3143	Science, Technology & Society	3-0-0	3

Details of Courses:

Introduction to logic

PCL 2042 **3-0-0=3**

The course aims to introduce students to the basic tenets of sentential and predicate logic. It shows how to formalize information and symbolize them as logical statements. It also shows how to reason systematically with this information to produce conclusions which are logically acceptable.

Course Content:

Propositional Logic - Truth and Validity, Inductive and Deductive Arguments, Simple and Compound Statements, Truth Functionality, Decision Procedures, Truth Tables, Inter-definability, Proof Construction

Syllogistic Logic - Categorical Propositions, Squares of Opposition, Categorical Syllogisms, Examining Syllogisms

Informal Fallacies and Mill's Method - Classification of Fallacies , Fallacies of Relevance and Defective , Induction, Fallacies of Presumption and Ambiguity, Mills Method

Predicate Logic - Singular Propositions and General Propositions, Quantification, Symbolization, Proving validity and invalidity

Recommended Bookss:

Introduction to Logic by Irving M.Copi
Symbolic Logic by Irving M. Copi

Advance logic

PCL 2047 **3-0-0=3**

Module I: Predicate Logic

1. Symbolization and the rules of Inference
2. Multiply General Propositions
3. Quantification rules
4. Conditional and Indirect Proof
5. Proving Invalidity

Module II: Induction

1. Probability
2. Statistical Reasoning
3. Hypothetical/ Scientific Reasoning
4. Science and Superstition

Module III: Logic Puzzles and Fallacies

1. Zeno's Paradox
2. Sorites' Paradox
3. Liar's Paradox
4. Circular Reasoning
5. Gambler's Fallacy
6. The post hoc ergo propter hoc Fallacy

Recommended Bookss:

Copi I. M. (2006). *Symbolic Logic*. (V Edition) New Delhi: Prentice Hall.
Hurley P. J. (2006) A Concise Introduction to Logic. (IX Edition): Thomson Wadsworth: Belmont
Clark, M. (2002). *Paradoxes from A to Z*. London: Routledge.

Indian Philosophy

PCL 1016 **3-0-0=3**

Philosophy is generally understood as merely conceptual analysis aiming at the clarity of ideas. Indian philosophy however finds an intimacy between philosophical thinking and the way of living. This course is designed to acquaint the students with the pragmatic attitude of Indian philosophical thinking. There seems to be no system of Indian philosophy which does not relate to the behavioural aspect of our life. As a result, no theoretical analysis which is merely mental exercise is found in the tradition. An awareness of the various paths discovered by the seers of ancient India is expected to evoke inquisitiveness in the minds of students in relation to its application in practical life. The course content is as follows:

Unit-I

1. Philosophy and Darsana
2. The Notion Orthodox (astika) and Heterodox (nastika)
3. The Carvaka Materialism
4. Buddhism and Jainism

Unit-II

1. Nyaya Realism
2. Vaisesika Metaphysics
3. Samkhya Metaphysics
4. Yoga Philosophy

Unit-III

1. Mimamsa Philosophy
2. Advaita Vedanta Philosophy
3. Visistadvaita Philosophy
4. Dvaitadvaita Philosophy

Recommended Bookss:

Raju, P.T. (1985), Structural Depths of Indian Thought, New Delhi: South Asian Publishers.
Puligandla, R. (2005), Fundamentals of Indian Philosophy, New Delhi: D.K. Printworld (P) Ltd.
Radhakrishnan, S. (1989), Indian Philosophy, Vol. 1&2, New Delhi: Oxford University Press.

Metaphysics of Human Existence

PCE 3021 **3-0-0=3**

The human existence is unique, because only humans are capable of asking questions regarding the existence in general and most importantly, the nature of their own existence. The topics included in the course touch upon various issues related to human existence. The discussion on these issues is meant to encourage students to engender reflective thinking. The course content is as follows:

1. Personal Identity
2. Mind and Body
3. Fatalism
4. God
5. Free will and Determinism
6. Why not nothing?
7. Knowledge and Skepticism
8. Right and Wrong

Recommended Bookss:

Conee, E. and Sider, T. (2007) Riddles of Existence: A Guided Tour to Metaphysics Oxford: Clarendon Press (paperback). (Chapters: 1, 2, 4, 5, and 6)
Nozick, R. (1981) Philosophical Explanations Cambridge, Mass: The Belknap Press of Harvard University Press. (Chapters: 1, 2, and 3)
Priest, S. (1991) Theories of the Mind Boston New York: Houghton Mifflin Company. (Chapter 1)
Dancy, J. (1985) Introduction to Contemporary Epistemology New York: Basil Blackwell. (Chapters 1 and 2)
Class discussion (10% weightage), two minors (40% weightage) and major (50% weightage)

Introduction to Philosophy

PCE 3011 **3-0-0=3**

Philosophy is a reflective inquiry into the problems which are fundamental to the human existence. The problems of philosophy range from 'what is the nature of ultimate reality?' to 'what is the nature and limits of our knowledge?' From 'what kind of things exist' to 'how we ought to live?' The course aims at acquainting the students to these problems through a guided tour in the three major areas of philosophy, viz., epistemology, metaphysics, and axiology. The course is to focus on introducing the ideas of philosophers in the context of the problems mentioned above.

Course Content:

Philosophy - Definition and scope of philosophy; philosophy and science
Metaphysics - Materialism; Idealism; Monism and Dualism
Epistemology - Nature of Knowledge; Sources of Knowledge; The problem of perception; Skepticism
Axiology - Normative ethics and Meta-ethics; free will and moral responsibility, understanding aesthetic experience and beauty

Recommended Bookss:

Alasdair McIntyre, A Short History of Ethics: A History of Moral Philosophy from Homeric Age to Twentieth Century, Routledge, 1998.

Robert Audi, Epistemology: a contemporary introduction to the theory of knowledge, Routledge, 1998
Richard Taylor, Metaphysics, Prentice Hall; 4 edition, 1991
George Dickie, Introduction to Aesthetics: An Analytic Approach, Oxford University Press, USA, 1997
James Rachels and Stuart Rachels (eds), Elements of Moral Philosophy, 7th Edition, McGraw-Hill 2012.
Roger Scruton, The Aesthetic Understanding, St. Augustine's Press, 1997

Introduction to Political Philosophy

PCE 3071 **3-0-0=3**

The course intends to introduce political philosophy, focusing on the basic concepts like, state, sovereignty, justice, equality, liberty, secularism, etc., along with outlining political theories such as democracy, socialism, communism, and fascism. The way in which different political philosophies have given expression to various forms of political institutions and our ways of life are examined throughout this course. A brief discussion on the Constitution of India is also included.

Recommended Bookss:

Sabine, George. *A History of Political Theory*. 4th ed., Hinsdale, IL: The Dryden Press, 1973.
Wolff, Jonathan. An Introduction to Political Philosophy. Oxford University Press, 1996.
Basu, Durga Das. Introduction to the Constitution of India, Prentice Hall India, 1982.
Selected readings to be posted online and distributed in class.

Professional Ethics

PCE 3132 **3-0-0=3**

The emergence of various professions as a result of scientific inventions and ever-increasing industrialization necessitates comparing of apparently incommensurable and qualitatively different values. The fact of multiple memberships in different social groups makes such a comparison obligatory. And it is, therefore, necessary to be aware of the ethical issues involved in the activities related to one's occupation and workplace. The main objective of this course is to sensitize the mind of students to new modes of thinking about how to respond to ethical issues with integrity and creative imagination in a given professional context. It also aims at enabling the students to recognize and deal ethically with conflicts of interest likely to arise while discharging their professional responsibilities. Moreover, the course aspires to inculcate a critical attitude in the students so that they can appreciate how ethical ideas relate to their professional practices and reflect on professional decisions in an ethical perspective. The course will focus on the following professions: business, engineering, medical, and legal. However, the issues intended to be covered can adequately address the ethical requirements of most of the professions.

Course Content:

Introduction - Understanding the core professional values which underpin the practices in (1) Business, (2) Engineering, (3) Medical, and (4) Legal professions
Underlying Ethical Theories - (a) Teleological, (b) Deontological, and (c) Virtue Ethical
Selected Case Studies - From Business, Engineering, Medical, and Legal professions
Criteria for holistic professional Codes - (1) Natural Acceptability, and (2) Experiential Validation
Ethical Skepticism

Recommended Bookss:

Robinson, Simon (et al), (2007), Engineering, Business and Professional Ethics, Oxford: Elsveir.
Naagarazan, R.S. (2006), A Text Book on Professional Ethics and Human Values, New Delhi: New Age International (P) Publishers.
Oakley, Justin and Cocking, Dean (2001), Virtue Ethics and Professional Roles, Cambridge: Cambridge University Press.
Case Studies based on particularly the decisions of Indian Judiciary.

Meaning of Life

PCE 3131 **3-0-0=3**

The prime aim of the course is to impart to students sensitivity towards some persisting problems pertaining to our day to day living and those arising at different interfaces of life. The discourse is not designed to be technically philosophical, but to introduce to the students some wider horizons of problems which we normally consider to be trivial or petty. Through the course it is aspired to make students aware of the certain 'human problems' which are universal in nature and proposed ways of overcoming them and how it relates to some fundamental ethical debates.

What are we seeking? How we look at the world, the other and ourselves? Relationship and isolation.
What is self and self-knowledge? Scientific-inductive ways of knowing and possibility of the other modes of knowing.
Human inquiry about Purpose: The juxtaposition of 'Logos' and 'Telosend'.
Human activity and the quest of Ideal Action. Action and Responsibility.
Anxiety, odium, pain, unease, fear, misery, loneliness. Concern, awareness, detachment, empathy, compassion, solitude, bliss.
What is 'instinctual' and what is 'human' in us? A scrutiny of libido-centric criticism of life and liberation-centric morality. Demystifying 'suffering' and 'liberation'. What is Death? Authentic awareness of death and its moral implications.

Recommended Bookss:

First and Last Freedom: J. Krishnamurty [cp. II, III, IV, IX, XXI; 6, 7, 8, 11, 23, 36]
Perennial Questions: " [selections]
Sri Lanka Talks: " [section 3]
Commentaries on Life: " [selections from vol.1]
Stages on Life's Way: Soren Kierkegaard
Life Divine: Sri Aurobindo [cp. 1, the Quest]
Dhammapada: Lord Buddha [selections]

Note: the study material as stated above or relevant to the course will be provided by the instructor.

Foundations of Cognitive Science

PCE 3141 **3-0-0=3**

The nature of the mind has been a topic of intense investigation for centuries. It is centered on the question how the human mind acquires and processes information about the physical world and makes use the information thus acquired for the production of behavior. The recent years have witnessed a number of attempts to study the nature and functions of the mind and these attempts began to crystallize in the second half of the twentieth century with the formation of an inter disciplinary field of inquiry called 'cognitive science'. It resulted from attempts within disciplines, such as psychology, linguistics, computer science neuro-science and philosophy to investigate the realm of the mental in a systematic manner. This course introduces various foundational issues in cognitive science and gives an overview of the role that various disciplines play in this cutting edge area of research.

Course Contents: Cognitive revolution, computational-representational understanding of mind, Chinese Room argument, Plato's problem, neurophilosophy.

Recommended Bookss:

What is Cognitive Science? - Barbara Von Eccardt, MIT Press, 1995.
Introductory articles in MIT Encyclopedia of Cognitive Science, MIT Press, 1999.
Consciousness Explained – Daniel C Dennett, Penguin Books, 1991.
Phantoms in the Brain - VS Ramachandran, Fourth Estate, 1999.
Neurophilosophy- Patricia Churchland, MIT Press, 1986.

Introduction to Human Rights & Values

PCE 3073 **3-0-0=3**

Human rights play a distinctive role as a "moral touchstone" in international life today. Human rights violations are often perceived as threats to peace, and aspirations of people to be treated with dignity are commonly framed in the capacious language of human rights. Indeed, respect for human rights is now seen as a prerequisite for harmonious relations between peoples and states, good governance, and the well-being of individuals and communities. Yet human rights violations remain widespread. And the sheer scale of the human rights problem makes the challenge to build effective human rights protections especially daunting. Today, no single powerful government stands out as the champion of human rights. This course introduces students with the central debates of Human Rights both in India and abroad.

Recommended Bookss:

O'Byrne, D.J.: Human Rights. An Introduction Pearson New Delhi (2007)
Reading Materials will also be provided by the Course Instructor.

Introduction to Indian Philosophy

PCE 3012 **3-0-0=3**

Philosophy (western) is often taken to be a mere conceptual analysis which can very well go without having anything to do with the way of life. Indian philosophy is unique in that it sees an intimate relationship between philosophical thinking and the way of living. This course is designed to acquaint students with the pragmatic attitude of Indian philosophical thinking. An awareness of the various paths discovered by the seers of ancient Indian is expected to evoke inquisitiveness in the minds of students to search for their meaning of life.

Course Content:

1. Philosophy and Darsana
2. Orthodox (astika) and Heterodox (nastika) philosophical traditions: Carvaka, Jainism, Buddhism. Nyaya, Vaisesika, Samkhya, Yoga, Mimamsa and Vedanta
3. Metaphysics - Carvaka, Jainism Buddhism, Nyaya, Vaisesika, Samkhya, Yoga, Mimamsa and Vedanta
4. Epistemology - Carvaka, Jainism, Buddhism, Nyaya, Vaisesika, Samkhya, Yoga, Mimamsa and Vedanta
5. Ethical Perspectives

Recommended Bookss:

Raju, P.T. (1985), Structural Depths of Indian Thought, New Delhi: South Asian Publishers.
Puligandla, R. (2005), Fundamentals of Indian Philosophy, New Delhi: D.K. Printworld (P) Ltd.
Radhakrishnan, S. (1989), Indian Philosophy, Vol. 1&2, New Delhi: Oxford University Press.

Science, Technology & Society

PCE 3143 **3-0-0=3**

The achievements and methods of science and technology in the modern society are so dominating that nothing less than the scientific is convincing to a modern mind. On the question as to what is scientific, however, there is no common agreement. Any discourse on such issues involved consideration of the various interactions of science and technology in a social context. Science and technology affect and are affected by the institutions and values of a society. The students engaged in scientific and technological studies are, on the one hand, required to be familiar with the technical details of their disciplines; on the other hand, they also need encouragement to examine the great edifice of scientific knowledge form various perspectives of history, sociology and philosophy. The course aspires to widen intellectual horizons of the students by exposing them to basic philosophical issues involved in the interactions of science and technology with the society, particularly Indian society. The course contents are as follows:

A Scientific View of the World: Concepts and Methods, Difference between Scientific Laws and Scientific Theories. Significant developments in the history of science and the influence of Science on society. Societal influences: The Influence of Religion, Caste, Gender and Politics, Communicating Scientific Ideas to the Public. Life Science Issues: Agricultural Biotechnology, Reproductive Issues, Genome Sequencing Projects, Human Health Issues

Issues in Technology: Atomic Power, Communication Tools, Energy, Pollution, and the Environment. Effect of Modern Technology on the traditional structure of Indian Society

Recommended Bookss:

Richards, Stewart (1987), Philosophy and Sociology of Science: An Introduction, Oxford: Basil Blackwell.

Husserl, Edmund (1970), The Crisis of European Science, trans. David C.Evanston, IL: Northwestern University Press.
Newton-Smith, W.H. (ed., 2001), A companion to the Philosophy of Science, Oxford: Blackwell.
Bose, D.M. (chief ed., 1989), A Concise History of Science in India, Delhi:INSA.

Morality in Indian Tradition

PCE 3061 **3-0-0=3**

The course aims at sensitizing the students about the moral thinking and perpetual cardinal values emanating from Indian culture. The course is not designed to be technically philosophical, but to introduce to the students some wider horizons of moral issues which we normally encounter in our day-to-day decision making. Further, it is to be examined how one can respond to some contemporary moral conflicts from the point of view of traditional Indian moral thinking. The course contents are as follows:
The Context of Origin of Indian Moral Thinking and its Presuppositions
Man as Moral Agent, Freedom of will and Responsibility
Law of Karma and it's Moral Implications; does it entail self-centricity?
Cardinal Values Emanating from Indian Culture: The Purusartha
Concept of Dharma: Mimamsa, Vaisesika and Buddhists' view
Jainism towards Environmental Ethics
Debates over Punishment and Expiation: The tension between the Dharmasastras and State Laws
Bhagavadgita's ideal of Niskama Karma
Modern Revival of Indian Moral Thinking: Neo-Vedanta, Meditative Traditions and Ethical Skepticism
Examining whether there is any Distortion in Traditional Way of Thinking or any Genuine Extension of it.
Some Contemporary Moral Issues Pertaining to Applied Ethics and Indian Response to them.

Recommended Bookss:

Bilmoria, Purushottam: Indian Ethics: Classical Traditions and Contemporary Challenges, Ashgate Publishing Limited, England, USA, 2007
Prasad, Rajendra: Varnadharma, Niskama Karma and Practical Morality, DK Printworld (P) Ltd., New Delhi, 1999
Prasad, Rajendra: Karma, Causation and Retributive Morality, ICPR, New Delhi, 1989
Balasubramanian, R.; Misra, Ramashanker: Man, Meaning and Morality, ICPR, New Delhi, 1995
Ranganathana, Shyam: Ethics and History of Indian Philosophy, Motilal Banarasidas Publishers Pvt. Ltd., Delhi, 2007
Saran, A.K.: Traditional Thought, towards an Axiomatic Approach, Central Institute of Higher Tibetan Studies, Sarnath, Varanasi, 1996

Introduction to Philosophy of Science

PCE 3142 **3-0-0=3**

This course will explore what science is, what it does, and how it works. We will examine: the features of its methodology which distinguish science from pseudo-science; how theoretical considerations and experiments interact to shape the scientific picture of the world; how scientific theories evolve and how theories from different scientific disciplines are related; and whether science does or should purport to give us a literally true picture of the world. We will consider not only what is peculiar to the culture of science, but also how this scientific culture fits into the culture of the larger society.

Recommended Bookss:

Newton-Smith, W.H.: A Companion to the Philosophy of Science. Blackwell (2001)
Carnap, R.: An Introduction to the Philosophy of Science. Dover (1966)
Reading Materials will also be provided by the Course Instructor.

Critical Thinking

PCE 3041 **3-0-0=3**

Critical thinking means reasonable, reflective thinking focused on deciding what to believe or do. It helps one to learn how to learn or how to think. This has to be a prerequisite before learning what to think. Most of our pedagogical practice is focussed around teaching what to think and this leaves hardly any room for learning how to learn. The course is designed to improve the skills associated with critical thinking such as using evidence skillfully and impartially, giving sufficient attention to probability in the formation of beliefs, overcoming biases due to factors such as observer selection effect, realising that the gut feeling of certainty is not a reliable indication regarding the veracity of belief in question etc. Developing these skills results in improving emotional intelligence and makes the student more inquisitive, objective, open minded, intellectually honest and capable of maintaining an overall balance.
Course Contents: kinds of thinking, common fallacies, definitions and fuzziness, cognitive illusions, decision making.

Recommended Bookss:

1- Thought and Knowledge: An Introduction to Critical Thinking by Diane F Halpern, Lawrence Erlbaum Associates Publishers, 2003.
2- Critical Thinking: An Exploration of Theory and Practise by Jennifer Moon, Routledge, 2008.

Introduction to Gandhian Thinking

PCE 3072 **3-0-0=3**

The philosophy of Mahatma Gandhi contains a comprehensive approach to life. It grew out of a real struggle to achieve liberation from all forms of bondage. Founded on the twin ideas of truth and non violence, Gandhi's philosophy ranges from personal life to the governance of the nation and a just world order. By refusing to accept any dichotomy between religion and politics, he makes morality central to all socio political discourse.

This has the potential to regenerate a decadent society. The study of Gandhian thinking is more relevant in our times when the most pressing global need is to save the planet from man-made destruction.
Course Contents: Brahmacharya, Truth and Non Violence, Nai Taleem, Satyagraha, Antyodaya, Sarvodaya, Grama Swaraj, Rama Rajya.

Recommended Bookss:

Hind Swaraj by M K Gandhi, Navjivan Trust, 1938.
My Experiments With Truth by M K Gandhi, Navjivan Trust 1927.
Gandhi's Political Philosophy by Bhikku Parekh
Gandhi and the Present Global Crisis by Ramashray Roy

Argumentative Methods in Indian Philosophy

PCE 3046 **3-0-0=3**

Philosophical traditions in India represent one of the earliest reflections of human mind. These traditions have survived till date due to their logical strength. Their strength has been growing despite the various ups and downs. One may however notice certain logical moves which are idiosyncratic to Indian philosophy. The peculiarity lies in the finest tuning of epistemological elements with that of logical forms in reasoning. This course intends to familiarize the learners with the logical techniques developed by Indian thinkers. The contents are as follows:

Unit-I

1. The Nature of Logic
2. The Logic Schools of Indian Philosophy
3. The Methods of Analogical Reasoning

Unit-II

1. The Nature of Inference
2. The Nyaya Concept of Inference
3. The Navya-Nyaya Method of Analysis

Unit-III

1. The Buddhist Understanding of Inference
2. The Jaina Process of Inference
3. The Fallacies of Reasoning

Recommended Bookss:

Barlingay, S.S. (1965). *A Modern Introduction to Indian Logic*. Delhi: National Publishing House.
Guha, D.C. (1979). *Navya-Nyaya System of Logic*. Delhi: Motilal Banarsidass.
Maitra, S.K. (1974). *Fundamental Questions of Indian Metaphysics and Logic*. Calcutta: University of Calcutta.
Matilal, B.K. (2008). *Logic Language and Reality*. Delhi: Motilal Banarsidass.
Pandeya, R. (1984): *Major Hetvabhasas.* Delhi: Eastern Book Linkers.
Vidyabhusan, S.C. (2006). *A History of Indian Logic*. Delhi: Motilal Banarsidass.

Fallacies in Common Reasoning

PCE 3048 **3-0-0=3**

Course Description: Reasoning is what distinguishes human beings from others. This reasoning can be correct or incorrect. Incorrect reasoning is understood as a fallacy. This course aims to provide an introduction to some of the common mistakes in reasoning (fallacies), we do in everyday life.

Unit I: Basic Notions

1. Logic and Reasoning
2. Sentences, Propositions and Arguments
3. Correct and Incorrect reasoning
4. Necessary and Sufficient conditions
5. Fallacies and their classification
6. Some Statistical Fallacies

Unit II: Emotional Coloration, Misusing Authority and Prejudice

1. Emotive Language
2. Ceremony or Setting
3. *Ipse Dixit*
4. Tradition or faith
5. Impressing by large numbers
6. Damning the origin

Unit III: Rationalization, Biased Misconstructions and Diversions

1. Self Righteousness and finding the 'good' reason
2. Wishful thinking
3. Invincible Ignorance and Personification
4. Cultural Bias
5. Humor and ridicule
6. Pointing to another wrong

Recommended Bookss:

1. Fearnside, W.W and Holther, W.B (1959). *Fallacy: The Counterfeit of Argument*. New Jersey: Prentice Hall.
2. Copi, I.M and Cohen C. (2008). *Introduction to Logic*. New Delhi: Pearson.

Shri Mata Vaishno Devi University

Campus: Sub Post Office, SMVD University, Katra 182 320
Phone: 01991-285699, 285634 Fax: 01991-285694

Public Relations Office:
15-C, IInd Extension, Gandhi Nagar,
Opp. Bahu Plaza, Jammu-180012
Telefax: 0191-2470067

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