WELCOME
TO
MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY
BHOPAL

PROSPECTUS AND ORDINANCE
POSTGRADUATION PROGRAMMES
(M.Tech, MCA, MBA & M.Plan)
AND
RESEARCH
(Ph.D)
(2013-2014)

MANIT, Bhopal 462 003
Telephone :+91 755-4051000, 4052000, +91 755 5206006, 07, 08, 09, 10
FAX:0755- 2670562. E.mail: info@manit.ac.in

MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY, BHOPAL, (M.P.) - 462 007.

GENERAL

1. INTRODUCTION

The Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, one of the first eight Regional Engineering Colleges started in the country, was inaugurated on 4th September 1960. The institute has been named after Maulana Abul Kalam Azad, a renowned educationist, scholar and academician of India.

The Government of India and Govt. of Madhya Pradesh had jointly sponsored this institute for the purpose of attracting bright students from all over the country and imparting quality training to them in various branches of Engineering and Technology. From August 1966 the institute has been conducting industrially Oriented M.Tech. Courses-under U.N. special Fund Assistance Programme the institute has got the status of academic autonomy from the academic session 1997-98.

The Government of India, Ministry of Human Resources Development, New Delhi has upgraded the institute as Maulana Azad National Institute of Technology (MANIT) along with a status of Deemed University with effect from 26th June 2002. Now, the Institute becomes the Intstute of national Importance by the parliament act in the year 2007.

Setting and Environment

Bhopal, the capital of Madhya Pradesh, is centrally situated and is connected by rail, road and air with many big cities of the country. It is at an altitude of 550 m. The climate is also moderate with the temperature ranging from 10°c to 45^{0}c.

Campus

The Government of Madhya Pradesh has made available for the institute a site of 265 hectares (650 acres) on a plateau commanding a magnificent view of the new township of Tatya Tope Nagar, adjacent hill and the Secretariat building on one side and the Habibganj Railway Station and Bharat Heavy Electrical Ltd. Township on the other side.

The foundation of the institute building was laid by the late Prime Minister Pandit Jawaharlal Nehru on 23rd April, 1961. The campus has been provided with Central Institutional buildings, Workshop, Energy Centre, Central Computer Centre, library, Hostel buildings for about 3000 students, girls hostel, staff quarters, hospital, shopping centre, guest house, students' activity centre etc.

As recommended in the Master plan for the institute, the entire campus with its administrative and instructional buildings, residential and recreational accommodation for

students, staff and other general amenities like Post-Office, Bank, Shopping centre, School for children Hospital, Auditorium and Play grounds in a fairly large and self contained campus.

1.2 Management of Organization

The institute which has a status of "Institute of national importance" is governed by a Board of Governors consisting of 10 members including nominees, Ministry of Human Resource Department of Technical Education and Faculty of the institute and a secretary, the name of the members of the Board of Governors are given Below.

BOARD OF GOVERNORS

1)	Chairman (An Eminent Technologist/ Engineer/Industrialist/ Educationist to be nominated By the Central Government	1.	Prof.G.K.Mehta Honorary Professor, IIT, Kanpur, Former VC, University of Allahabad.

MEMBERS

2)	Ex-Officio Member	2.	Dr. Appu Kuttan KK Director Maulana Azad National Institute of Technology Bhopal
3)	Nominee of the Ministry of Human Resource Development, Government of India	3	Shri. Ashok Thakur Secretary (Higher education) Government of India Ministry of Human Resource Devlopment. Dept. of Secondary &. Higher Education Shastri Bhavan, New Delhi-110001
4)	Financial Adviser, Department of Higher Education Human Resource Development, Government of India	4.	Shri. Navin Soi Director (Finance) Department of Higher Education Human Resource Development, Government of India
5)	Nominee of Department of Higher/ Technical Education, Govt. of Madhya Pradesh India	5.	Dr.Navin Chandra Advanced material &Research Institute (AMPRI), Bhopal

6)	Head of another Technical institution in the Region 'or an eminent technologist nominated by the Central Government	6.	Shri P.T.Deo, Director Indian Power Management Academy Bhopal
7)	Director of Indian Institute of Technology [in the region] or His nominee.	7	Dr.Ritu Barhwal Professor and Head Department of Bio technology IIT, Roorkee
8)	An alumnus of the Institute from amongst alumni in Education/ Industry to be Nominated by the B.O.G.	8	Dr.Puneet tandon Professor) Mechanical Engineering and Design IIITDM, Jabalput
9)	One Professor Professor of the institute by Rotation	9.	Dr.Geetha Agnihotri Professor Department of Mechanical Engg. Engineering MANIT, Bhopal
10)	One Assistant Professor Professor of the institute by Rotation	10.	Dr Usha Chouhan Assistant Professor Department of Mathematics MANIT, Bhopal
11)	Secretary	11	Registrar M.A.N.I.T., BHOPAL-462007

1.3 Finance of Institute

The establishment, development and maintenance of the institute are carried out with funds provided by the Government of India.

The government of India also provides for the non-recurring expenditure on buildings and equipment and all the funds for P.G. courses. The names of the finance committee are given below.

FINANCE COMMITTEE
MEMBERS

1)	Chairman (An Eminent Technologist/ Engineer/Industrialist/ Educationist to be nominated By the Central	1.	Prof.G.K.Mehta Honorary Professor, IIT, Kanpur, Former VC, University of Allahabad.

2)	Ex-Officio Member	2.	Dr. Appu Kuttan KK Director Maulana Azad National Institute of Technology Bhopal
3)	Financial Adviser, Department of Higher Education Human Resource Development, Government of India	3.	Shri. Navin Soi Director (Finance) Department of Higher Education Human Resource Development, Government of India
4)	Director NIT's, Department of Higher Education Human Resource Development, Government of India	4.	Shri. Rajesh Singh Director NIT's Department of Higher Education Human Resource Development, Government of India
5)	Head of another Technical institution in the Region 'or an eminent technologist nominated by the Central Government	5.	Shri P.T.Deo, Director Indian Power Management Academy Bhopal
6)	One Professor Professor of the institute by Rotation	6.	Dr.Geetha Agnihotri Professor Department of Mechanical Engg. MANIT, Bhopal
7)	Secretary	7	Registrar M.A.N.I.T., BHOPAL-462007

2.0 DEPARTMENT OF TEACHING AND RESEARCH

There are five divisions and sixteen departments and centers are under the divisions in the institute as mentioned below:
Machine Technology Division
   1. Department of Civil Engineering-
   2. Department of Electrical Engineering
   3. Department of Mechanical Engineering
   4. Department of Material Science and Metallurgy

Soft Technology Division
1. Department of Computer-Science and Engineering
2. Department of Electronics and Communication Engineering
3. Department of Chemical Engineering
4. Department biological science and engineeing

Architecture and Planning Division
1. Department of Architecture
2. Department of planning

Science Division
1. Department of Chemistry
2. Department of Physics
3. Department of Mathematics- Master Computer Application, Bioinformatics, and Applied mathematics

Humanities and management Division
1. Department of Humanities and social science
2. Department of Management studies

Centers
1. Energy Centre
2. Remote sensing and GIS and GPS center.
3. Nano Science and engineering center

All the engineering and science departments have well equipped Modern Laboratories for under graduate practical work and post graduate research. A fully equipped and well staffed workshop caters to the under graduate training and post graduate research needs of all the departments.

3.0 INSTITUTE LIBRARY

The institute library has a collection of more than 103764 Books and back volume Journals of Technical, scientific and general subjects and these are computerized on modern line. More than 67 current National & International Journals are subscribed. Good numbers of back volume journals in hard copies and online are available. The Library remains open from 8.00 a.m. to 8.00 p.m. on all working days.

The library has reprography section to provide the facility to its readers. A separate Book Bank has been set up for SC & ST and general category student consisting of 19,248 and 6217 books respectively, through which textbooks are provided on long term loan basis to the poor and needy students.

An Audio-Visual section having 384 Educational video cassettes (now converted into CD's) on Engineering subject & have 2 T.V. monitors and 2 VCR respectively. Arrangement for Resource sharing among various NITs, online journals through optical LAN and VSAT have been made. The library has been connected with Internet there is a collection of 522 CD's on engineering 7 science streams.

3.1 INDEST consortium

The ministry of Human Resource Development (MHRD) has set up a "Consortia-based Subscription to Electronic Resources for Technical Education System in India". The consortium is named as the "Indian National Digital library in Science and Technology (INDEST) Consortium MANIT, Bhopal is member of INDEST Consortia.

At MANIT, Bhopal, Institute able to access the following online resources:

S. No.	Electronic Resources	URL

Full – text – E - Resources

1.	ACM Digital Library	http://portal.acm.org/portal.cfm
2.	ASCE Journal	http://www.pubs.asce.org/journals/jrns.html
3.	ASME Journal	http://www.asme.org/pubs/journals/
4.	IEL Online	http://ieeexplore.ieee.org/
5.	Indian standards	Internet Version
6.	Nature	http://www.nature.com
7.	ProQuest Science	http://il.proquest.com/pqdauto
8.	Springer Verlag's Link	http://www.springerlink.com/
Bibliographic Database		
9.	J-Gate Customs Content for Consortia	http://jeee-indest.informindia.co.in

All the above mentioned journals can be accessible online from any computer connected to Internet through institute internet.

4.0 STAFF

The staff is well qualified and experienced and opportunities are provided to them from time to time to improved their qualification and professional experiences.

5.0 ADMISSION TO INSTITUTE

Admission is open to students of both sex without any distinction of caste, creed or color. However, those candidates against whom disciplinary action has been taken in the past or those with moral turpitude will not be granted admission to any class/course conducted in this institute. Similarly, the students who are expelled from this or any other institute/school will not be granted admission under any circumstance to any class/course conducted in this institute. Foreign student nominated by the Government of India, against the seats reserved for them are also admitted. In case they are admitted they will be required to pay in amount of Rs.2000/- as security deposit as per uniform policy for all REC's/NITs

The institute does not accept any foreign students directly for admission; however admission is given to foreign students through DASA as per the directive of Govt. of India.

REGULATIONS, COURSE STRUCTURE AND COURSE CONTENT

These Rules/Regulations may be called "MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY (BHOPAL) REGULATIONS for postgraduate and research programmes.

Definitions

- " Institute "/"NITB"/MANIT" means, Maulana Azad National Institute of Technology, Bhopal.
- "BOG"/"Board" means, the Board of Governors (BOG) of the Institute
- "MHRD" means, the Ministry of human resource development, GOI.
- "Chairman" means, the Chairman of the Board,
- "Director" means, the Director of the Institute,
- "Registrar" means, the Registrar of the Institute,
- "GATE " means, Graduate Aptitude Test.
- 'Senate" means, the senate of the Institute
- "BOS" means, the board of studies of the Institute
- "Finance Committee" means the Finance Committee of the Institute.
- "Building and Works Committee" means the Building and Works Committee of the Institute.
- "Authorities", "Officers" and "Professors" respectively mean , the authorities
- "Regulations" means, the Regulations of the Institute.
- "Dean (AA)" means, the Dean (Academic Affairs)
- "Dean (SW)" means, Dean (Students welfare)
- "HOD" means, the Head of the department.
- "Course coordinator" means, a faculty in charge of and academic programme
- "Course" means, a specific subject usually identified by its course number followed by course title with a specified course description, references, taught by subject coordinator to a specific class (Group of students) during a specific academic session/Semester.
- " DPGC" means, the Departmental Post Graduation programme committee
- " DRPC" means, the Departmental Research programme committee
- " SRPC" means, the Students Research programme committee
- "RDC" means, Research Degree committee to doctoral programme of the Institute
- " DTAC" means, the Departmental Thesis Assessment Committee
- "Regulations" means, the set of academic Regulations of the progrmme.

POSTGRAGUATE PROGRAMMES
REGULATIONS
1. INTRODUCTION

The goals of the postgraduate programmes at the Maulana Azad National Institute of Technology (MANIT) Bhopal are the development of technological and engineering manpower of the highest quality, to meet to the needs of educational institutions, R & D organizations and industries, , a deep understanding of the area of specialization, an innovative ability to solve new technological problems, and a capacity to learn continually and interact with multidisciplinary groups. With these goals, the postgraduate programmes are designed to include courses of study, seminars and project/thesis through which a student may develop his/her concepts and intellectual skills.

The procedures and requirements stated in this ordinance include the philosophy of the postgraduate education and ensure a high standard of performance at the Institute.

1.1 Postgraduate Programmes

(i) The Institute offers programmes leading to the Master of Technology (M.Tech.) degree under Machine Technology Division gives in Engineering materials, Stress and vibration, Structure engineering, environment engineering, Geotechnical engineering, Hydro power Engineering, Transportation Engineering, water resource, geo-informatics, Thermal engineering, Industrial design, Maintenance Engineering and Management, Power Systems, Electrical drives and material science and technology, Soft Technology division gives Digital Communication, VLSI and Embedded System, Information security, advanced computing, Computer Net working, Renewable energy, Green technology, Bio technology and Chemical process design, under Science Division gives Bio-informatics, Nano Technology, Computation and system bioinformatics

(ii) The Institute also offers the Programme leading to the Master of Business Administration (MBA) degree and Master of Computer Applications (MCA).

(iii) Under architecture and planning division gives M.Plan (Urban Development) and M.Plan (Housing);

The Senate Sub-Committee (SC), established according to the bylaws of the Senate, operates through the Departmental Postgraduate Programme Committees (DPPCs) to administer all aspects of the above programmes.

2. ADMISSION

2.1. Academic Session
The academic session of the Institute is divided into two regular semesters. The first semester will normally commence in July of every year and the second semester in January of every year.

2.2 Eligibility for admission

(i). The eligibility conditions given below are the absolute minimum. Departments may prescribe any requirements over and above these, subject to the approval of the Chairman Senate.

(ii). For admission in M.Tech/M.Plan, a candidate belonging to General Category and Other Backward Class (OBC) must processes a minimum of 55 percent marks /equivalent CGPA 5.5 and above on a 10 point scale in the final year of the qualifying examination in appropriate branch of engineering.

(iii). For the above a candidate belonging to Scheduled caste/Scheduled Tribes Category (SC/ST) must processes a minimum of 50 percent marks /equivalent CGPA 5.0 and above on a 10 point scale in the final year of the qualifying examination in appropriate branch of engineering.

(iv) The M.Tech/M.Plan admission will be based on all India entrance examination "GATE" (graduate Aptitude Test for Engineering) score and all the qualified candidates are eligible for scholarship.

(v). The eligibility criterion for MBA program is a graduate in any discipline with minimum 55% marks/ equivalent CGPA 5.5 on a 10 point scale. The same will be up to 50% marks/ equivalent CGPA 5.0 on a 10 point scale in case of SC/ST candidates.

(v) Reservations of seats for OBC/SC/ST/PH will be as per MHRD/GOI norms/rules.

(vi) The admission in MCA will be based on an all India entrance examination conducted by any one of the NITs every year. The admission criterion for MCA will be same as decided by NIMCET committee.

Eligibility criteria for M.Tech admission is given in the table below:

	Department of Civil Engineering	
	Course	Edibility criteria
1	M.Tech in Structural Engineering	BE/B.Tech in civil/Construction Technology and management /Structures
2	M.Tech in Environment Engineering	BE/B.Tech in civil/Chemical Engineering /Environment
3	M.Tech in Geotechnical Engineering	BE/B.Tech in civil Engineering
4	M.Tech in Hydro power engineering	BE/B.Tech in civil/Mechanical Engineering
5	M.Tech in Transportation Engineering	BE/B.Tech in civil/Transportation/Architecture
6	M.Tech in Water resource	BE/B.Tech in civil/ Engineering /Agriculture

	Department of Mechanical Engineering	
	Course	Edibility criteria
7	M.Tech in Thermal Engineerin	BE/B.Tech in mechanical/ Automobile
8	M.Tech in Industrial design	BE/B.Tech in mechanical/Industrial production
9	M.Tech in Maintenance Engineering	BE/B.Tech in mechanical/Industrial production
10	M.Tech in Engineering Materials	BE/B.Tech in civil/Mechanical/aeronautical/ Material science and metallurgy
11	M.Tech in Stress and Vibration Analysis	BE/B.Tech in civil/Mechanical/aeronautical/

	Department of Electrical Engineering	
	Course	Edibility criteria
12	M.Tech in Electrical drives	BE/B.Tech in Electrical/Electrical & electronics/ Electronic instrumentation/Instrumentation and control
13	M.Tech in Power system	BE/B.Tech in Electrical/Electrical & electronics

	Department of Material science and Metallurgy	
	Course	Edibility criteria
14	M.Tech in Material science and technology	BE/B.Tech in Mechanical/ Material science and metallurgy

	Department of Chemical engineering	
	Course	Edibility criteria
15	M.Tech in Chemical process design	BE/B.Tech in Chemical Engineering

	Department of Electronics and communication	
	Course	Edibility criteria
16	M.Tech in Digital communication	BE/B.Tech in Electronics /Electronics and communication/telecommunication
17	M.Tech in VLSI and embedded systems	BE/B.Tech in Electronics /Electronics and communication/telecommunication

	Department of Computer science and Engineering	
	Course	Edibility criteria
18	M.Tech in Information security	BE/B.Tech in Computer science and Engineering/ CS/Information technology
19	M.Tech in Advanced computing	BE/B.Tech in Computer science and Engineering/ CS/Information technology
20	M.Tech in Computer net working	BE/B.Tech in Computer science and Engineering/ CS/Information technology

	Department of Biological science and Engineering	
	Course	Edibility criteria
21	M.Tech in Bio technology	BE/B.Tech in Chemical Engineering/Bio technology

	Department of Mathematics	
	Course	Edibility criteria
22	M.Tech in Computation and system Bio informatics	BE/B.Tech in Computer science and Engineering/ BIO-technology/ Information technology/ Bio informatics and B.Sc in Maths/Biology/Agriculture
23	M.Tech in Bioinformatics	BE/B.Tech in Computer science and

		Engineering/ BIO-technology/ Information technology/ Bio informatics and B.Sc in Maths/Biology/Agriculture

	Energy Center	
	Course	Edibility criteria
24	M.Tech in Renewable energy	BE/B.Tech in Electrical/Mechanical/Civil/ Chemical Engineering, Energy
25	M.Tech in Green technology	BE/B.Tech in any discipline

	Nano science and engineering center	
	Course	Edibility criteria
26	M.Tech in Nano technology	BE/B.Tech in Mechanical/ Material science and metallurgy/Electronics and communication/Electrical and B.Sc (Physics)

	Remote sensing and GIS and GPS center	
	Course	Edibility criteria
27	M.Tech in Geoinformatics	BE/B.Tech in any discipline

	Department of Archetecture and planning	
	Course	Edibility criteria
28	M.Plan in Urban development	BE/B.Tech in Civil/B. Arctecture /B. Planning
29	M.Plan in Housing	BE/B.Tech in Civil/B. Arctecture /B. Planning

2.3 Admission Procedure

The Admission to the M.Tech./M.Plan programme will be made on the basis of GATE scores of the candidates. Through central counseling jointly conducted by all National Institutes of Technology (CCMT), admission is allowed to the candidates.

 The total number of seats and admission of OBC/SC/ST/PH candidates will be decided as per the MHRD/GOI rules and CCMT display the seat matrix in the website..

The selected candidates who have completed all the examinations including project/thesis examination and the viva voce before the date of registration but are unable to produce the certificate in proof of having passed and secured the minimum specified qualifying marks, may be considered for provisional admission. However, if admitted provisionally, they will be required to produce the evidence of their having passed the qualifying degree examination with minimum specified marks by the last date for document submission as specified in the academic calendar (usually about 2 weeks from the date of registration), failing which the admission is liable to be cancelled.
The MBA admission will be made by the Institute. The applicants must apply for admission on prescribed forms, which must be sent directly to the AR(Admission) before the last date specified in the advertisement for PG admission every year. The selection of the candidate is only for CAT/GMAT qualified students. The admission is bound on merit proposed on the basis

of CAT score (70% wirghtage) Group discussion (20% weitage) and personal Interview(10%) All admissions will be made on approval by the Chairman Senate, on the recommendations of the duly constituted admission committees.

On approval by the Chairman, Senate, the admission section will issue the admission letters to the candidates who will be required to accept the offer of admission by depositing the prescribed fee before the specified date.

In case a candidate does not accept the offer by paying the prescribed fee by the specified date, the offer of admission may stand withdrawn, and the admission will be offered to the candidates in the waiting list, if any, in order of merit.

The offer of admission may also stand with drawn if the candidate who has accepted the offer fails to register by the date for late registration.

2.4 Admission for Foreign Students

A foreign student (NRI and Foreign Nationals) seeking admission in any PG program of MANIT should have a qualifying degree from any institute/university recognized by the Association of Indian Universities or abroad.

(The application of such students shall be routed through MHRD/Agencies authorized by MHRD to the institute before the last date of the submission of applications as prescribed by the institute.

The number of seats for such candidates and the required fee shall be fixed by the institute in consultation with MHRD/ Government of India.

These students shall not be eligible for GATE scholarships.

2.5 Admission for Sponsored Students

(i) Any student seeking admission under this category shall be working on a regular post in any Government/semi government/public sector units/industries/ academic institutes/research organizations/Architectural firm for a minimum of two years at the time of admission. Admission of such candidates will be based on the institute test/interview and the required working experience. Scientist working in Government of Indiain Research organization such as ISRO, DRDO, CEPET, etc. can seek direct admission with the permission of senate.

(ii) The application form of such candidates should be duly forwarded by the parent organizations and should record that the candidate will be allowed to attend the classes in day time and will be allowed to stay in the campus/Bhopal during his/her PG program.

(iii) There will be NO concessions on fee to be deposited in MANIT, Bhopal. However the candidates employed in MANIT Bhopal may be given fee concession subject to approval of Chairman Senate The institute prefer to admit the GATE qualified students to join

M.Tech/M.Plan programme. If seats are available which will be filled by the sponsored candidate and it is fully depend on the academic body of the Institute (Senate)..

(iv) No financial liability will be on the part of the MANIT.

2.7 Admission Fee

The students admitted will have to pay the full fee for one semester/one year as applicable to the particular category of the candidate as per the institute norms. The institute reserves every right to modify the admission fee from time to time based on the approval of competent authority. Any student will be admitted only when he/she has deposited the full fee for one semester/one year as applicable to him.

2.8 Financial Assistant

(i) The Institute may provide to postgraduate students, financial assistance in the form of teaching or research assistantships. Assistantships are awarded on a semester to semester basis for a period of up to four semesters for M.Tech. students. The stipend for the assistantship is paid as per the rates by approved MHRD.

(ii) A student is expected to devote up to eight hours per week towards job(s) assigned to him/her by the concerned departments. The renewal of assistantship is contingent on the student's satisfactory performance in the academic programme and in the discharge of assistantship duties.

(iv) A student on teaching/research assistantship is also reimbursed annually for some contingency expenses as per the approved terms and procedures to be notified by the MHRD/GOI from time to time.

3. REGISTRATION

A student is required to register in the beginning of each semester for the courses that he/she intends to pursue in that semester. The registration process involves:

(i) The payment of fees for that semester and clearance of any outstanding dues. Without clearance of the dues a student cannot be allowed to register in the next semester.

(ii) A new entrant to any PG program, who is awaiting the results of the qualifying examination, will be allowed to register "provisionally" on submission of a certificate from his/her institution certifying that he/she has appeared in the final qualifying examination (including all papers in theory, practical, project, oral, etc.). The candidate will submit attested copies of the certificates of having passed the qualifying examination by the last date for document submission as specified in the academic calendar (usually about 2 weeks from the date of registration), failing which the admission may be cancelled.

(iii) All the students has to do course registration in the department in the prescribed form in each semester. The course registration form contains the details of the course , course instruction, etc.

3.1 Late Registration

(i) If for any compelling reason like illness, a student is unable to register on the day of registration, he/she will be allowed to register till the day of late registration specified in the academic calendar. Any student registering late will be required to pay the specified late registration fee. No late registration is permitted after this due date.

(ii) In exceptional cases, the chairman senate, on the recommendation of the HOD through Dean (Academic Affairs) may consider registration beyond the date of late registration. In such a case, the student will be allowed to register for thesis units only if he/she has completed all the course credit requirements.

4. STUDENT'S LEAVE RULES

Students may be granted leave under sections 4.1 and 4.2 on application to the Head of the Department concerned through the DPGC. Leave under sections 4.3 and 4.4 will be sanctioned by Dean (academic affairs) on the recommendation of HOD. Applications must be submitted well in advance of the date of commencement of the leave requested. Leave for a period longer than that specified in sections 4.1, 4.2 and 4.3 may be sanctioned by Chairman Senate on the recommendation of HOD through Dean (Academic Affairs) and it will entail loss of financial assistantship for the extended period.

4.1. Vacation and Casual Leave

(i) A postgraduate student may be allowed vacation leave during any period of the Institute's vacation or during the mid-semester break up to a maximum of 15 days per semester, subject to a maximum of 8 days at a time. Leave not availed in one semester may be carried over to the next semester up to a maximum of 15 days.

(ii) In addition, a student may be allowed casual leave for up to 5 days per semester to the condition that such leave will not be allowed for longer than 3 days at a time. The casual leave cannot be combined with any other kind of leave, and will not be carried over.

(iv) There will be no loss of financial assistantship for students going on vacation or casual leave.

4.2. Medical Leave

Leave on medical ground, duly supported by a medical certificate, may be granted to a student up to 8 days per semester. Unavailed leave may be carried over to the next semester up to a maximum of 8 days. However, at a stretch, the medical leave shall not exceed 15 days. Such leave shall not entail any loss of financial assistantship.

4.3. Maternity Leave

A female student may be granted maternity leave for a maximum of 3 months. Leave up to 6 weeks can also be granted for miscarriage including medical termination of pregnancy, if supported by a proper medical certificate. Such leave can be combined with any other leave due and will not entail any loss of financial assistantship.

4.4. Semester Leave

If a student falls ill while on the MANIT campus, the medical certificate must be obtained from the Institute's medical officer. If he/she falls ill outside the campus while on sanctioned leave, the medical certificate must be obtained from a registered medical practitioner.

4.5 Absence without Sanctioned Leave

Absence without sanctioned leave will entail loss of financial assistantship for the period of absence, and may result in the termination of the student's programme on the recommendation of the DPGC and approval of Chairman Senate.

5. PERMISSION TO PROCEED FOR ACADEMIC ACTIVITIES

The PG students can be permitted to proceed for academic activities outside MANIT to carry out field work, library work, computational work, experimental work, and Lab works, and also to attend conference, courses and to undertake other research work etc. as recommended by the department. Permission for a duration up to 16 days be sanctioned by the Dean (Academic Affairs) through the concerned head of the department/center with an intimation to chairman Senate and more than 16 days by the Chairman-Senate on the recommendation of the Departmental head through Dean (academic Affairs). Such leave will be beyond all leave in section 4.

6. ACADEMIC REQUIREMENTS
6.1 Number of Semester, Maximum Duration and Academic Requirements
The following table lists the maximum duration allowed in the programme, and credits requirements for post-graduation in the various programmes. A student must complete the entire academic requirements prescribed by the institute/department/center before proeeding for the thesis/project work.

Name of Programme	Number of Semester Required	Maximum Duration Allowed to complete the program
M.Tech.	4 Semester	4Years
MBA	4 Semester	4 Years
MCA	6 Semester	6 Years

No student who has completed the prescribed maximum duration in the programme shall be allowed to register in the subsequent semester unless he/she has been granted extension of the programme by the Chairman Senate on the recommendations of the HOD and Dean (Academic Affairs).

6.2 Requirement of Attendance

 (i) Students are expected to attend all the classes. Institute expect 100 % attendance in the class is desirable for a student to be eligible to appear for the end semester examination in every course in each semester. However students may be given a concession of 25 % on account of sickness or any other genuine reason. A student shall be eligible to appear in the examination in any course if and only if he/she has attended more than 75 % of the total number of classes scheduled in the course in that semester before each examination.

(ii) Attendance for the above purposes shall be compiled and reported by each subject teacher to the concerned HOD before the start of the examination.

(iii) The decision on the prevention shall be made by a committee duly constituted by the concerned HOD for the same.

6.3 Evaluation process for M.Tech./MCA/MBA

Theory paper

End term Examination (Duration 180 minutes) Maximum mark	Mid term Continuous Evaluation			Total Marks (Theory)
	Distribution		Total	
60	Minor I	20		
	Innovative work/ assignment	20	40	100

Practical

End Term Examination (Duration 120 minutes) Maximum mark	Continuous Evaluation (Practical)			Total Marks (Practical)
	Distribution		Total	
60	Laboratory/ workshop work	20		
	Mid term Submission & viva	20	40	100

Evaluation process for M.Plan

End term examination (180 minutes duration) Maximum mark (Theory)	Mid term Continuous Evaluation			Total Marks (Theory)
	Distribution		Total	
40	Mid term examination (90 minute duration)	20	60	100
	Studio, Viva & Assignment	40		

6.4 Credits, Grades, Semester and Cumulative Grade Performance Average

(i) In each course a student is registered, he/she earns certain approved credits and is awarded a letter grade indicating his/her overall performance in that course. There are seven letter grades: A^+, A, B^+, B, C, D and F. The minimum passing grade in a subject is D. Their equivalent numeric values are given in the following table.

(ii) F grade are treated as Fail grade. Any student getting these grades will have to appear in the examination again whenever it is scheduled by the institute. A student can not be allowed to have F grades in more than two subjects in one semester. Also he/she has to improve these grades in maximum two consecutive attempts.

Letter Grades	Grade Points	Description of Performance
A^+	9.0 to 10	Outstanding
A	8.0 to 8.99	Excellent
B^+	7.0 to 7.99	Very Good
B	6.0 to 6.99	Good
C	5.0 to 5.99	Average
D	4.0 to 4.99	Satisfactory
F	< 4.0	Fail

(iii) If a student does not complete all the requirements including the mid-terms and end term for a course for a genuine reason, the course instructor may award grade I (Incomplete). An I grade must be converted by the instructor to a regular letter grade by conducting the re-examination for such candidate by the last date for the submission of the grades specified in the Academic Calendar, failing which it is automatically converted to an F grade.

(iv) A student getting D grade in a course may be allowed to repeat it, provided his/her CGPA is less than the prescribed minimum and the student are allowed to continue in the programme.

(v) Mandatory learning courses will be graded as satisfactory (S) or unsatisfactory (U) and will carry zero credits.

6.5 Computation of the Semester Grade Performance Average (SGPA) and Cumulative Grade Performance Average (CGPA)

The SGPA is an indicator of the overall academic performance of a student in all the courses he/she has registered during a given semester. If the grades awarded to a student are G_1, $G_2 \ldots G_n$ etc in courses with corresponding credits C_1, $C_2 \ldots C_n$ etc, the SGPA is given by-

$$SGPA = \frac{C_1 G_1 + C_2 G_2 + \ldots + C_n G_n}{C_1 + C_2 + \ldots + C_n}$$

Similarly, the CGPA indicates the cumulative academic performance in all the courses/subjects taken during the entire stay in the institute. If the SGPA awarded to a student in each semester are S_1, S_2, . . ., S_n, the CGPA is given by:

$$CGPA = \frac{S_1 G_1 + S_2 G_2 + \ldots + S_n G_n}{C_1 + C_2 + \ldots + C_n}$$

The course credits and thesis/project credits will be shown separately in the final grade card with overall CGPA. In case a student is clearing any fail subject, the new grade obtained will replace the older one while calculating the overall CGPA.

The final grade index and grade shall be displayed in Institute web site and student can approach the concerned subject coordinator (s) for any clarifications within one week of the announcement of the grades. The process of evaluation shall be transparent and the students shall be made aware of all the factors included in the evaluation. In case of any corrections, the subject coordinators (s) shall have to incorporate the same before finalizing the grade and printing the mark list.

For promotion in next higher classes (II/III years), required Cumulative Grade point average (CGPA) at the end of even semester is 4.0, and CGPA for completion of course is also 4.0. Further the student must complete the M.Tech and M.Plan programme in a maximum of 4 years and MCA. in 6 years.

6.6 Academic Performance Requirement

(i) The minimum SGPA requirement for continuing in the programme or for post graduation is 4.0 for M.Tech./M.Plan/MBA and 6.0 for MCA.

(ii) If a M.Tech./M.Plan/MBA/MCA student secures a CGPA 4.0, he/she may be allowed to continue in the following semester on the recommendation of the DPGC and with the approval of the Chairman senate.

(iii) A student will not be allowed to continue in the M.Tech./M.Plan/MBA/MCA. programme if:

(a) His/her CGPA is below 4.0 in two consecutive semester.
(b) He/she obtains more than two F in the same or different courses.
(c) He/she accumulates three or more F grades before the start of the final semester/thesis.
However, those who have completed course work and CGPA is less than 4.0 or discontinued from the course, diploma in the course can be awarded by the recommendation of the chairman, senate.

(iv) The DPGC will keep a watch on the progress of every student and whenever a student fails to meet the requirements will intimate the Dean (Academic Affairs) who can start the termination procedure. If a student's program is terminated, the Head of the Department will issue the letter of termination with consultation of Dean (Academic Affairs) through Controller of examination (COE).

Maximum credit point average, CGPA required for M.Tech/M.Plan degree is 90 credits, for MCA it is 150 credits and for MBA it is 100 credits.
The provisions of conducting the Revaluation of answer books and supplementary examinations are completely abolished.

7. DISCIPLINARY/GRIEVANCE COMMITTEE

(i)   An academic grievance committee is constituted for the smooth functioning of all the post graduate programs of the institute and it consists of the following members:

Dean (Academic Affairs)	**Convener**
Dean (Student Affairs)	**Member**
Concern HOD	**Member**
Controller of Examination	**Member**
Associate Dean (PG and research)	**Member**

The above committee will be dealing with all the PG student's academic matters/grievances related to attendance, academics etc. problems in the PG program. The committee will meet as and when necessary and send the recommendations to the Chairman senate for final approval and action.

(ii) Although all PG students residing in the hostels or outside hostels are expected to maintain the decorum and harmony of the hostels and campus community to the best of their behavior, a disciplinary committee will be constituted for the smooth running of the hostels life of all PG students in the MANIT campus. This committee consists of the following members.

Dean (Student Affairs)	**Convener**
Dean (Academic Affairs)	**Member**
Concerned HOD	**Member**
Concerned Warden(s)	**Member**
Proctor(s)	**Member**

The above committee will be dealing with all the administrative/disciplinary matters related to the PG students leaving in and out of institute hostels. The committee will meet as and when necessary and send the recommendation to the director of the institute for final approval and action.

8. M.Tech/M.Plan/MBA/MS Thesis/Project

8.1 Supervisor(s) Selection

Any PG student who has completed all the academic requirements as prescribed by the institute can proceed to select a thesis/project supervisor(s) from the research area in which he/she is interested to work in his parent department. A student can also choose the thesis supervisor from other departments of the institute if the chosen supervisor has the same working area in which the student is interested. For this due permission should be taken from the Dean (Academic Affairs) through head of the parent department of the student. The same procedure should be adopted if a student is choosing the supervisor from any other academic institute (NOT below the level of NITs)/industries/research organizations. In case a thesis supervisor leaves the institute permanently/ for more than three months before the completion the thesis, a student can choose other supervisor with consultation of the Department Post-graduation Programme committee (DPGC) and HOD with the intimation to Dean Academic. DDPC chairman will be department HOD or professor nominated by HOD and All the post-graduation course instructors are members of DPGC.

8.2 Thesis/Project Writing and Submission

A PG student who has completed all the necessary work of the thesis/project to the satisfaction of the concerned supervisor(s) may write his/her thesis/project report in the prescribed format of the PG thesis and must submit the same in the academic section, with the clearance of all dues, before the last date specified by the institute failing which he/she will have to pay the late fee as indicated in section 3. The thesis must be soft bounded with ***blue color cover page*** and must be certified by the concerned supervisor(s) that the required work was done under his/her/their supervision and there is no duplication of the work. The thesis/ project report should be arranged in following manner and should strictly be followed.

(i)   Cover page with blue color hard paper followed by white paper having the cover page items.
(ii) Certificate by supervisor(s) in the format specified by the institute
(iii) Acknowledgement by candidate.
(iv) Preface/Abstract
(v)   Table of Contents followed by Chapters of the thesis
(vi) Appendices if any
(vii) List of Publications, if any.
(viii) References.

The details about the PG thesis format will be available on institute website.

8. 3 Thesis/Project Oral Examination Board

(i) The thesis/project will be examined by an oral examination board formed by the thesis supervisor(s) in consultation with the Head of the Department. It must be recommended by the DPGC and approved by the Chairman senate.

(ii) The committee shall consist of the thesis supervisor(s) and at least one member from outside the department and a member from the concern department. The head of the department or person deputed by the head of the department will act as the Convener of the Committee.

(iii) In addition to these board members any thesis/project oral examination/ defense must be open to those all who are interested to be the part of the same. A notice regarding thesis defense should be placed on notice boards before one week of its schedule clearly indicating the date, time and venue. Except in some exceptional cases normally the theses defense will not be on any holiday including Saturday and Sunday.

8.4 Use of Unfair means/Copying of Thesis

(i)   Use of unfair means in any examination of the institute is strictly prohibited and is considered as a serious offense. If any such matter is reported by an invigilator, the grievance committee given in Para 7 will recommend any one of the following punishment based on the written report of the invigilator, relevant papers etc. The disciplinary committee will use its own discretion for all the points of category/punishment not covered in the following table.

Category	UFM Type	Punishment
A	During the course of any examination if any book or written paper related to the examination is found with the candidate.	Examination of that theory paper of the candidate will be cancelled.
B	If a candidate leaves the examination hall finally without handing over the answer book to the invigilator or smuggles in an answer book or replaces the continuation sheet during or after the examination.	His/her full semester examination will be cancelled.
C	Getting impersonated by any other person or refuses to hand over the materials used for copying or destroyed the proofs or refuses to sign on UFM Performa all such candidates will be put under this category.	Present examination will be cancelled in full and the student will be debarred from appearing in the next examination and there fore the candidate can not be admitted in next coming semester exams.
D	If a candidate tries to disrupt or actually disrupts the examination or tries to forcefully obstructs the others not to appear in the examination	Present examination will be cancelled in full and the candidate will be debarred for next two examinations.
E	A candidate misbehaves or uses abusive languages or beats or fights or threatens to harm or tries to bribe or actually bribes an invigilator or a person appointment for examination work at the center or carries any	Cancellation of present full examination and debarred from appearing next four examination and FIR will be sent to police for

	weapon in examination center or takes any dog or any other animal or birds in the exam hall will be grouped under this category	criminal proceeding of the candidate.

(ii) Copying of the thesis from any source at any stage is strictly prohibited and is treated as a criminal offense. If any candidate is found guilty in this offense at any stage of the program, his/her thesis liable to be cancelled after a due departmental enquiry set up by the Chairman Senate for the same. The Chairman senate is empowered to take any decision on such matters including the termination of the program of candidate.

9. CHANGE OF RULES

Although the rules and regulations mentioned in this ordinance are not variable but, the Senate, as the Supreme academic body of the institute, from time to time, may revise, amend or alter the regulations, courses of study, their credits and syllabus as and when found necessary. In case a rule needs urgent revision for smooth conduction of academic semester, the same can be done by Chairman Senate and will be ratified in the subsequent senate meeting. *If there is difference of opinions in understanding/interpretation of any rule/regulation given here, the decision of the Chairman senate shall be final.*

10.0 REGULATION FOR DOCTORAL PROGRAMME (Ph.D degree)

The doctoral program leading to Ph.D degree is offered in the following departments/ centers of the Institute

1. Civil Engineering (CE)
2. Mechanical Engineering (ME)
3. Electrical Engineering (EE)
4. Material Science and Metallurgical engineering (MSME)
5. Biological Science and Engineering (BSE)
6. Chemical Engineering (CE)
7. Computer-Science and Engineering (CSE)
8. Electronics and communication Engineering (EC)
9. Energy Center (ENE)
10. Nano Science and Engineering center (NSE)
11. Remote sensing , GIS and GPS center (REM)
12. Architecture (AR) and Planning (PLA)
13. Chemistry (CH)
14. Physics(PHY)
15. Mathematics, Computer Application and Bioinformatics (MTH,MCA, BI)
16. Humanities and social Science (HUM)
17. Management studies (M AN)

The provisions contained in the Regulations govern the conditions for imparting courses of instructions, conducting the examinations and evaluation of students performance leading to Ph.D. Degree. These Regulations are applicable to any new disciplines that are introduced time to time and applicable to the students already registered for the Ph.D degree programme. The Senate should exercise its powers to change/amend/interpret/implement decisions and actions concerned with academic matters. The Board of Governors of the Institute may, on the recommendation of the Senate, change any or all parts of these Regulations at any time.

10.1 Admission

There shall be provision for two categories of registration to the candidates willing to register for Ph.D. degree.

i. Full- Time : Students who are willing to pursue Research studies on full time basis with Institute scholarship or scholarships awarded by QIP/CSIR/AICTE/UGC or other equivalent organizations

ii. Part Time : Any employee working on regular position in any academic/research/public sector organization duly recognized by

MHRD/AICTE/UGC/Central government/State Government/ or other reputed organizations approved by Institute..

iii. Junior Research fellow working in any project of the institute allowed for admission for Ph.D (Part time). Also, scientist working in a Government of India research organization who have more than ten years of research experience allowed admission Ph.D (part time)'

iv. All the admission depends only on the availability of the guides with doctoral degree.

Eligibility for Admission

The eligibility for admission to Ph.D. in Engineering Faculty, Architecture and planning faculty, Science Faculty, and interdisciplinary areas. A candidate shall possess master's Degree in relevant area of Research and should have passed with minimum of 55% marks / (CGPA 5.5) or equivalent. The candidate with B.E./ B.Tech./ B.Arch./B.Plan qualification may be admitted directly to Ph.D programme subjected to following conditions:

i. CGPA More then 8.5 or 85 % marks in UG Exam

ii. Extra course work to be completed during Ph.D programme

MCA/Science/Humanities department may consider PG degree in relevant discipline approved by MHRD/AICTE/UGC. For Ph.D in a management studies, the candidate must have MBA degree or two years PGDM from Intuitions recognized by MHRD/AICTE/UGC. The minimum requirement for all interdisciplinary departments/ centers shall be as decided by senate time to time. Candidate must have the final result of the qualifying examination and NOC in original from employer at the time of interview.

10.2 Course structure

The complete Research Programme will be of minimum 3 years duration for all full-time candidates and 4 years duration for all part-time candidates. The maximum period allowed to complete the course is 5 years (for both full time & part-time), which may be extended to 7 years subject to approval of Senate. A relaxation of 1 year in minimum duration may be given to teacher candidates subject to the approval of SENATE.

Every stream of specialization in the Programme will have a curriculum and syllabi for the courses approved by the Institute. The curriculum should be so drawn up that the minimum number of credits for successful completion of the course work including seminar in any stream.

In addition the guide can provide a self study courses to the candidate as self study courses. However, proper examination and evaluation has to be done by the course instructor. Candidates also can give open seminar of the topic relevant to his research works and evaluation committee consists of Head of the department, Guides and an professor from department and another expert professor in the field of research from other department.

The medium of instruction for examination, seminar and reports will be in English.

Course credit requirements

The distribution of credits for the programme shall be as follows

Semester I/II	Credits		
	MCA/M.Sc/ .MBA	M.Phill/M.Tech./ M.Arch/ M.Plan	B.E./B.Tech./ B.Arch.
Minimum credit for the Course work	15 (5 courses)	12 (4 courses)	24 (8 courses)
2 Seminars	4	4	4
Total Credits	19	16	28

One of the courses may be on Analytical techniques/Design tools.

The minimum CGPA to clear the course work will be 6.5 The grading pattern for individual subject will be same as for M.Tech./M.Plan./MBA

Failure in Courses

If any student fail in course work, may be allowed only once to re-appear in the exam after due permission from Dean (AA) & Chairman senate.

Failure in Seminar

If a student does not submit the seminar report and / or present the Seminar on the scheduled date, he will be awarded F grade unless extension of date is granted by chairman senate.

10.2 Research supervisor

In each Department, applicants will be given the details of various research topics proposed by various faculty members for Ph.D. programmes at the time of selection so that they will have an

opportunity to discuss those topics with the respective faculty members and thereafter, indicate their choice in order of preference.

All selected candidates shall be assigned to Research Supervisor(s) at the time of selection by selection committee. The following guide line should be followed in selection of research supervisors.

a) Each external candidate shall have maximum one Supervisor from sponsoring organization where he is employed and one or two supervisor(s) at the institute.

b) The research programme and the title of the research topic of a selected candidate shall be finalized by his Supervisor(s) after mutual discussion and approved by Students Research Programme committee (SRPC).

Change of Supervisor(s) under exceptional circumstances shall be permitted on recommendation of the SRPC after obtaining the consent of (i) the candidate (ii) the present Supervisor(s) and (iii) the proposed Supervisor(s).

c) If the Research programme and / or area of the work require modification due to this change, the there is a change in the Research programme and/ or title of the work, the registration date shall be revised, if found necessary.

d) In the event research Supervisor leave the Institute on lien / sabbatical leave etc. justified under institute regulations and if he / she is the main guide he / she continues to be the main guide and has to opt a co-guide. If period of leave increases more then three years the co guide becomes the main guide.

e) The candidate is not permitted to change the department where he/she has registered. At least one guide should be there in the concern department of the student. However, student can opt co-guide from other department

f) At any given time the Maximum number of candidate of Ph.D. under a supervisor as guide or co guide in the institute or outside is FIVE In this regard an undertaking is to be furnished by the guide at the time of RDC. Further the chairman senate is empowered to allot more than five candidates to a supervisor depending upon his / her merit.

10.3 ELIGIBILITY FOR RESEARCH SUPERVISOR

A permanent faculty of MANIT, Bhopal having at least three years of teaching experience and possessing Ph.D. shall be recognized as a Research Supervisor. External Guide

from other NITs, IITs and National level Research laboratories/Institutions may be associated as Co- guide only with due approval of the Director (Chairman Senate). The Department Research Programme Committee (DRPC) shall scrutinize the Bio-data of supervisor(s) and on its recommendation, the Dean (AA) shall issue a recognition letter to all such supervisor(s).

In case of more than one supervisor(s) involved in guiding a student, then the recognition of the Co-Supervisor by the Institute shall be necessary and DRPC shall adopt the same procedure adopted for recognition of Institute Supervisors.

However, in all cases for Ph.D. registration, one of the supervisor(s) shall be compulsory from the Institute.

10.4 Procedure for admission

Application forms for Ph.D. will be available in Admission Section. Admission will normally be done once in each semester through advertisement/ notification. The merit will be prepared by chairman, Senate based on test/ interview/ presentation / evaluation.

10.5 Procedure for registration

If the candidate is found eligible to be registered in Ph. D., he/she should complete the course work in maximum of two semesters (i.e. in one years). After the completion of course work. A project proposal is to be submitted to SRPC. The SRPC conduct a comprehensive viva voce examination and give permission to the candidate to continue the research work.

There after SRPC meeting to be conducted to asses the progress of the work of the candidate in every semester. At the third year, Research degree committee (RDC) is formed with expert from outside to review the work and recommendation for the synopsis submission.

10.6 Place of work, progress and duration

Place of Research work will be MANIT, Bhopal. However on the recommendations of the supervisor (s) and SRPC, the institute may allow the Research work for the Ph.D degree to be partially or fully carried out at another organization duly approved for this purpose by the institute for part-time Ph.D students.

The external organization where a candidate wishes to carry out the Research work partially or fully shall have to be recognized by the institute before such work is undertaken, which will depend on the facilities available for proposed research work in that institute.

Change of status form part-time to full time or vice-versa will be subject to the approval of the senate. An external organization may be granted recognition by the SRPC as an approved place of work after inspection by a committee constituted by the chairman of Senate.

i. A particular candidate shall normally give the recognition only for the purpose of individual research project.

ii. The details of research facilities available in the organization shall be furnished by the candidate along with the application for admission to Ph.D Programme.

iii. The SRPC shall examine the details given and may decide either to ask for further information, if necessary, or even collect first hand information. Only when the SRPC is fully convinced about the adequacy of the research facilities, the institute shall be permitted to be used by the candidate at a fee prescribed by the institute.

iv. The RDC shall give the final approval for the submission of the thesis after the due consideration of the recommendations of the SRPC.

All candidates shall, after registration, submit through their supervisor(s), progress report of their work to the concerned SPRC twice a year in July/ January depending upon the date of their admission.

In addition, all registered candidates must give at least one Seminar per year at the institute until they submit the synopsis. At the end of three years from the date of their admission, the DRPC shall review the candidate's progress in Course/ Seminar/ Approved Research programmed and shall forward the report to Dean (AA). The continuation of registration of all candidates is subject to satisfactory progress made by them. In the case of institute scholarship holders, the continuance of scholarship beyond 3 years and up to a maximum of 6 months will also be considered, subject to satisfactory progress made by them which will be assessed by by Dean (AA) through the recommendation of SRPC.

Every external candidate shall carry out a part study of his Research work residing at the institute for period, which shall be in no case less than one semester, including course work.

Candidate sponsored by local/Government organizations may, on the basis of an application, recommended by SRPC, be exempted from stay on the institute campus

The organization has to certify that the candidate has been fully relieved of his normal duties/ granted leave during the period of the residential requirement.

External candidates will be provided with hostel accommodation only during the semester(s) in which the residential requirement is fulfilled, subject to availability.

Every external candidate shall put-up at least 60 days of research duration with his guide at MANIT, Bhopal in every year. For all categories of candidates, the period of validity of their Ph.D. registration is 7 years. The candidate may submit their thesis before the end of this period. Any candidate who concurrently registers for any postgraduate degree at another organization shall be automatically de-registered at the institute.

Research Scholars/ staff who has submitted the synopsis of thesis may be permitted to leave the institute by SRPC on recommendation and submit from outside within a period of six months. In case a candidate does not submit his thesis within six month from the date of submission of synopsis, his registration will be deemed to be cancelled.

10.7 THESIS EVALUATION

Prior to the submission of the synopsis of the thesis, a comprehensive internal assessment of the Research work should be made by panel (RDC) appointed by Dean (AA) in consultation with a supervisor(s). The thesis may only be submitted if candidate publishes two pear reviewed papers with high impact factor or SCI journal of International repute or International journal with ISSN number

A panel consisting of two faculty members from the institute (one from the department and other from the outside the department) conversant with the field of Research work, supervisor(s) and an external member of Research degree committee (RDC) chaired by HOD of the department. shall asses the work. The candidate can submit the synopsis only when the RDC panel is satisfied about the quality of the work for submission as a Ph.D. Thesis.

The Convener of the RDC shall forward the panels report to the Dean(AA)

Details of the pre-synopsis seminar shall adequately notified so as enable the interested staff members and students to attend the same.

The candidate shall submit the synopsis of his work at least one month before submitting the thesis. The synopsis written in the approved format shall be submitted to SRPC for consideration. After approval by the SRPC five copies of the synopsis will be submitted to the Dean (AA) with the following certificates:

      (a)   Certificate from the Convener SRPC that the prescribed course credits and related RDC viva are completed.

(b)   Certificate from the Convener SRPC that the prescribed seminar has been completed satisfactory.

(c)   Certificate from the Research Supervisor stating:

  i. That there is a prima facie case for consideration of the thesis,

  ii. That the thesis does not contain any work which has been previously submitted for the award or any degree, and

  iii. The extent of collaboration, if any

(d)   Certificate from the Accounts section that there are no dues up to the date of submission of the synopsis.

The thesis shall be written in the approved format.

(a)   The candidate shall submit four copies of the thesis to the Dean (AA) within the prescribed time limits, namely, not earlier than one month and later than six months from the submission of the synopsis.

(b)   Along with the thesis, the candidate shall submit the requisite forms containing the authorization from the Research Supervisor(s) for submission of the thesis and a certificate from accounts section that there are no dues against the candidate.

Two external referees are chose by Senate Chairman from the set of panel of experts from IIT/NIT/IISc/ equivalent institute in India and a set of panel experts from abroad as recommendation by the SRPC and duly approved by the Dean (AA). In the set of panels at least five experts in the field of research is to be recommended. The referees will evaluate the thesis on the following basis:

i. A critical survey and evaluation of the quality and quantity of the work as embodied in the thesis.

ii. Question, if any, to be asked or points to be clarified at the viva-voce examination,

iii. A definite recommendation as to whether the thesis is acceptable for the award of the degree of Doctor of Philosophy.

If referee in his report in not in a position to make a definite recommendation for the award of the degree, he should be requested to assist the Senate in deciding whether the candidate be required to make:

i. Substantial revisions involving rewriting of one or more chapters without, however, doing any further Research work.

ii. Completely rewrite the thesis if the thesis, though not acceptable in the present forms, reveals sufficient quality and quantity of work to warrant the candidate being given an opportunity for further Research work and/ or reinterpretation of results.

The copies of the referees' reports when received shall be confidentially made available to the Research Supervisor(s). the Research Supervisor(s) shall send comments on these reports for consideration by the DRPC.

(a) On the basis of the referees' reports and the Supervisor' comments thereon, the SPRC shall, recommend to the Senate Chairman whether the thesis be accepted for the viva-voce examination or be rejected or be referred again to a new referee.

(b) A thesis may be considered acceptable for holding the viva-voce examination if both the referees give positive recommendations, if one of them accepts and the other rejects the thesis, as it is, shall be referred to a third referee chosen from the panel of examiners by the Senate Chairman.

(c) Wherever a thesis is referred to a third referee the comments of the Research Supervisor point by point for the queries by the first two referees should also be reported to the senate.

(d) The senate shall, however, be the final authority in deciding whether the thesis be accepted for the award of the degree.

If the referees recommend acceptance of the thesis subject to minor modifications only, the thesis can be resubmitted only once after incorporating the modification, within a period of six months, the same referee(s) shall examine the thesis so resubmitted.

(a) A thesis rejected by two referees may be re-submitted after revision, not earlier then one year and not later than two years from the date of such intimation to the candidate by the Dean (AA). The thesis so resubmitted may be examined by the same referees or by new referees.

(b) Rejection of the thesis so resubmitted will disqualify the candidate from further consideration for the award of the Ph.D degree, in the topic of research chosen by him.

A candidate, whose thesis has been accepted for the award of Ph.D degree shall be required to defend his work at an open viva-voce examination conducted by a Board of Examiners at the

institutes. The Board of Examiners shall be appointed by the Senate Chairman and shall consist of:

      i. HOD of the department as chairman

      ii. A professor from outside the department

      iii. A professor from the department

      iv. The Research Supervisor(s);

      iii. One of the referees who evaluated the thesis, failing which an examiner from approved panel of examiners.

The Board of Examiners shall submit its report in the prescribed format to the Senate within 3 days after completion of viva-voce examination. The consolidated statement of the thesis and minutes of viva voce examination prepared by research supervisor (s), external examiner and chairman along with recommendation of DRPC is to be submitted for the chairman. Senate. After satisfactory completion of the viva-voce examination, the degree may be conferred upon the candidate after approval by the senate. If a thesis has been accepted but the candidate fails at the viva-voce examination, he may be permitted by the Senate Chairman to re-appear for viva-voce examination once again at a later date. The Recommendation of the board of examiners conducting the viva-voce examination shall be considered in taking a decision in this respect.

10.8 Constitution of SRPC for each candidate

1	Chairman	HOD of concern department
2	Member*	One representatives from the department possessing doctoral degree
3	Members*	One representatives from other department possessing doctoral degree
4	Convener	Supervisor (s)

*The concern supervisor has to suggest two experts from department and two experts from the other department. Then, Dean (Academic affairs) select one member from each set to form a SRPC members.

10.9 Constitution of DRPC for each candidate

1	Chairman	HOD of concern department
2	Members	All the eligible Ph.D supervisors of the concern department
3	Convener	A member of DRPC selected by concern HOD.

Constitution of RDC for each candidate

1	Chairman	HOD of concern department
2	Member*	One expert from IIT / NIT / IISc
3	Member	One representatives from the department
4	Members	One representatives from other department
5	Convener	Supervisor (s)

* Supervisor has to suggest three external experts name confidently and chairman senate approve one external member for the RDC. Necessary arrangements for issuing notices for RDC meeting / seminars and honorarium to external examiner are proposed to be made by convener.

Functions of DRPC

    a) Evaluation of proposed research work and to approve the topic of the proposed research work along with its synopsis.

    b) Evaluation of Supervisors bio-data and recognize them as approved supervisors in the respective discipline.

    c) To approve the external research centers for carrying out research work in a given discipline.

    d) Any other advice/ recommendations desired by Dean (AA) time to time.

Functions of SRPC

    a) Conduct the comprehensive viva voce examination based on the research proposal submitted by the candidate

    b) The semester wise evaluation of the progress of the research work of the candidate.

    c) Annual open seminar evaluation of the candidate/

Functions of RDC

    a) Verification of the journal paper published by the candidate and its evaluation

    b) The quality and quantity evaluation of the research work carried out by the candidate

11.0 COURSE STRUCTURE (M.Tech)

The M.Tech courses were originally designed keeping in view the industries around the Bhopal and National level requirements. The courses are modified /updated keeping latest advancement in the subjects and new PG courses are introduced. The collaboration with industries is considered as an important ingredient and courses content and structure are modified in view of i) strengthening industry-institute interaction ii) imparting industry oriented education and training iii) enhance collaborated research.

The M.Tech courses are in 24 months duration comprising of 4 semesters about 6 months each, with particular emphasis on project/dissertation in 3rd and 4th semesters. First and second semester only have the theory and practical/seminar classes. In the second year student are required to perform preliminary investigation, literature review on a selected topic of project and research work which is to be presented as thesis report. Since the second year students only have to do the project work, all the departments has to follow the rule for the evaluation as below.

Third Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	23*
As applied by the department (600 series)	Project Phase - I	-	3	20	

*Out of 23 credits, 05 credits will be assigned to mid- term project-seminar. Remaining 18 credits will be assigned to end term seminar.

Fourth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	23*
As applied by the department (600 Series)	Project Phase – II/ Dissertation	-	3	20	

*Out of 23 credits, 5 credits will be assigned to mid- term project-seminar. Remaining 18 credits will be assigned to end term seminar.

For the first and second semester course structure are given below in department wise. For a particular course students have to take some core subjects, department electives and open electives. Any student from the Department registered for particular programme can take department electives. Open electives can be registered from any department depend upon the opinion of staff advisor or area related to his interest.

MACHINE TECHNOLOGY DIVISION
11.1 DEPARTMENT OF CIVIL ENGINEERING

i) M. Tech. in Structural Engineering

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
STR511	Theory of Elasticity	2	2	-	3
STR512	Advanced Structural Analysis	2	2	-	3
STR513	Design of R.C.C. Structures & Steel Structures	2	2	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
STR514	Structure Lab – II	-	-	2	2
STR515	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
STR521	Prestressed Concrete	3	-	-	3
STR522	Structural Dynamics	3	-	-	3
STR523	Theory of Plates & Shells	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
STR524	Structure Lab – II	-	-	2	2
STR525	Seminar 2 and mini project	-	2	-	2
				Total credit	22

List of department electives

STR 531 Soil Structure Interaction
STR 532 Design of Steel Concrete Composite Structures
STR 533.   Maintenance and Rehabilitation of Structures
STR 534   Tall Structures   STR 535 Bridge Design

STR 536   Safety in Construction   STR 537   Advanced Steel Structures
STR 538 Earthquake Analysis and Design of structures
STR 539 Design of foundation systems   STR 541 Advance RCC Structures

ii) M. Tech. in Environment Engineering

First Semester

Course No.	Subject	Scheme of periods per week			Total Credits
		L	T	P	
ENV511	Physico-Chemical Treatment Processes	3	-	-	3
ENV512	Air and Noise Pollution Control	3	-	-	3
ENV513	Biological Treatment Processes	3	-		3
	Elective 1	3	-	-	3
	Elective 2	3	-	-	3
	Open Elective 1	3	-	-	3
ENV514	Advanced Environmental Engg Lab	-	-	2	2
ENV515	Seminar 1 and mini project	-	2	-	2
				Total credits 22	

Second Semester

Course No.	Subject	Scheme of periods per week			Total Credits
		L	T	P	
ENV521	Advanced Treatment Methods	3	-	-	3
ENV522	Solids Waste Management	3	-	-	3
ENV523	Environmental Impact Assessment & Legislation	3	-		3
	Elective 3	3	-	-	3
	Elective 4	3	-	-	3
	Open Elective 2	3	-	-	3
ENV524	Treatment Plant Design Lab.	-	-	2	2
ENV525	Seminar 2 and mini project	-	2		2
				Total credits 22	

List of Department Elective

ENV531   Environmental Microbiology & Ecolog   ENV532 Environmental Chemistry
ENV533   Environmental Quality Monitoring   ENV534 Environmental Auditing
NV535   Industrial Waste Treatment   ENV536   Energy by Bio-conversion
ENV537   Hasardeuse Waste Management & Risk Analysis
ENV538   Environnemental Economics & Socio-Economic Planning

iii) M. Tech. in Geotechnical Engineering

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
GEO511	Advanced Geotech Engg.	3	-	-	3
GEO512	Foundation Engg. - I (Shallow	3	-	-	3

Course Number	Subject	L	T	P	Total Credits
	Foundation)				
GEO513	Machine Foundation Vibration	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
GEO514	Lab. Practice - I Soil Mech.	-	-	2	2
GEO515	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
GEO521	Soil Dynamics	3	-	-	3
GEO522	Design and Construction of Machine Foundation	3	-	-	3
GEO523	Foundation Engg. - II (Deep Foundation)	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
GEO524	Lab. Practice - II Soil Dynamics	-	-	2	2
GEO525	Seminar 2 and mini project	-	2	-	2
				Total credit	22

List of department electives

GEO531 Advance structure analysis   GEO 532 Structural dynamics
GEO533 Reinforced soil structure   GEO534 Rock machines and engineering geology
GEO 535 Environmental geo- technique   GEO 536 Theory of elasticity and plasticity
GEO537 Geotechnical Investigations and Field Testing of Soils
GEO538 Critical State Soil Mechanics   GEO539 Earthquake Engineering
GEO541 Strength and Deformation Behaviour of Soils
 GEO542 Modern Geotechnical Processes

iv) M.Tech in Hydro Power Engineering

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH511	Advanced Fluid Mechanics	3	-	-	3
HYD512	Instrumentation and measurement	3	-	-	3
HYD513	Hydrology and Hydro Power	3	-	-	3

	Plants				
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
HYD514	Hydraulic Lab Practice-I	-	-	2	2
HYD515	Seminar	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
HYD521	Fundamentals of Hydraulic Machines	3	-	-	3
HYD522	Design of Hydraulic Machines- Turbines	3	-	-	3
HYD523	Design of Hydraulic Machines- Pumps	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
HYD524	Hydraulics Lab Practice-II	-	-	2	2
HYD525	Computational Lab Practice	-	2	-	2
				Total credit 22	

List of department electives

HYD531	Theory of Cascades	HYD 532	Water Resources Systems
HYD533	Manufacturing Processes	HYD534	Hydro Power Structures
HYD535	Hydraulic Transients	HYD536	Design of Power House
HYD537	Industrial Hydraulics	HYD 538	Governing systems

v) M.Tech. in Transportation Engineering

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
TRE511	Analysis and Design of Pavement Structures	3	-	-	3
TRE512	Traffic Engineering and Management	3	-	-	3
TRE513	Transport Planning	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
TRE514	Lab practice –I	-	-	2	2

TRE515	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
TRE521	Highway Construction and Maintenance	3	-	-	3
TRE522	Public Transport System	3	-	-	3
TRE523	Highway Geometrical Design	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
TRE524	Lab practice II	-	-	2	2
TRE525	Seminar 2 and mini project	-	2	-	2
				Total credit	22

List of department electives

TRE 531 Geotechnical Investigations and Field Testing of Soil

TRE 532 Analysis and Design of Highway Intersections

TRE 533 Concrete Technology   TRE 534 Bridge and Tunnel Engineering

TRE 535 Fundamentals of Remote Sensing, GIS and GPS

TRE 536 Highway Maintenance Management System

TRE537 Environmental Impact Assessment TRE538 Planning and Design of Airports

vi) M.Tech. in Water Resources Engineering

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH 511A	Advanced Mathematics	3	-	-	3
WRE512	Advanced Fluid Mechanics	3	-	-	3
WRE513	Applied Hydrology	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
WRE514	Lab Practice- I	-	-	2	2
WRE515	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
WRE521	Advanced Hydraulic	3	-	-	3

	Structures				
WRE522	Water Resources Systems	3	-	-	3
WRE523	Open Channel Hydraulics	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
WRE524	Lab Practice- II	-	-	2	2
WRE525	Seminar 2 and mini project	-	2	-	2
	Total credit 22				

List of electives
WRE531 Irrigation & Drainage Engineering   WRE532   Water Supply Distribution System
WRE533 Geo Technical Investigations in Water Resources Projects
WRE534 Integrated Watershed Management   WRE535Hydraulic Measurement Systems
WRE 536 Flood Control & River Training Works WRE 537 Ground Water Engineering
WRE538. Hydraulic Energy Dissipaters
WRE539 Water Resources Project Planning, Economics & Management
WRE541 Sediment Transportation Engineering   WRE 542 Stochastic Hydrology
WRE543 Eco-hydrology

11.2 DEPARTMENT OF MECHANICAL ENGINEERING
vii) M.Tech. in Thermal Engineering
First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH511B	Advanced Mathematics	2	2	-	3
TH 512	Advanced Thermodynamics	3	-	-	3
TH 513	Advanced Heat & Mass Transfer	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
TH 514	Thermal Engg Lab - I	-	-	2	2
TH 515	Seminar 1 and mini project	-	2	-	2
	Total credit 22				

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
TH 521	Instrumentation & Control	3	-	-	3
TH 522	Thermal Environmental Engg	3	-	-	3

TH 523	Theory and Design of Heat Exchangers.	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
TH 524	Thermal Engg Lab - II	-	-	2	2
TH 525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives

TH531 Numerical Heat Transfer   TH532 Experimental Stress Analysis

TH533 Maintenance of Thermal Power Plant Equipment

TH534 Refrigeration System and Component Design TH535 Theory and Design of Gas Turbines

TH536 Combustion

TH537 Vibrations and Its App for Design of Turbomachinery

TH538 Theory & Des. of Blowers & Compressors & Ind. Steam Turbines

TH539 Gas Dynamics and Flow Through Turbomachines

viii)   M.Tech. in Industrial Design

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ID 511	Computational Methods	2	2	-	3
ID 512	Mechanism & Synthesis	3	-	-	3
ID 513	Reliability Engineering	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
ID 514	Dynamics of Machines Lab.	-	-	2	2
ID 515	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
ID 521	Advanced Computer Aided Graphics	3	-	-	3
ID 522	Stress & Vibration Analysis	3	-	-	3
ID 523	Advanced Product Design	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
ID 524	CAD Lab.	-	-	2	2
ID 525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives

ID531 Bearing Design & Selection   ID532 Design and Development of Prototype Product.
ID533 Computer Aided Facility & Process Planning ID 554 Product Design for Market
ID 535 Accelerated Product Design & Development   ID536 Electronics Packaging Design
ID537 Complex Mechanism & Graph Theory   ID538 Nature of Materials and Processes
ID539 Detailed Design of Rotating Machines   ID541 Advanced Machine Dynamics

ix) M.Tech. in Maintenance Engineering

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH511C	Statistics and Probability	2	2	-	3
MT512	Maintenance Management – Policies, Strategies & Options	3	-	-	3
MT513	Lubrication Management & Practice	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
MT514	Maintenance Engg Lab-I and Tribology Lab	-	-	2	2
MT515	Seminar 1 and mini project	-	2	-	2
	Total credit 22				

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
MT521	Reliability, Availability & Maintainability Engineering	3	-	-	3
MT522	Failure Analysis & Prevention	3	-	-	3
MT523	TPM, CBM and RCM	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
MT524	Maintenance Engg Lab-II and Diagostics Lab.	-	-	2	2
MT525	Seminar 2 and mini project	-	2	-	2
	Total credit 22				

List of department electives

MT531 Maintenance Audit   MT532 Risk Analysis and Safety
MT533 Concurrent Engineering   MT534 Maintenance Awareness
MT535 Maintenance of Agriculture and Earth Moving Machinery

MT536 Bulk Solids and Handling MT537 Maintenance of Electrical Machines
MT538 Maintenance of Power Plant Machinery MT539 Maintenance of Transport Machinery
MT541 Mechatronics and NDT in Maintenance Engineering
MT542 Maintenance of CNC Machines MT543 Restoration, Repairs and Retrofitting
MT544 Machinery Vibration Monitoring Analysis
MT545 Maintenance of Chemical Plant Machinery

x) M.Tech. in Engineering Materials

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH511D	Advanced Engineering Mathematics & Optimization Techniques	3	-	-	3
EM512	Material Science	3	-	-	3
EM513	Behavior of Materials	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
EM514	Behavior of Materials Laboratory	-	-	2	2
EM515	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
EM521	Material Processing	3	-	-	3
EM522	Materials Management	3	-	-	3
EM523	Tribology & Wear Analysis	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
EM524	Advanced Materials Laboratory	-	-	2	2
EM525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department Electives

EM531 Bio-Materials EM532 Nuclear Materials
EM533 Aerospace Materials EM534 Polymer Engineering
EM535 Corrosion Engineering EM536 Metal Forming
EM537 Theory of Plasticity EM538 Advanced Materials
EM539 Product Design & Development EM-541 Intellectual Property Right
EM 542 Fracture & Failure of Materials EM543 Composite Materials

xi) M.Tech. in Stress and Vibration Analysis

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH511E	Advanced Engineering Mathematics & Optimization Techniques	3	-	-	3
SV512	Theory of Elasticity	3	-	-	3
SV513	Theory of Vibrations - I	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
SV514	Vibration Analysis Laboratory	-	-	2	2
SV515	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
SV521	Experimental Stress Analysis	3	-	-	3
SV522	Theory of Plates	3	-	-	3
SV523	Theory of Vibrations - II	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
SV524	Experimental Stress Analysis Laboratory	-	-	2	2
SV525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department Electives

SV531 Advanced Machine Design SV-532 Theory of Elastic Stability
SV533 Theory of Plasticity SV-534 Product Design & Development
SV535 Earthquake Engineering SV-536 Non-linear & Random Vibrations
SV537 Stress & Vibration Analysis in Turbo-machinery
SV538 Rotor Dynamics & Balancing SV-539 Analysis & Design of Shells
SV541 Analysis of Composite Structures SV542 Computer Aided Design
SV543 Mechanics of Composite Materials

11.3 DEPARTMENT OF ELECTRICAL ENGINEERING
xii) M.Tech. in Electrical Drives
First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ED511	Power Controller	3	-	-	3
ED512	Electrical Drives	3	-	-	3
ED513	Modeling & Analysis of Electrical Machines	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
ED514	Machines & Drives Laboratory	-	-	2	2
ED515	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
ED521	Advanced Power Electronics	3	-	-	3
ED522	Advanced Control System	3	-	-	3
ED523	DSP & Its Applications	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
ED524	PLC & Micro controller Laboratory	-	-	2	2
ED525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives

ED531 Power Quality	ED532 Traction Drives
ED533 Advanced Electrical Drives	ED534 Microcomputer & its Application
ED535 Reactive Power Control and Facts	ED536 Evolutionary Techniques
ED537 Microcomputer Controlled Drives	ED538 Instrumentation in Electrical Drives
ED539 Special Machines	ED541 EHV AC & DC Transmission

xiii) M.Tech. in Power systems
First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
PS511	Power System Analysis	3	-	-	3
PS 512	Advanced Power System	3	-	-	3

Course Number	Subject	L	T	P	Credits
	Protection				
PS513	Evolutionary Techniques	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
PS514	Power System Laboratory	-	-	2	2
PS515	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
PS521	Modern Trends in Power System Operation	3	-	-	3
PS522	Advanced Control System	3	-	-	3
PS523	Power System Stability and Control	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
PS524	Computer Applications in Power System Lab	-	-	2	2
PS525	Seminar 2 and mini project	-	2	-	2
				Total credit	22

List of department electives

PS531 EHV AC and DC Transmission   PS532 Power Controller
PS533 Economics of Regulation and Restructuring of Energy Industries
PS534 Computer Aided Power System Analysis
PS535   Microcomputer & its Applications   PS536 Power Quality
PS537   Instrumentation   PS538 Advanced Power Electronics
PS539 Modeling and Analysis of Electrical Machines
PS541 Power System Planning & Management PS542 Power System Transients
PS543 DSP & its Applications   PS544 Advanced Electrical Drives
PS545 Reactive Power Control and Facts   PS546 Power System Economics

11.4 DEPARTMENT OF MATRIAL SCIENCE AND METULLURGY
xiv)   M.Tech. in Material science and technology

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MSME 511	Concepts in Materials Science	3	-	-	3
MSME	Thermodynamics and Kinetics	3	-	-	3

Course Number	Subject	L	T	P	Total Credits
512	in Materials				
MSME 513	Mechanical Behavior of Materials	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
MSME 515	Materials Characterization Lab	-	-	2	2
MSME 51`6	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
MSME 521	Nano Materials	3	-	-	3
MSME 522	Advance Materials Processing	3	-	-	3
MSME 523	Research Techniques in Material Science	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
MSME 524	Materials Processing Lab	-	-	2	2
MSME 525	Seminar 2 and mini project	-	2	-	2
				Total credit	22

List of department electives

MSME531Experimental technique in material scienc

MSME532 X-ray diffraction and electron microscopy

MSME533 Science and technology of magnetic materials

MSME534 Advanced physical and mechanical metallurgy

MSME535 Plastic deformation and microstructure evolution

MSME536 Order-disorder transformation

MSME 537 Solid state transformations   MSME 538 Welding science and technology

MSME 539 Corrosion and its prevention   MSME 541 Structural materials for aerospace applications

MSME542 Powder metallurgy   MSME543 Superconductivity, materials and applications

SOFT TECHNOLOGY DIVISION
11.5 DEPARTMENT OF CHEMICAL ENGINEERING
xv) M.Tech. in Design of processing Plants

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH511F	Optimization Technique	3	-	-	3
CH512	Advanced Transport Phenomena	3	-	-	3
CH513	Heterogeneous Catalysis and Reactor Design	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
CH514	Advanced Chemical Engineering Lab	-	-	2	2
CH515	Seminar1 and mini project	-	2	-	2
	Total credit 22				

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
CH521	Advanced Process Dynamics & Control	3	-	-	3
CH522	Advance Heat & Mass transfer	3	-	-	3
CH523	Advanced Thermodynamics in Chemical Engg.	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
CH524	Software Lab	-	-	2	2
CH525	Seminar 2 and mini project	-	2	-	2
	Total credit 22				

List of department electives

CH531 Polymer Science & Technology   CH532 Nano Technology
CH533 Bioprocess Technology   CH534 Pinch Technology
CH535 Advanced Fluid Dynamics   CH536 Bio-energy Engineering
CH537 Food Processing & Technology   CH538 Advanced Separation Technology
CH539 Textile Technology   CH541 Petroleum Engineering & Technology
CH542 Multiphase flow/CFD of Multiphase reactor

11.6 DEPARTMENT OF BIOLOGICAL SCIENCE AND ENGINEERING
xvi)   M.Tech. in Biotechnology

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
BIO511	Instrumentation in Biotechnology	3	-	-	3
BIO512	Genetic Engineering and Population genetics	3	-	-	3
BIO513	Cell and tissue culture engineering	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
BIO514	Biotechnology laboratory 1	-	-	2	2
BIO515	Seminar1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
BIO521	Chemo-informatics and drug designing	3	-	-	3
BIO522	Molecular Bio-typing	3	-	-	3
BIO523	Bio-nano-technology	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
BIO524	Biotechnology laboratory 2	-	-	2	2
BIO525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives

BIO531 Bio-ethics, bio-safety regulations and IPR   BIO532 Computational Biology
BIO533 Microbiology and immunology   BIO534 Computational Phylogenic
BIO535 Protein Engineering and Enzyme Technology
BIO536 Bio-processing engineering   BIO 537 Genomics and trascriptomics

11.7 DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
xvii) M.Tech. in Information Security

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
IS511	Computer and net work	3	-	-	3

Course Number	Subject				
	security				
IS512	Cryptography	3	-	-	3
IS 513	Cyber crime and information warfare	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
IS514	Computer Laboratory 1	-	-	2	2
IS515	Seminar 2 and mini project	-	2	-	2
	Total credit 22				

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
IS521	Database security and access control	3	-	-	3
IS522	Security assessment and risk management	3	-	-	3
IS523	Biometrics	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
IS524	Computer Laboratory 2	-	-	2	2
IS525	Seminar 2	-	2	-	2
	Total credit 22				

List of department electives

IS531 Advanced Software Engineering   IS532   Distributed Computing
IS533 CAD of Digital Systems   IS534   Digital Image Processing
IS535 Data Mining and Warehousing   IS 536 Advanced data structure
IS 537 Advanced computer networks   IS538   Graph Theory and Network Algorithms
IS539 Information theory and coding   IS541   Simulation and modeling
IS542 Operation system design   IS543   Architecture of large systems
IS544 Wireless communication and mobile computing
IS545 Cloud security   IS 546   Intrusion detection systems

xviii)   M.Tech. in Advanced computing

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
AC511	Mathematical Foundations of Computer Science	3	-	-	3
AC512	Advanced Data Structures	3	-	-	3
AC513	Advanced Computer Networks	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
AC514	Modeling and Simulation Lab	-	-	2	2
AC515	Seminar 1 and mini project	-	2	-	2
	Total credit 22				

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
AC521	Architecture of Large Systems	3	-	-	3
AC522	Operating System Design	3	-	-	3
AC523	Soft Computing	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
AC524	Modeliing and simulation laboratory.	-	-	2	2
AC525	Seminar 2 and mini project	-	2	-	2
	Total credit 22				

List of department electives

AC531 Advanced Software Engineering   AC532   Distributed Computing
AC533 CAD of Digital Systems   AC534   Digital Image Processing
AC535 Data Mining and Warehousing   AC536 Advanced data structure
AC 537 Advanced computer networks   AC538   Graph Theory and Network Algorithms
AC539 Information theory and coding   AC541   Simulation and modeling
AC542 Operation system design   AC543   Architecture of large systems
AC544 Wireless communication and mobile computing
AC545 Cloud security   AC 546   Intrusion detection systems

xix)   M.Tech. in computer networking

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
CN 511	Advanced computer networking	3	-	-	3
CN 512	Graph theory and network algorithms	3	-	-	3
CN 513	Net working algorithms.	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
CN 514	Computer Simulation Lab	-	-	2	2
CN 515	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
CN 521	Wireless Networking	3	-	-	3
CN 522	TCP/IP Networking	3	-	-	3
CN 523	Network Security	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
CN 524	Communication Engg. Lab.	-	-	2	2
CN 525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives

CN531 Advanced Software Engineering   CN532   Distributed Computing
CN533 CAD of Digital Systems   CN534   Digital Image Processing
CN535 Data Mining and Warehousing   CN 536 Advanced data structure
ICN537 Advanced computer networks   CN538   Graph Theory and Network Algorithms
CN539 Information theory and coding   CN541   Simulation and modeling
CN542 Operation system design   CN543   Architecture of large systems
CN544 Wireless communication and mobile computing
CN545 Cloud security   CN546   Intrusion detection systems

11.8 DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS
xx)   M.Tech. in Digital communication

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
DC511	Satellite Communication	3	-	-	3
DC512	Advanced Digital Communication	3	-	-	3
DC513	Optical Communication.	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
DC514	Modeling and Simulation Laboratory	-	-	2	2
DC515	Seminar 1 and mini project	-	2	-	2
	Total credit 22				

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
DC521	D.S. P. & its Applications	3	-	-	3
DC522	Information Theory and Coding	3	-	-	3
DC523	Digital Image Processing	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
DC524	Communication Engg. Lab.	-	-	2	2
DC525	Seminar 2 and mini project	-	2	-	2
	Total credit 22				

List of department electives

DC531 Mobile communication	DC532 Microwave Communication
DC533 VLSI Design	DC534 Statistical Signal Analysis
DC535 Queuing Theory	DC536 Detection & Estimation Theory
DC537 Modern Telecom Switching Systems	DC-538 Data Compression & Cryptography
DC-539 Optical Network	DC541 Neural Networks
DC542 Fuzzy Logic	DC543 Active RF Devices and Circuits

xxi)   M.Tech. in VLSI and embedded systems

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
VED511	VLSI Technology	3	-	-	3
VED512	VLSI Design	3	-	-	3
VED513	Embedded systems	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
VED514	VLSI Lab	-	-	2	2
VED515	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
VED521	Low power VLSI Design	3	-	-	3
VED522	VLSI Signal Processing	3	-	-	3
VED523	Testing og VLSI elements	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
VED524	CAD Laboratory	-	-	2	2
VED525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives

VED531 Digital System Design   VED532 Mixed signal design
VED533 MEMS   VED534 Design of Semiconductor Memories
VED535 Active filter design   VED536 Physical Design Automation
VED537 ASIC Design   VED538 Co-design of large systems
VED539 Design of analog IC   VED541 Design for Testability
VED542 Advanced Signal &Image Processing V ED543   Device Modelling and simulation

SCINECE DIVISION

11.9 DEPARTMENT OF MATHEMATICS

xxii) M.Tech. in Bioinformatics

First semester

Course Numbeer	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
BI511	Bioinformatics Computing	3	-	-	3

BI512	Biological Databases and their Management	3	-	-	3
BI513	Biomathematics	3	-	-	3
	Elective-I	3	-	-	3
	Elective-II	3	-	-	3
	Open Elective-I	3	-	-	3
BI514	Lab Practice-I	-	-	2	2
BI515	Seminar1 and mini project	-	2	-	2
				Total Credits	22

Second semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
BI521	Data Mining and Data Warehousing in Bioinformatics	3	-	-	3
BI522	BioModeling and Simulation	3	-	-	3
BI523	Optimization Technique & Graph Theory	3	-	-	3
	Elective-III	3	-	-	3
	Elective-IV	3	-	-	3
	Open Elective-II	3	-	-	3
BI524	Lab Practice-II	-	-	2	2
BI525	Seminar 2 and mini project	-	2	-	2
				Total Credits	22

List of department electives

BI531 genome informatics and protome informatics

BI532Metabiomics informatics and metabolomics

BI533Bio inspired artificial intelligence and soft computing technics .

BI534langauges, algorithems and tools in bioinformatics

xxiii) M.Tech. in computational and systems bioinformatics

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
CSB511	Foundations of computational and system biology	3	-	-	3
CSB512	Applied bioinformatics	3	-	-	3
CSB513	Mathematical and Computational Biology	3	-	-	3
	Elective – 1	3	-	-	3
	Elective – 2	3	-	-	3
	Open elective-1	3	-	-	3

CSB514	Computational; laboratory 1	-	-	2	2
CSB515	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
CSB521	Mathematical modeling and simulation of biological systems	3	-	-	3
CSB522	Applied bioinformatics	3	-	-	3
CSB523	Mathematical and computational biology	3	-	-	3
	Elective – 3	3	-	-	3
	Elective – 4	3	-	-	3
	Open elective-2	3	-	-	3
CSB524	Computational; laboratory 2	-	-	2	2
NT525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives
CSB531 genome informatics and protome informatics
CSB532Metabiomics informatics and metabolomics
CSB533Bio inspired artificial intelligence and soft computing technics .
CSB534langauges, algorithems and tools in bioinformatics

11.10   ENERGY CENTER
xxiv) M.Tech. in Renewable Energy
First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
EN511	Renewable Energy sources	3	-	-	3
EN512	Energy Conservation and Management	3	-	-	3
EN513	Ecology & Environment	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
EN514	Energy Laboratory –I	-	-	2	2
EN515	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
EN521	Wind Energy & Utilizations	3	-	-	3
EN522	Solar Energy and its Utilizations	3	-	-	3
EN523	Energy Economics, Policy & Planning	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
EN524	Energy laboratory-II	-	-	2	2
EN525	Seminar 2 and mini project	-	2	-	2
				Total credit	22

List of department electives

EN531 Instrumentation and Control   EN532 Energy Storage Technology
EN 533 Power Plant Engineering   EN534Solar Passive Architecture
 EN535 Energy Efficient Electric Drives

xxv)   M.Tech. in Green Technology

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
GT511	Renewable Energy sources	3	-	-	3
GT512	Energy audit and Management	3	-	-	3
GT513	Energy Modeling & Simulation	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
GT514	Sustainable Energy Laboratory-I	-	-	2	2
GT515	Seminar 1 and mini project	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
GT521	Solar Thermal & PV System	3	-	-	3
GT522	Wind Energy & Small Hydro Power	3	-	-	3
GT523	Carbon Sequestration &	3	-	-	3

	Emission Trading				
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
GT524	Sustainable Energy Laboratory-II	-	-	2	2
GT525	Seminar-2 and mini project	-	2	-	2
	Total credit 22				

List of department electives

GT531 Instrumentation & Control   GT532 Energy Storage Technology
GT533 Intellectual Property Rights   GT534 Hydrogen and Fuel Cell
GT535 Power Plant Engineering   GT536 Geothermal, Tidal and Ocean energy
GT537 Energy efficiency in Electrical Utilities GT538 Environmental Impact assessment

11.11 NANO SCIENCE AND ENGINEERING CENTER
xxvi) M.Tech. in Nanotechnology

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
NT511	Structure and Properties of Solids	3	-	-	3
NT512	Properties of Nano Materials	3	-	-	3
NT513	Processing and Fabrication of Nanostructures	3	-	-	3
NT531-NT534	Elective - 1	3	-	-	3
NT535-NT538	Elective - 2	3	-	-	3
NT551-NT554	Open elective-1	3	-	-	3
NT514	LAB-Practice-I	-	-	2	2
NT515	Seminar	-	2	-	2
	Total credit 22				

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
NT521	Nanostructure Characterization Techniques	3	-	-	3
NT522	Properties of Low-dimensional System	3	-	-	3
NT523	Instumentation	3	-	-	3
NT541-NT544	Elective - 3	3	-	-	3
NT545-NT548	Elective - 4	3	-	-	3
NT555-NT558	Open elective-2	3	-	-	3

NT524	LAB-Practice-II	-	-	2	2
NT525	Seminar	-	2	-	2
				Total credit 22	

List of department electives

NT531 Physics of nano fluids and surfaces   NT532 Physics of amorphous materials
 NT 533 Laser technology   NT534 Semiconductor devices

11.12 REMOTE SENSING, GIS AND GPS CENTER

xvii)   M.Tech. in Geo-informatics and its Applications

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
GI511	Basics of mapping and cartography	3	-	-	3
GI512	Basic concepts of photogrammetry	3	-	-	3
GI513	Principles of remote sensing technology	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
GI14	Remote sensing & cartography lab	-	-	2	2
GI541	Seminar 1 and mini project	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
GI521	Space geodesy and GNSS based mapping	3	-	-	3
GI522	Basic concepts of GIS	3	-	-	3
GI523	Digital processing of remotely sensed data	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
GI524	DPS and GIS lab	-	-	2	2
GI525	Seminar 2 and mini project	-	2	-	2
				Total credit 22	

List of department electives
GI531 Remote sensing and GIS for environmental engineering
GI532 Microwave remote sensing   GI533 Air borne laser terrain mapping
GI534 Hyper-spectral remote sensing
GI535Remote sensing and GIS for hydrology and water resources
GI536 Change detection using remote sensing
GI537 Remote sensing and GIS for earth sciences   GI538 Digital photogrammetry
GI539 Remote sensing and GIS for agriculture & forestry

List of open electives for the M.Tech students
STR 551 Advanced Soft Computing Techniques STR552 Finite Element Method

ENV551   Environmental Modelling   ENV552   Global Issues in Environment
ENV553   Engineering Environmental legislation

GEO551 Advanced Soft Computing Techniques

HYD551 Computer Applications to Hydraulic Systems
HYD552 Instrumentation and Measurement HYD553   Computational Fluid Dynamics

TRE551 Probability and Statistics   TRE552   Optimization Techniques
TRE 553 Operation Research
MAN554 Engineering Economics and Project Management

WRE551 Geospatial Techniques in Water Resources Engineering
WRE552 FEM in Water Resources Engineering WRE553 Transients in Pipe flow

TH551 Non-Conventional Thermal Energy System   TH552 Thermal Power Plant Engineering
TH553 Power Generation Systems.

ID 551 Applied Ergonomics.   ID 552 Concurrent Engineering
ID553 Design of Computer Aided Engineering System

MT551 Theory of Tribology Elements
MT552 Maintenance Economics and Turn Around Management
MT Computer aided maitenance management

ED551 Maintenance Economics   ED552 Turn Around Management.
ED553Maintenance Economics   ED554 Turn Around Management

EM 551 Advanced Mechanics of Materials
SV552 Condition Monitoring

MSME551 Multifunctional oxides : thin films and devices   MSME552 Nuclear materials
MSME553 Material for biomedical application   MSME554 Transport phenomena

MSME555 Materials and processes for semiconductor devices
MSME556 Magnetism and magnetic materials
MSME557 Computational methods for metal forming analysis MSME 558 Tribiology of materials

CH551 Pollution control & Engineering and Safety
CH552 Modeling & simulation of Chemical Engineering. Systems
CH553 Industrial Catalysis   CH554 Pharmaceutical Technology
CH 555 Advanced environmental biotechnology   CH 556 Corrosion engineering

BIO551 System Biology   BIO 552 Molecular and cellular diagnosis
BIO553 Computational Advancement in Biotechnology
BIO554 Quality management and Process design marketing.
BIO555 Bio processing engineering

IS551/AC551/CN551 Technical Foundation for E-commerce
IS552/AC552/CN552 Digital forensics   IS553/AC553/CN553 Cluster and grid computing
IS554/AC554/CN554   Object-oriented Design and Modeling

DC551 Computational Methods for Comm.   DC552 Numerical Analysis
DC553 Data communication Network   DC554Internet Technology
DC555 B ISDN and ATM

VED551 Computational Techniques in digital system design
VED554   CAD of Digital System   VED555 Microprocessor and Micro-controller
VED556   Advance Computer Architecture   VED557 Advanced control Systems

BI 551/CSB551 Chemoinfromatics and drug design
BI552/CSB552 machine learning techniques informatics

EN 551 Green Building   EN552 Power Conversion Techniques
EN553 Integrated Energy Systems   EN554 Energy from Waste

GT551 Green Buildings   GT552 Energy, Environment Policy & Planning
GT552 Bio-energy Conversion systems
GT553 Environmental Pollution Control Technologies

NT551 Advanced low temperature physics   NT552 Molecular electronics & bio molecules
NT553 Instrumentation   NT554 Advanced low temperature physics
NT555 Molecular electronics & bio molecules

GI551 Advanced soft computing techniques
GI552 Geo-informatics in urban mapping and management
GI553 concepts of database systems
 GI554 Geo-informatics applications in engineering projects and utility management
GI555 Remote sensing and GIS for disaster management

MTH 551 Advanced Mathematics

MTH553   Probability and statistical methods   MTH554 Financial Mathematics

MAN554 Project Planning and Management

ARCHITECTURE AND PLANNING   DIVISION

11.13 DEPARTMENT OF ARCHITECTURE AND PLANNING

xxviii) M.PLAN. in Urban Development

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
CM 511	Evolution and theory of planning	3	-	-	3
CM 512	Urban sociology	3	-	-	3
CM 513	Urban economics	3	-	-	3
CM 514	Remote sensing and GIS	3	-	-	3
CM 515	Quantitative research methods	3	-	-	3
CM 516	Introduction to housing	3	-	-	3
CM 517	Seminar -1	-	-	2	2
CM 518	Studio -1	-	2	-	2
				Total credit 22	

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
UD 521	City and Regional Planning	3	-	-	3
UD 522	Statistics and Demography	3	-	-	3
UD 523	Traffic and Transportation Planning	3	-	-	3
UD 524	Elective- 1	3	-	-	3
UD525	Elective 2	3	-	-	3
UD526	Planning legislation and professional practice	3	-	-	3
UD 527	Planning Studio-II	-	-	2	2
UD 528	Planning Studio Seminar- II	-	2	-	2
				Total 22	

List of department electives

UD 531 Energy Efficient Environment Services

UD 531 Ecology & Resource Development Ancient Indian Planning

UD532 Environmental Planning
UD 534Planning of Disaster prone areas   UD535 Urban Energy Systems
UD536 Rural planning & development   UD537 Urban Conservation
UD538 Planning & Development of Informal sector
UD539 Landscape planning

xxix) M.PLAN. in Housing

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
CM 511	Evolution and theory of planning	3	-	-	3
CM 512	Urban sociology	3	-	-	3
CM 513	Urban economics	3	-	-	3
CM 514	Remote sensing and GIS	3	-	-	3
CM 515	Quantitative research methods	3	-	-	3
CM 516	Introduction to housing	3	-	-	3
CM 517	Seminar -1	-	-	2	2
CM 518	Studio -1	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
HU 521	Urban infrastructure planning	3	-	-	3
HU 522	Elective 1	3	-	-	3
HU 523	Housing project formulation and development	3	-	-	3
HU 524	Housing finance	3	-	-	3
HU 525	Land and housing economics	3	-	-	3
HU526	Planning and development of informal sector	3	-	-	3
HU 526	Seminar -2	-	-	2	2
HU 528	Studio -2	-	2	-	2
				Total	22

List of department electives

HU531 Land-use and transportation planning
HU532 Rural development & rural housing
HU533 Housing design and technology

11.14 MCA (MASTER IN COMPUTER APPLICATIONS)

I SEMESTER

Subject Code	Subjects	Periods per Week			Total Credits
		L	T	P	
MCA511	Mathematics-I	3	---	---	3
MCA512	Computer Organization & Architecture	3	---	---	3
MCA513	Data Structure	3	---	4	5
MCA514	Operating System	3	---	---	3
MCA515	Programming through C & C++	3	---	---	3
MCA516	Programming Lab - I	---	---	10	5
	Total	15	---	14	22

II SEMESTER

Subject Code	Subjects	Periods per Week			Total Credits
		L	T	P	
MCA521	Mathematics-II	3	---	---	3
MCA522	Advance Computer Architecture	3	---	---	3
MCA523	Software Engineering	3	---	4	5
MCA524	Principles of Programming Languages	3	---	---	3
MCA525	Theory of Computation	3	---	---	3
MCA526	Programming Lab - II	---	---	10	5
	Total	15	---	14	22

III SEMESTER

Subject Code	Subjects	Periods per Week			Total Credits
		L	T	P	
MCA611	Mathematics-III	3	---	---	3
MCA612	Unix & its Internal	3	---	2	4
MCA613	Windows Programming & Scripting Languages	3	---	---	3
MCA614	Analysis & Design of Algorithm	3	---	---	3
MCA615	Database Management System	3	---	---	3
MCA616	Minor Project - I	---	---	12	6
	Total	15	---	14	22

IV SEMESTER

Subject Code	Subjects	Periods per Week			Total Credits
		L	T	P	
MCA621	Computer Oriented Optimization	3	---	---	3
MCA622	Computer Networks	3	---	2	4
MCA623	Compiler Design	3	---	---	3
MCA624	Distributed Systems	3	---	---	3
MCA625	Web Based Applications Development	3	---	---	3
MCA626	Minor Project - II	---	---	12	6
	Total	15	---	14	22

V SEMESTER

Subject Code	Subjects	Periods per Week			Total Credits
		L	T	P	
MCA711	Computer Graphics	3	---	2	4
MCA712	Intelligent Systems	3	---	---	3
MCA713	Mobile Application Development	3	---	---	3
	Elective – I	3	---	---	3
	Elective – II	3	---	---	3
MCA716	Minor Project - III	---	---	12	6
	Total	15	---	14	22

VI SEMESTER

Subject Code	Subjects	Periods per Week			Total Credits
		L	T	P	
MCA721	Final Dissertation (Major Project)	--	---	30	30
MCA722	Seminar/Presentation (Major Project)	---	---	10	10
	Total	---	---	---	40

List of department electives

MCA631 Data Warehousing and Mining   MCA632 Multimedia Computing
MCA633 Advanced Software Engineering   MCA634 Parallel Computing
MCA635 Advanced RDBMS   MCA636 Cloud Computing
MCA637 Information Retrieval   MCA638 Image Processing
MCA639 Natural Language Processing

11.15 MBA(MANAGEMENT BUSINESS ADMINISTRATION)

First Semester

Subject code	Subject	Periods per week			Total Credits
		L	T	P	
MBA511	Principles and practices of management	3	-	-	3
MBA512	Organizational behaviour	3	-	-	3
MBA513	Managerial economics	3	-	-	3
MBA514	Business statistics	3	-	-	3
MBA515	Information technology and applications	3	-	-	3
MBA516	Business and corporate laws	3	-	-	3
MBA517	Financial accounting & analysis	3	-	-	3
MBA518	Business communication	3	-	-	3
				Total credit 24	

Second Semester

Subject code	Subject	Periods per week			Total Credits
		L	T	P	
MBA521	Financial management	3	-	-	3
MBA522	Marketing management	3	-	-	3
MBA523	Human resource management	3	-	-	3
MBA524	Cost and management accounting	3	-	-	3
MBA525	Management information system	3	-	-	3
MBA526	Business environment	3	-	-	3
MBA527	Research methodology	3	-	-	3
MBA528	Operational research	3	-	-	3
				Total credit 24	

Third Semester

Subject code	Subject	Periods per week			Total Credits
		L	T	P	
MBA611	Strategic management	3	-	-	3
MBA612	Supply chain management	3	-	-	3
	Operations Management	3	-	-	3
	Elective 1	3	-	-	3
	Elective 2	3	-	-	3
	Elective 3	3	-	-	3
MBA613	Seminar	-	2	-	2
MBA614	Summer Training	-	-	2	2
				Total credit	22

Fourth Semester

Subject code	Subject	Periods per week			Total Credits
		L	T	P	
MBA621	International business and trade	3	-	-	3
MBA622	Project management	3	-	-	3
MBA623	Business Ethics and corporate governance	3	-	-	3
	Elective 4	3	-	-	3
	Elective 5	3	-	-	3
	Elective 6	3	-	-	3
MBA624	Seminar	-	2	-	2
MBA625	Project work	-	-	20	10
				Total credit	30

List of department electives

MBA631 Security analysis and portfolio management

MBA632 Corporate tax planning and management

MBA633 Management of financial institution and markets

MBA634 International finance　　　　　　　　MBA635 Working capital and management

MBA635 Financial audit

MBA641 Product and brand management   MBA642 Marketing research

MBA643 Sales, distribution and retail management

MBA644 Consumer behaviour and marketing communication

MBA645 Rural marketing and agro business   MBA646 Marketing of services

MBA651 Human resource development   MBA 652 Industrial relations and labour legislation

MBA653 Compensation and performance management

MBA654 Strategic human resource and planning

MBA655 Organizational development and change management

MBA656   International human resource management

MBA671 Data warehousing and data mining

MBA672 Technology and innovation management   MBA673 E business

MBA674 Software product management

MBA675 Enterprise resource planning   MBA676 Business and IT strategy

COURSE CONTENTS

12.   DEPARTMENT OF CIVIL ENGINEERING

i) STRUCTUREAL ENGINEERING (M.TECH)

STR 511   THEORY OF ELASTICITY

Elasticity: Stress tensor and transformation, equilibrium conditions, simple state of stress, Strain displacement relations, strain tensors and its transformation. Compatibility condition. Constitutive relations, energy principles, problems of linear elasticity- basic equation, boundary value problems, solution of basic equation and equation of plane problems

References

    1. Theory of Elasticity   Timoshenko and Goodier

    2.   Applied Elasticity   Wang

    3.   Mechanics of deformable solids   Irving Shames

    4. Elasticity in Engineering   Scholer

STR 512 ADVANCED STRUCTURAL ANALYSIS

Buckling loads of prismatic and non prismatic beam columns. Finite difference and integration methods. Newmark's approach. Extrapolation by Aitken's delta square procedure. Richardson's extrapolation.

Analysis of frames by Kani's method. Matrix methods of analysis for beams and frames. Flexibility and stiffness methods.

References

    1. Matrix Computer Analysis of Structures   Moshe F. Rubinstein,

    2. Structural Analysis   R.C. Coates & MG Coutie, FG Kong,

    3. Analysis of frame structures   J M Gere & W. Weaver,

    4 , Advanced theory of structures.   N. C. Sinha & P. K. Gayen.

STR 513 DESIGN OF R.C.C. STRUCTURES & STEEL STRUCTURES

Revision of basic concepts of limit State Design of prismatic members in flexure, shear and bond. Redistribution of moments in fixed and two span continuous beams. Calculation of deflection due to load shrinkage and creep and calculation of crack width as per IS code. Yield line theory for slabs, yield line mechanics , equilibrium and virtual work methods special.

Analysis and Design of axially loaded Short column and analycic with unaxial anf biaxial bending column interaction diagram , its construction and use. Introduction to design and analysis of slender columns.Introduction to analysis and design of folded plates and circular shells.

Design of steel structural elements in accordance with IS : 800-2007. Load and Resistance Factor Design. Design of bolted and riveted joints . Block shear failure and shear lag . Design of welded joints.

Design of tension members. Design of compression members. Overall buckling strength and section strength. Combined direct and bending strength. Laced and battened columns. Design of columns bases.

References
1.   Design of Steel Structures   N.Subramanian

STR 514 STRUCTURAL LAB 1

List of Experiments
1.   Field related structural design problems and their solutions by using software packages.
2.   Field related testing of structural materials and components

STR 515 SEMINAR 1

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second Semester

STR 521 PRESTRESSED CONCRETE

Design of prestressed elements by working stress and Limit state approach.. Design of Beams : Critical load condition, Permissible stresses, Various suggested methods of design, Composite Beams and Continuous Beams, Partial prestressed beams.. Slabs: Design of various type of slabs.

Shear and Bond in Prestressed Concrete, Anchorages in Prestressing, Post tensioned Construction. Prestressing cable at the centroidal axis, Symmetric multiple cable, cable with eccentricity, Inclined cables, Spalling and bursting stresses.. Miscellaneous Structures : compression members, tension members, prestressed concrete pavements, folded plate and shells, arches, rigid frames, cylindrical tanks.

References
1. Prestressed Concrete.   G. S. Pandit, S.P.Gupta.
2. Prestressed Concrete   N. Krishna Raju.
3. Prestressed Concrete.   Libby,

STR 522 STRUCTURAL DYNAMICS

Structures modelled as a single degree of freedom system. Structures Modelled as shear buildings. Framed structures modelled as discrete multi degree of freedom systems. Structures modelled with distributed properties. Random vibrations.

References
1.   Structural Dynamics Theory and computation   MARIO PAZ

STR-523 THEORY OF PLATES AND SHELLS

Pure Bending of Plates, Symmetrical Bending of Circular Plates, Rectangular Plates Different forms of shell structures, Analysis of Shell Structures, Membrane Analysis of Shells, Folded Plate Structures, Introduction to Grid Structures

References

1. Theory and Analysis of Plates,   Rudolph Szilard,
2. Theory of plates and shells,   S. Timoshenko and Woinowsky Krieger,
3Theory of plates   . K. Chandrashekhara,
4. Beam plates and Shells   Lloyd Hamilton Donnell,

STR-524STRUCTURAL LAB –II

Field related structural design problems and their solutions by using software packages.

Field related testing of structural materials and components.

STR 525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

STR 531 SOIL STRUCTURE INTERACTION

Soil Foundation interaction, soil foundation – structure interaction, soil – fluid structure interaction, idealization of soil by various linear and non-linear, isotropic and anisotropic models, soil – parameters : Interpretation of parameters encountered in various idealized soil models, experimental investigations. Finite difference solution to problems of beams on linear and non – linear winkler models. Soil – structure Interaction in framed structure, FEM Modelling. Use of appropriate software packages. Introduction to dynamic soil structure interaction as well as non linear soil / concrete behavior.

References

1. Dynamic Soil-Structure Interaction   John, P. Wolf,
2. Soil-Structure Interaction in Time Domain   John, P. Wolf,
3. Constitutive Modelling of Soil and Rocks.   Desai, C.S. Srivardhane,

STR 532 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

Introduction to steel concrete composite structures. Composite beams. Composite columns. Composite floors.

References

1. Composite structures of steel and concrete.   Johnson, R. P

STR-533 MAINTENANCE AND REHABILITATION OF STRUCTURES

Quality assurance for concrete construction, concrete properties: strength, permeability, thermal properties and cracking.

Influence on Serviceability and Durability, Maintenance and Repair Strategies, Materials for Repair, Techniques for Repair.

References

1 Concrete Structures, Materials,   Denison Campbell
2. Repairs of Concrete Structures,   Allen, R.T. and Edwards, S. C.,
3.. Concrete Technology   Shetty, M.S.,
4.. Training Course notes on Damage Assessment and repair inLow Cost Housing, Santhakumar, A.R.,

STR-534 TALL STRUCTURES

Principles of Planning of Tall Buildings, Loads on Tall Buildings, Analysis of Tall Buildings (With and Without Shear Walls), Design of Tall Buildings, Soil Structure Interaction

References

1. Tall Building Structures – Analysis and Design   Bryan Stafford smith and Alex Coull,

STR-535 BRIDGE DESIGN

Bridge System, Considerations in alignment, planning, economic consideration, aesthetics and selection of type of bridge. Loading Standards, Super Structure Analysis, Design of Bridge Decks and Bearings, Connections, Substructure Analysis and Design, Foundations, Construction & Maintenance, Dynamic Behaviour, Long Span Bridges, Design of Aqua-duct & Box culverts.

References

1Concrete Bridge Practice   . Raina, V. K.,

2. Essentials of Bridge Engineering,   Victor, D.J.,

3. Bridge Engineering   Demetrios E. Tonias,

STR-536 SAFETY IN CONSTRUCTION

Accident prevention, Cost of accidents, Safety and productivity, Safety provisions in the factories act, Accident reporting investigation and statistics. Safety Equipment, Safety Systems, Safety in Hand Tools, Safety in Demolition Work

References

1. BHEL Safety Manual, BHEL, Trichy.

2. Construction Technology   Akaev, S.S.,

3.. Construction Hazard and safety Hand Book   Hudson, R.,

2. Safety in the Build Environment   Janathen D. Sime,

STR537 ADVANCED STEEL STRUCTURES

Communication and transmission line steel towers, masts. Design of Industrial structures, composite steel and insitu concrete beams and slabs.

References

1. Design of Steel structures   P.Dayaratnam,

2. Composite Structures   R.P.Johnson,

3.   Design of steel structures   N.Subramanyam,.

STR538 EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES

Earth Quake ground motion. Structural Dynamics. Concepts of earth quake resistant design of Reinforced concrete buildings. Seismic analysis and modelling of reinforced concrete building. Earthquake resistant design of reinforced concrete buildings. Earthquake resistant design of masonry buildings. Seismic evaluation and retrofitting of reinforced concrete and masonry buildings.

References

   1.   Earth Quake Analysis And Design Of Structures   Pankaj Agrawal and Manish Shrikhande.

STR539 DESIGN OF FOUNDATION SYSTEM

Shallow foundations: Bearing capacity equations, special footing problems, I.S. Codes, Design of foundations and computation of settlements. Pile foundations: Type of piles, estimating pile capacity, pile load tests, negative skin friction, modulus of sub-grade reaction for laterally loaded piles, lateral resistance. Pile group considerations, efficiency, settlement of pile groups, pile caps, I.S. Codes Well

Foundations: Types, shapes, bearing capacity and settlements, determination of grip length by dimensional analysis, stability of well foundations by IRC Method, construction, Tilts & shifts.

Sheet pile Structures: Types, Design / methodology Anchors Braced Sheeting, Cofferdams, single well cofferdams, cellular cofferdams, stability of cellular cofferdam, instability due to Heave of Bottom.

References

1. Soil Mechanics   Lamb and Whitman
2. Soil Engineering   Alam Singh,
3. Foundation Engineering   Bowles

STR541 ADVANCED RCC STRUCTURES

Multi-storeyed building systems, grid floors , tubular structures, RCC domes and shell roofs.

References

1. Advanced Reinforced concrete design,   N.Krishna Raju,
2. Design of R.C.C structures   P.Dayaratnam,

ii) ENVIRONMENT ENGINEERING (M.TECH)

ENV511 PHYSICO-CHEMICAL TREATMENT PROCESSES

Definitions of unit operations and processes. their applications in environmental engineering. unit operations : mixing : types of impellers, baffling, fluid regions, power curves, scale up, mixing and gas transfer, flocculation. sedimentation : types, long tube tests, scale up, sedimentation equipment, batch flow and continuous flow operations. flotation and aerosol separation : methods of flotation, chemical agents promoting flotation, gas particle contact. aerosol, separation- particle characteristics, gravity setters, centrifugal separators, impingement separators, electrostatic precipitators, scrubbers. flow through beds of solids : slows and filters, rapid sand filters, ion exchange units, adsorption towers, contacting towers, flow through expanded beds, flow through porous plates and membranes. vacuum filtration - rotary drum filters yields, specific resistance, experimental determination of specific resistance. gas transfer - mechanism of transfer, film coefficients and equilibrium relationship, gas disperses, packed columns, tray columns, spray units adsorption and leaching - fixed bed and moving bed adsorption, leaching, dispersed contact operation, leaching calculations.

unit processes - chemical unit processes -chemical precipitation, adsorption and desorption disinfection with various agents

References

1. Water Supply and Sewerage   Steel
2. Environmental Engineering   Arcadio P. Sincero and Gregoria A. Sincero
3. Water Quality and Treatment Handbook   American Water Works Association,
4. Water Treatment plant Design   American Society of Civil Engineering

ENV512 AIR AND NOISE POLLUTION CONTROL

Sources of air pollution- effects of air pollution in regional and global scale, air pollution episodes; emission factors inventory and predictive equations, atmospheric meteorology, air quality monitoring, dispersion of air pollutants and modelling, air pollution control devices.

Noise pollution: basics, sources, indices, noise instrumentation and monitoring procedure. outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: noise standards and limit values, control

References

1. Air Pollution   C.R.Philips.

2. AIR Pollution	MN Rao & MN Rao
3. Environmental Noise Pollution	PE Cunniff
4. Air Pollution	Perkins, H.C

ENV513 BIOLOGICAL TREATMENT PROCESSES

Sewage characteristics, quantity & quality, flow rate, treatment flow -sheets. sewage treatment process, reactor type, hydraulic characteristics, C-diagram, principle of biological treatment-derivation of bacterial growth kinetics used in designing of wastewater treatment plant. process design and operation of activated sludge process and its modification. bulking and rising sludge. design of secondary settling tank. oxidation ditch, extended aeration system, SBR; process design and operation of mechanically aerated lagoon and waste stabilization pond system, septic tank, cesspools and their effluent disposal methods. Design and operation of biological nitrification - denitrification system; luxurious phosphorus uptake, aerobic attached growth process -process design and operation of trickling filter, RBC, biofilter, anaerobic treatment: process microbiology and biochemistry; application for treatment of sewage, advantage and disadvantages, floating aquatic plant system and its design and operation, sludge characteristics and disposal methods -design and operation of sludge drying bed.

References

1. Wastewater Engineering: Treatment, disposal, Reuse	Metcalf & Eddy
2. Environmental Engineering	Peavy, HS, Donald RR &
	G. Tchobanoglous
3. Wastewater Treatment for Pollution Control	Soli J Arceivala
4. Wastewater Treatment Plants: Planning, Design and Operation	
	S.R..Qasim, Holt, Rinehart & Winston,

ENV514 ADVANCE ENVIRONMENTAL ENGINEERING LAB

Sampling and analysis of inorganic and organic substances ,experiments on UV-VIS spectrophotometer, Flame photometer, AAS, GC, TOC etc. Determination of SPM; PM_{10}; SO_2; NO_x and CO in ambient air; Respirable dust monitoring experiments on noise pollution monitoring equipment; experiments on stack monitoring kits; Wind rose diagram. Determination of MLSS and MLVSS. Sludge Volume Index (SVI) and development of sludge settling characteristics curve and design of PST based on settling curve. Determination of BOD_5 :TKN ratio, determination of the COD:BOD_5 ratio

ENV515 SEMINAR 1

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second semester

ENV521   ADVANCED TREATMENT METHODS

Ion exchange and Membrane Process,   Separation processes, reverse osmosis, Ultra filtration, Electrodialysis. Chemical oxidation : Oxidation processes, principle & theory of chemical oxidation, , Disinfection : Disinfection processes, non-chemical methods for disinfection, chemical disinfectants, Halogens other than chlorine, oxidizing agents other than halogen, miscellaneous reagents. Effect of chemical constituents in waste water, Unit operations and process and treatment flow sheets. Nitrogen Conversion and Removal : Nitrification, denitrification, nitrification-denitrification Nitrogen removal by by physical-chemical process phosphorous removal, removal of repactory organics, removal of dissolved inorganic substances, removal of dissolved,inorganic substances,. Ultimate disposal of contaminants. Land treatment method : Development of land treatment systems. Land application of sludge, effluent disposal & reuse.

Reference

| 1. Wastewater Engineering: Treatment, Disposal, Reuse | Metcalf & Eddy |
| 2. Wastewater Treatment for Pollution Control | Soli J. Arceivala |

3. Wastewater Treatment Plants: Planning, Design & Operation	S.R.Qasim,Holt,Rinehart, Winston,
4. Wastewater Treatment	DWSunderstorm and H.E. Klei

ENV522 SOLID WASTE MANAGEMENT

Solid Waste, Sources, types, composition, physical, chemical and biological properties of solid wastes, sources and types of hazardous and infections wastes in municipal solid wastes, Solid waste generation and collection, Handling, storage, processing, transportation, Disposal of solid wastes : Materials separation and processing, thermal conversion, biological and chemical conversion, recycling of material in municipal solid wastes, Land filling, Composing, gas generation, closure of landfills, Industrial solid wastes: Composition, biodegradable, non biodegradable hazardous, toxic solid wastes,, methods of detoxification, disposal on land disposal into water bodies.

Legal aspects of municipal solid waste collection, conveyance, treatment and disposal, Hazardous wastes: Origin, quantity and quality parameters, Treatment and disposal methods: Physico-chemical and biological, stabilization and solidification, thermal methods, land disposal, site remediation.

References

1. Solid Waste Management	Frank Kreith
2. Management of Solid Wastes in Developing Countries	Frank Flintoff
3. Solid Waste Conversion to Energy	Harvey Alter, J.J. Dunn

ENV523 ENVIRONMENTAL IMPACT ASSESSMENT AND LEGISLATION

Role of EIA as a tool for Sustainable Development. Concept of Carrying Capacity and Limits to growth in terms of population, Food, Resources, Capital, Energy, Land Services etc.

Impact Assessment: Environmental, Social and Economic issues, Issues in collection of baseline data, preliminary concept of Natural Resource Accounting, Concept of Screening, Initial environmental examination (IEE), Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS), and Strategic Environmental Assesment., Rapid and Comprehensive EIA. Methodologies: Including Checklists, Matrices and Networks, EIA: Case studies and Issues. Procedures for Environmental Clearance by the Government of India, Mitigation Strategies, Environmental Management, Appropriate Setting of Industries and Projects for minimising impacts. Concept of Zoning Atlas.

Environmental acts - Their need, historical background, national and international acts; Case laws - Principles of case laws, statutory interpretations, site selection, land use planning, town planning act. ISO: 14000 - its need, procedure to be followed to obtain ISO:14000 certification, implications of ISO.

References

1. Environmental Impact Assessment	Larry, W. Canter .
2. Introduction to Environmental Impact Assessment	John Glasson, R. Therivel, et al
3. Methods of Environmental Impact Assessment	Peter Morris, Riki Therivel
4. A Practical Guide to Environmental Impact Assessment	Paul, A Erickson

ENV524 TREATMENT PLANT DESIGN LABORATORY

Experiments in water treatment plants

ENV525 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

ENV531   ENVIRONMENTAL MICROBIOLOGY AND ECOLOGY

 Microorganism ,nutrition and growth conditions , metabolic classification of microorganisms , ATP formation , metabolism , kinetics of biological growth bacterial growth in terms of numbers and mass, growth curve, interpretation of curve, substrate limited growth, Monod's expression, substrate utilization and cell growth, effect of endogeneous metabolism, effect of temperature application of growth and substrate removal kinetics to biological treatment, central pathways; aerobic anaerobic metabolism of carbohydrates, proteins, lipids, nucleic acids and hydrocarbons, control of metabolic reactions.

microbiology and ecology of activated sludge process, trickling filters, oxidation ponds, aerobic and anaerobic digesters, anaerobic filters, UASB reactors, composting, vermiculture and other methods. Reduction of pathogen in treatment processes. Nuisance microorganisms, Indicator microorganisms, Bacteriological tests : plate count, presumptive confirmed and completed tests for coliforms, fecal coliforms test fecal streptococci test, bifido bacterium test, clostridium welchii test, MTD MF techniques, algae counting. ecology: basic principles, food chain, trophic structure, grass production to total community respiration ratio (P/R), biogeochemical cycles, limiting factors - liebig's law extended, ecological regulation, important ecosystems.

References

1. Fundamentals of Ecology   MC Dash
2. Microbiology   Michael J.Pelzer et.al
3. Fundamentals of Ecology (3rd ed).   Eugene P. Odum
4. Microbiology for Environmental Scientists and Engineers   Gaudy, AF and Gaudy

ENV532 ENVIRONMENTAL CHEMISTRY

 Acid base equilibria, solubility equilibria , oxidation reduction equilibria , solubility equilibrium for slightly soluble salts, effect of other solutes on salt solubilities, competing acid-base equilibra, effect of complexions, hydrolysis, computing total soluble species concentration, competing solid phase equilibria, equilibrium diagrams. oxidation reduction processes, Nernet equation, stability, diagrams, measuring redox potential.

Colloidal chemistry , nuclear chemistry , adsorption , basic concepts, factors affecting adsorption, isotherm studies. ion exchange, reverse osmosis, fluoride removal iron and manganese removal analysis of various ions , trace organics and trace inorganics, instrumental methods of analysis, gas analysis.

References
1. Chemistry for Environmental Engineering and Sciences   CN Sawyer, PL McCarty and GFParkin,
2. Environmental Chemistry   Stanley E. Manahan
3. Aquatic Chemistry   W.Stumm & JJ Morgan
4. Principles and Application of Aquatic Chemistry   FMM Morel & JG Hering

ENV533 ENVIRONMENTAL QUALITY MONITORING

Principals of instrumentation: advantages.applications and limitations of the analytical techniques-spectrophotometry, atomic absorption and emission spectrophotometry, flame photometry, nephelometry, inductively coupled plasma spectrometry , mass spectrometry, FTIR, NMR, electrochemical methods: polrography, ionselective electrodes, chromatography: classification, general ideas about absorption,partition and column chromatography, paper and thin layer chromatography, gas chromatography, high performance liquid chromatography, ion chromatography, remote sensing application: basics of remote sensing, application of remote sensing in environmental monitoring – landforms, soil, vegetation, land use and wetland mapping, monitoring of air quality parameters: methods, equipments, standards monitoring of water and soil quality parameters: methods, equipments, units and standards , environmental quality modeling, environmental quality indices.

References
1. Instrumental Methods of Analysis   HH Willard & LL Dean, John Wiley,
2. Instrumental Methods of Chemical Analysis   GW Ewing
3. Modern Methods of Chemical Analysis   RL .Recsok & LD Shields
4. Fundamentals of Molecular Spectroscopy   CN. Banwell

ENV 534 ENVIRONMENTAL AUDITING AND MANAGEMENT SYSTEMS

Concepts of environmental audit, objectives of audit. types of audits; features of effective auditing; programme planning; organisation of auditing programme, pre-visit data collection. audit protocol; onsite

audit; data sampling - inspections - evaluation and presentation; exit interview; audit report - action plan - management of audits; waste management contractor audits. life cycle approach.

introduction; principles & elements of successful environmental management; ISO principles; EMS; Creating an environmental management system in line with ISO: 14000; benefits of an environmental management system; principles & elements of successful environmental management: leadership, environmental management planning, implementing an environmental management system, measurement & evaluations required for an environmental management system, environmental management reviews & improvements; legal and regulatory concerns; Integrating ISO 9000 & ISO 14000.

References:
1. Renewable Energy Environment and Development   Maheswar Dayal
2. Planning and Implementation of ISO14001, Environmental Management System
                                                           Girdhar Gyani
3. ISO: 14000 Handbook   Joseph Caseio (Ed),
4. INSIDE ISO: 14000 – The Competitive Advantage of Environmental Management
                                                           Don Sayre

ENV535 INDUSTRIAL WASTE TREATMENTS

Effluent standards, minimal national standards (minas). sources and effects of various pollutants, disposal of industrial wastes-on land, in creeks and the sea, in inland streams, into impoundments, importance of planning location of industries and industrial estates, common effluent treatment plants, their economics and management, pretreatment of wastes : volume and strength reduction, recovery of bye products , reuse of wastewater, waste segregation. conventional methods of treatment of wastewater: removal of suspended solids, inorganic and organic dissolved solids, sludge disposal. low cost treatment plants. common effluent treatment plant, design and operation.

Detailed considerations of wastes from industries such as textile (cotton, wool, rayon, synthetics), sugar, pulp and paper, distilleries, oil refineries, petrochemicals, pharmaceuticals, dairy, food processing, soaps and detergents, mining, iron and steel, pickling, plating, galvanizing, tanning slaughterhouse, fertilizers, pesticides, dyes and dye intermediates, radioactive wastes, Recovery of hyproducts, reuse of wastewaters with or without treatment.

References
1.   Industrial Water Pollution Control   Eckenfelder
2.   Environmental Industrial Pollution control   P.R.Trivedi and Gurdeep Raj.
3.   Pollution Control in process industries   S.P.Mahajan.
4.   Waste Water Treatment for Pollution Control   Soli J.Arcieivala.

ENV536 ENERGY BY BIO CONVERSION

Biomass as a source of energy, type of biomass, biomass as conversion technology: wet process & dry process. anaerobic digestion: the biochemistry of anaerobic digestion, factors affecting anaerobic digestion, types of digesters, process design, gas production, collection. method for maintenance of biogas plant, problems related to bio gas plants. bio fuels: energy plantation, plants proposed for energy plantation, ethanol production, biodiesel, esterification & economics of bio diesel. biological production of hydrogen. thermal processes: combustion of bio-fuel, gasification of biomass, classification of gasifiers, chemistry of gasification process, problems in gasifiers, pyrolysis, alcohol fuels.

References
1. Bio-energy   Caroline S. Harwood, Arnold L. Demain
2. Bio fuels Engineering Process Technology   Cype Drypcho
3. Biomass to bio fuel: Strategies for global industries   Dr Alain Verts, Dr Nasib Qureshi,
                                                            Hideaki Yukawa and Hans P. Blaschek.
4. Non conventional energy resources   G.D. Rai.

ENV537 HAZARDOUS WASTE MANAGEMENT AND RISK ANALYSIS

Hazardous wastes: landmark episodes, classification, generation, guidelines of HWM, regulatory frame work, basal convention, monitoring of critical parameters/provide risk analysis. hazon, hazop,

consequence analysis. faculty and eventry analysis. emergency management: Indian and international legislation in respect of the above. case studies, leakage, explosion, oil spills and fire of hazardous chemical storage. leakage in atomic plants, hazardous chemicals: physical properties, chemical composition, lethal dose and concentration. storage, collection and transport, hazardous waste treatment: characterization of waste, compatibility and flammability of chemicals, physico-chemical and biological treatment of hazardous waste including waste reduction, neutralization, incineration, combustion and pyrolysis, stabilization , solidification, bio-remeadiation, precautions in collection, reception, , transport, storage and disposal. import procedure for environmental surveillance, radioactive waste management - sources, measures, health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options, environmental risk assessment: defining risk and environmental risk, methods of risk assessment, case studies, dose-response assessment, risk exposure assessment.

Reference books:

1. Solid Waste: Engineering Principles & Management Issues G.Tchobanoglous, GH. Theisen
2. Environmental Engineering   HS Peavy, DR Rowe & G Tchobanoglous
3. Quarry Reclamation   NJ Coppin and A.D.Bradshaw,
4. Hazardous Waste Management (2nd ed)   MD, PL Buchingham & JC Evans,

ENV538 ENVIRONMENTAL ECONOMICS AND SOCIO-ECONOMIC PLANNING

Economy and environment -the historical development of environmental economics; the circular economy, the sustainable economy. economics of pollution;-the optimal level of pollution, the market achievement of optimal pollution, taxation and optimal pollution, environmental standards, taxes and subsidies, marketable pollution permits, measuring environmental damage -total economic volume and valuation methodology, pollution control policy in mixed economics. environmental values ethics; discounting the future, alternative to adjusting discounting rates, economics of natural resources;- renewable resources, extinction of species, optimal use of exhaustible resources measuring and mitigating natural resource scarcity. development and environment;- development, preservation and conservation, irreversibility and sustainability, environment and the developing countries. carrying capacity based development planning. cost benefit analysis of environmental change; appraisal of sustainable development projects; principles of cost allocation, preventive, punitive and social costs, socio-economic planning: importance of socio-economic development planning. social indicators and their importance; social impacts of industrial and developmental activities. quality of life concept- and its use in development planning. social surveys and socio-economic data generation. social cost of environmental pollution. rehabilitation and resettlement of project affected people. laws related to social development.

References:

1. Economic Analysis of Environmental Impacts   Dixon, John, A, Scura LF
2. Values for the Environment: A Guide to Economic Approach

                                                          Winpeny JT
3. Environmental Assessment Source Book (Vol – 1)   World Bank, Environment
4. The World bank, Valuing the Environment   Barde J and Pearce DW

iii) GEOTECHNICAL ENGINEERING (M. TECH.)

First Semester

GEO 511   ADVANCED GEOTECHNICAL ENGINEERING

Definition of Soil, Geological cycle of formation of soil, differences in behaviour of soil and other engineering materials. Common clay minerals, development of plasticity in soils, significance and range of index properties of coarse and fine soils. Empirical connection of index properties with engineering parameters. Common soil deposits in Madhya Pradesh and their typical characteristics. Problems of black cotton soil.

Flow of water through saturated soil- permeability, derivation of Poiseuille's law and discussion of factors affecting permeability. Flow nets, quick conditions, flow of water in unsaturated form. Mechanism of consolidation, consolidation test, determination of field compression index for normally and over consolidated soils, coefficient of consolidation and its determination. Calculation of settlements, calculation of time rate of settlement. Three dimensional consolidation, design of sand/rope drains.

Mohr-coulomb equation, determination of shear strength, Behavior s of sands under shear, dilatancy, behaviour of clays under shear, pore pressure coefficients and their use. Introduction to rock mechanics- Difference in behaviour of rock and soil, physical properties of rock, classification of rock, mechanical properties of rock, in-situ stress in rock behaviour of rock in triaxial compression.

References:

1. Soil Mechanics.   Lambe and Whitman
2. Physical properties of soils.   Means and Parcher
3. Soil Mechanics   Bowles
4. Foundations on expansive soils.   Chem

GEO512   FOUNDATION ENGINEERING – I (SHALLOW FOUNDATIONS)

Introduction: The components of foundation, classification of foundation, steps involved in choice of foundation. Soil Design Parameters: Bearing capacity, settlement, depth of foundation, depth of soil exploration, footings subjected to moments, footings subjected to Tension. Study of IS Codes: IS : 1498,1982,IS : 1888, IS : 2131, IS: 6403 and IS : 1904, All other relevant codes with latest editions. Shallow Foundations in clay: Soil design of footings in clay with settlement calculations,

Shallow foundations in sand: Soil designing of footings in sand. Raft Foundations: Rafts in clay and in sand. Floating rafts, buoyancy rafts and basement rafts. Retaining Structures: Types, Stability Analysis, Anchored- bulkheads.

GEO 513   MACHINE FOUNDATION VIBRATIONS

Terminology used in study of vibrations: Accelerating bodies (acceleration, velocity, displacement), amplitude (displacement, vibration) Static and Dynamic Balancing of a rotating body, phenomenon of beat, damping, different types of excitation- impulse, inertial, harmonic, periodic, transient, Type of machine foundation structure- block type, Frame type, mat type, Overturned & under turned machine Foundation.

Frequency: Angular, damped, natural, operating, fundamental, Magnification or Amplification Factor. Mass: Continuous and equivalent lumped mass Motion: Periodic, aperiodic, simple harmonic, sub-harmonic, super harmonic.

Modes of vibration: Phases angle, resonance, spring stiffness, degree of freedom. Fundamentals of theory of vibrations, single degree of freedom system- calculation of parameters for mathematical model: Equivalent mass, equivalent spring constant, Equivalent forcing function.

Formulation of Mathematical Model: Transient or free vibrations, steady state solution of forced vibration. Dynamic system subjected to rotating mass type Excitation. Two degree of freedom system without and with damping, multi degree of freedom

system. Vibration of block foundation. Induced Vibrations due to Vehicular traffic and blast waves, vibration of structures due to earth quake and man made ground vibration, structural damage and human sensitivity to the vibration. Vibration isolation- active and passive, various methods of vibration isolation.

Suggested Text Books and References:

1. Soil dynamics and machine foundation   Swami saran

2. Soil dynamics	Shamser Prasad
3. Mechanical Vibration	Grover

GEO 514 LOBORATORY PRACTICE

Expeimrnts of soil mechanics

GEO 515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second Semester

GEO 521 SOIL DYNAMICS

Historical development of soil dynamics, Damage to foundations and earthen structures due to vibrations and other dynamic forces. Earthquakes and related terminology. Propagation of Elastic waves in soil.

Dynamic soil properties factor affecting, Determination using various laboratory and field methods, selection of appropriate value of dynamic soil property for the Design of Structure subjected to vibration. Dynamic earth pressures: Active and Passive Pressures, Retaining wall problems under Dynamic loads. Dynamic Bearing Capacity of soils. Dynamic characteristics of Pile Foundation.

Laboratory Work: Laboratory experiments to cover the above course. List o experiments will depend on the facilities available.

 References

1. Soil dynamics and Machine foundation	Swami saran,
2. Soil dynamics	Shamser Prasad,
3. Analysis and design of foundation for vibration	P. J. Moore,

GEO522 DESIGN AND CONSTRUCTION OF MACHINE FOUNDATIONS

Classification of machine foundations and fundamental principles for the design of machine foundation under static and vibratory systems. Criteria for design. Dynamic Soil investigation: Theoretical and practical determination of elastic properties of soil, Behaviour of soil under dynamic loads, determination of allowable soil stress for dynamic loads.

Computation of machine foundations taking into consideration the vertical, horizontal and rotational vibrations for heavy machines like mechanical hammers, reciprocating engines, turblnes, rolling mills, forging presses and crushing machines. Structural details for machine foundations- Concreting of foundations and their connection to superstructure including details of form work-reinforcements. Floors and their connection to buildings. Prestressed concrete, brick work and shallow foundations. Plants and equipments used for the construction of machine foundations. Examples of heavy machine foundations in one major design of heavy machine Isolation

of machine foundations.

GEO 523 FOUNDATION ENGINEERING – II (DEEP FOUNDATION)

Introduction to various types of deep foundations, cofferdams, diaphragm walls and foundation dewatering. Piles: Types, mechanics of load transfer, negative skin friction, determination of ultimate load capacity of individual and group of piles, under reamed piles.

Study of Codes: Study of all the codes of Indian Standards relevant to deep foundations, such as IS: 8009, IS: 3955, IS 2911 latest editions. Well Foundations: Classification, forces acting and stability construction techniques, tilt and shift, dewatering.

Piles: Analysis and design of flexible piers, Drilled Piers. Supporting system for cuts, Heave at the bottom of cuts. Arching of soils. Earth Pressure in Tunnels, Soil Pressure on conduits.

GEO 524   LABORATORY PRACTICE- II SOIL DYNAMICS

Laboratory Practice II, Soil Dynamics

This will include

1. Determination of cyclic/ dynamic soil parameters such as coefficient of elastic uniform compression, coefficient of elastic uniform shear, shear modulus, elastic modulus and damping ratio by block resonance test, cyclic plate load test, surface wave propagation test, cyclic Triaxial test and Standard penetration test etc.

2. Data interpretation and selection of appropriate value from the results of tests, salient features of different methods, merits and demerits

Reference

IS 5249-1992: Code of Practice for Determination of Dynamic properties of soils

IS 1888-1982: Code of Practice for Load test on soils

IS 2131-1981: Code of Practice for Standard Penetration Test

Soil dynamics by Swami Saran, Galgotia Public

GEO525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

GEO- 531 ADVANCED STRUCTURAL ANALYSIS

Analysis of beams and plates for static and dynamic loads. Introduction to matrix method of analysis-Force and displacement method. Introduction to finite difference methods.

Approximate methods for analysis of frames under static and dynamic loads

GEO 532 STRUCTURAL DYNAMICS

Simple structures, single degree of freedom system, mass spring-damping system, equation of motion: external force and earthquake excitation, static and dynamic response. Free vibration, undamped free vibration viscously damped free vibration, energy in free vibration, coloumb damped free vibration.

Response to harmonic and periodic excitations, Numerical evaluation of dynamic response. Earthquake response of linear systems.

Multi degree of freedom systems general approach for linear system, static condensation, symmetric and unsymmetric plan systems-ground motion. Structural dynamics in Building codes.

References

1. Dynamics of Structures   Anil K. Chopra,
2. Dynamics of Structures   R. W. Clough and J. Penzien,
3. Dynamics of Structures   J. L. Humar Printice Hall

GEO 533 REINFORCED SOIL STRUCTURES

Reinforced Earth: History, field of applications, natural fibres, overview of Geotextiles, Geomembranes, Geogrids, Geonets, Geowebs, Geomats and Gecompsites, economic aspects of their applications Production of Geotextiles, composites, physico-mechanical, hydraulic and chemical   Properties. Functions of Geosynthetics, fluid transmission, filtration, separation,protection. Soil Reinforcement: Basic principle of soil reinforcement, shear strength of reinforced soil, theoretical strength models, factors affecting, requirements on synthetic reinforcement, installation techniques.

Calculation methods: Basic concepts, embankment on soft soils, internal stability, overall stability, foundation stability and bearing capacity failures Construction of the steep slope, retaining walls-external stability, internal stability.

Use of Geosynthetics in Roads and Railways, drainage system- Control of groundwater level, dewatering and reclamation of land, use of Geomembranes – For lining applications, management and maintenance.

References

1. Geo-textiles and Geo-membranes in Civil Engg.   Gerard P.T.M. Van Santvrot A. A.
2. Reinforced Soil and Geo-textiles-   J. N. Mandal,
3. Geosynthetics: Applications, Design and construction   R. J. Tarmat
4. Geosynthetics World.   J. N. mandal

GEO 534 ROCK MECHANICS & ENGG. GEOLOGY

Sub surface Exploration: General Principles, Geophysical explorations, Structural features of Rock Masses, Engineering Properties of intact/in-situ rock, Rock mechanics. Clay Mineralogy: Definition, Classification, identification and structure of clay minerals, base-exchange, PH values, clay water system. Model Simulation of Rock mechanics Problems: General Principles of mechanical similitudes in elastic and ultimate load ranges, Development of a model for rock mass. Rock mass joints behaviour and stability of slopes. Dynamic behaviours of Rock mass: Dynamic sources and effects in rock earthquake intensity scales Mechanism of earthquake and vibrator and vibration of structures, lateral forces of an earthquakes. Rock as a structural foundations: Foundation problems in Igneous, Sedimentar and metamorphic rocks, Geotechnical investigation for dam, Tunnels, Bridges and pavements. Ground water Geology: Classification and distribution of ground water, Geologic control of Ground water, free and confined ground water, hydrologic properties of water bearing material except soil.

GEO535 ENVIRONMENTAL GEOTECHNIQUE

Soil Formation, Solids composition and characterization, Mineral composition, Role of Composition and soil structure in the Engineering Behaviour of soils. Flow of water in soils; Energy states of water in soil, principles of flow in saturated soils, Governing equation for saturated flow, principle of flow in unsaturated soils, Governing equation for unsaturated flow.   Mass Transport; mass transport mechanisms, mass transfer mechanisms Site characterization and contaminant release mechanism – Site contamination, characterization of site, Geo statically applications, contaminant release mechanisms: Vaporization, dusting, leaching.

Principles of site and Geo-material treatment techniques: - Treatment approaches, basis for treatment technology selection, in situ soil flushing, in situ vitrification principles, natural attenuation principles, phyto remediation and bioremediation principles, ex-situ stabilization and chemical treatment principles. Waste containment system implementation – Essentials of waste containment, hydraulic and physical containment, containment effects on source terms, site selection techniques for containment, containment site improvement.

Introduction to Landfills: Environmental impact assessment and management – Initial environmental evaluation, Elements of EIA, preparation of environmental base map, classifications of environmental parameters. Identification of hazardous waste; Introduction to exposure assessment, Riskbased estimation of required cleanup levels. Non aqueous – phase liquids in soils: Introduction, Principles of NAPL entrapment in soils, Conceptualization of field-scale transport of NAPLs, phase diagram for soil – water – LNAPL – Air systems, Mobilization of residual NAPLs.

References

1. Geo-Environmental Engineering   Lakshmi N. Reddy
2. Principles and Applications   Hilary. I. Inyang

GEO-536 THEORY OF ELASTICITY AND PLASTICITY

Theory of Elasticity: Analysis of stress, stress vector at a point across an area components of stress tensor and sign convention. Definition of surface and body forces. Principal stress, Mohr's circle, Stress invariants, transformation of axes complementary shear. Equations of stress equibrium. Faint venant's Principles. Strain tensor, strain invariants, spherical and Deviator stress and strains, Tdransformation of axes, Mohr's Diagram for strain, Relations between strain and displacements, Equations on compactibility – Physical significance of.

Generalised Hooke's law. Relationship between the various elastic constants e.g. between Young Modulus of Elasticity, Poisson's Ration. Modulus of Rigidity and Buld modulus. Plain stress and Plain strain: Formulation of problem in two dimension. Airy's stress function. Polynomial and series solutions to the Biharmonic equations. Airys stress function in polar Coordinates. Solutions for displacements. Two dimensional problems will include the following: (1) Cantilever loaded at ends (2) Stress in a plate with a circular hole (3) Concentrated load on a semi infinite plate. Introduction to the general three –dimention problem in theory of Elasticity. Equations expressed in terms of displacements. Boussines's solution.

Theory of Plasticity: The stress strain curve. The ideal plastic body. Theories of failure and Criterion for yielding (plasticity conditions) Material, Reuss's and Henky's theories of plastic deformations work of plastic deformation. Two dimensional plastic flow problems: incompressible two dimensional flow, Stresses in plastic Materials in conditions of place strain. Eqilibrium equations referred to slip lines. The simples stop line fields. Example- strip load on a semi infinite body.

GEO 537 GEOTECHNICAL INVESTIGATION AND FIELD TESTING OF SOILS

Need and importance of site investigations, sits exploration and phasing of site exploration programme, Spacing and depth of bore holes, significant depth. Methods of site exploration-soundings, bore holes, drilling methods and equipment wash boring, rotary boring and percussion boring in soils at stabilization of bore holes Procuring and handling od disturbed and un disturbed samples- various types of samplers and sampling techniques, their relative merits and suitability in particular cases, lowering of water table. Geophysical methods of soil exploration. Observation of ground water level and pressure Soil testing techniques used in Laboratory, Simple field tests for permeability, in place density, vane test, plate bearing test, standard penetration test.

Discussion and seminar on published papers of recent origin connected with exploration and testing of soils, case histories of failure of structures.

GEO538 CRITICAL STATE SOIL MECHANICS

Introduction to constitutive modelling of soils, stress and strain parameters, elasticity (including anisotropy), plasticity and yielding (yield surface, hardening law, flow rule), volume changes under isotropic stress states or one-dimensional straining (normal compression line, swelling lines), shearing and the critical state line, drained and undrained shearing of normally consolidated and overconsolidated samples, Modified Cam Clay as an example of a simple elasto-plastic model, strength of soils, index tests interpreted through critical state soil mechanics, application of critical state soil mechanics, complexities of real soil behaviour and development of advanced constitutive models.

References:
1. Soil behaviour and critical state soil mechanics   Wood, D.M.
2. An introduction to the mechanics of soils and foundations   Atkinson, J.H.,

| 3. The mechanics of soils: an introduction to critical | Atkinson, J.H. and Bransby, P.L., |
| 4. Finite element analysis in geotechnical engineering, | Potts, D.M. and Zdravkovic, L |

GEO539 EARTHQUAKE ENGINEERING

Introduction to tectonic plate theory. Definitions : Focus, Epicenter, Magnitude, Intensity, etc. Geotechnical aspects of Earthquake Engineering. Codal provisions for Earthquake resistant design and construction of R.C.C. Structures, Masonary Structures, etc. Case studies of previous Earthquake Geotechnical engineering problems.

References

1. Dynamics of Structures   Anil K. Chopra,
2. Geotechnical Engineering Principles and Practices   Donald P. Coduto,
3. Geotechnical Earthquake Engineering   Steven L. Kramer
4. Geotechnical modelling,   Muir Wood, D.,

GEO-541 STRENGTH AND DEFORMATION DEHAVIOUR OF SOILS

in Clays and Sands, Behavior of Normally Consolidated Clay, Behavior of Overconsolidated Clay, Soil Composition, Water Absorption, Clay-water Forces and Measurement of Soil Suction, Soil Structure, Basic Strength Principles and Stress-Strain Behavior of Simple Clay; Soil Modeling, Types of Triaxial Tests and Strength Principles, Mechanisms of Volume (Pore Pressure) Change Hvorslev Parameters and Extension Tests Modified Cam-Clay Model, Consolidation Behavior of Saturated Soils:

2-D and 3-D Settlement (Initial, Amount and Rate of Consolidation) Problematic Soils (Sensitive, Organic, Expansive, Collapsing, Varved, etc.) Stability Problems and Drained Strength Analyses Effective Stress Parameters for Drained Analyses Undrained Strength-Deformation Behavior of Saturated Clays and Undrained Strength Analyses, Conventional Practice for UU Case (In Situ and Lab Techniques) Sample Disturbance, Stress System (s2 and Anisotropy), Staged Construction (CU Case), Strength-Deformation Behavior of Cohesionless Soils Strength Components and Steady-state Line, Effects of Density, Confinement and $\square$ 2 on Drained and Especially Undrained BehaviorEffects of Sand Structure (Anisotropy, Stress History, Heterogeneity etc.) Compacted Clays, Compaction Process (Fundamentals) Structure and Engineering Properties, Effective Stress with S < 100%, Constitutive Modeling, Miscellaneous including Precompression, Vertical Drains, and Case Histories

GEO542 MODERN GEOTECHNICAL PROCESSES

Soil Stabilization- Mechanical Stabilization, role of fine and coarse fraction, method of mixing soils to get designed plasticity index and particle size distribution stabilization using cement, lime, fly ash etc., effect on soil properties. Compaction. Laboratory compaction, comparison of properties of oil compacted to wet -of and dry-of omc. Field compaction- Available equipments and their suitability, methods for shallow surface compaction, deep compaction. Difficulties in compaction. Specification for compaction requirements, compaction central tests, Dewatering Methods-Dewatering of excavation and drainage of slopes, electro-kinetic dewatering. Pre loading and use of vertical drains. Grouting- Grout materials, grouting techniques and central methods. Reinforces Earth- Principles method. Use in retaining wall, design of retaining wall. Geosynthetics- various types, testing of geosynthetics, case studies.

References

1. Engineering Principles of Ground Modification-   M. R. Hausemann
2. Soil Stabilization   Ingles and Metcallf.
3. Soil Engineering   Her Mayesties Stationary Office.
4. Earth and Rockfill Dams   Sherard et. al.

5. Earth and Rockfill Dams   Bharat Singh and Sharma

iv) HYDRO POWER ENGINEERING (M.TECH)
First semester
HYD511 ADVANCED FLUID MECHANICS
Review of principles of fluid mechanics, boundary layer theory and its computations, flow separation, boundary layer control, drag and lift on submerged bodies, Navier' stokes equations, laminar and turbulent flow through pipes, flow between parallel plates, turbulence models, flow in open channels.
Reference
1.   Fluid Mechanics   Streeter & Wylie.
2.   Fluid Mechanics   Douglas J.F. Gasiorek, & Swaffield J. A
3.   Solution of problems in Fluid Mechanics, Part 1&2   Douglas J.F.
4.   Mechanics of Fluids   Shames
5. Mechanics of Fluids   White.
HYD512 INSTRUMENT AND MEASUREMENTS
Accuracy, error analysis, pressure measurement, velocity measurement, discharge measurement, speed measurement, force and torque measurement, temperature measurement, viscosity measurement, acoustic measurement
References
1.   Instrumentation, Analysis and Measurement   Nakra and Choudhary
2.   Industrial Instruments   A.L. Seutko, Thomas Delmer
3.   Measurement and Instrumentation Systems   W. Bolton
HYD513 HYDROLOGY AND HYDROPOWER PLANTS
introduction, types of hydropower plants and schemes, hydrology: runoff studies, flood estimation studies, assessment of hydropower potential of a basin, storage and pondage, load studies, elements of hydropower plants and their hydraulic design: dams, intakes, conveyance system (power canals, penstocks, tunnels), power house: types and planning
References
1.   Water Power Engineering   M.M. Desmukh
2.   Water Power Engineering   M. M. Dandekar & K.N. Sharma
3.   Water Power Engineering   H.K. Barrows
4.   Water Power Development Vol. I & II   E. Mosoyni,
HYD514 HYDRAULIC LAB PRACTICE 1
Experiments on fluid mechanics.
HYD515 SEMINAR 1
Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure
Second semester
HYD521 FUNDAMENTALS OF HYDRAULIC MACHINES
Classification and constructional aspects of hydraulic turbine and pumps, energy losses in hydraulic machines, scale effects, hydraulic similarity, non-dimensional numbers and model laws , cavitation, similarity laws in cavitation flows, affinity laws for hydraulic machines, model testing and performance characteristics
References
1. Fluid Mechanics of Turbo Machinery   G. Wislicenus, Dever
2. Principle of Turbo Machinery   D.G Shepherd

HYD522 DESIGN OF HYDRAULIC MACHINES - TURBINES

Standardisation and selection of turbine, method s of Francis turbine runner design, design of axial turbine runner including bulb turbine, hydraulic , hydraulic calculations of spiral casing and guide wheel, draft tube theory , standardization of and applications draft rube, Pelton turbine design

References

1. Hydraulic Turbines,   M. Nechleba
2. Hydraulic Turbine and Pumps,   I. Smirnov
3. Hydraulic Machines,   Jagdish Lal,
4. Hydro Power- The design, Use and Function of Hydro Mechanical Hydraulic and Electrical Equipment,   Raabe Ing. Joachim

HYD 523 DESIGN OF HYDRAULIC MACHINES - PUMPS

Pumps characteristics curves, theory of impeller, design and design of impellers, design of pump casing, axial and radial flow thrust, shaft design for critical speed, special purpose pumps, bowers and compressors

References

1. Centrifugal and axial flow Pump   A.J. Stephenoff
2. Impeller Pumps   Stephen Lazarkiewicz and Adam T.

HYD524   HYDRAULIC LAB PRACTICE 2

Experiments on hydraulics machines

HYD525 COMPUTATIONAL LAB PRACTICE

Introduction to different CFD software

Department Elective

HYD531 THEORY OF CASCADES

Potential flow, Rankine body, doublet, flow past cylinder, pressure distributions around cylinder, circulation around hydrofoil, forces and moments on the profiles, Kutta-Joukowski theorem, lift and drag forces, induced drag, velocity triangles, cascade parameters, direct and indirect problem, flow through cascades, conformal transformation.

References

1. Fluid Flow   Rolf H. Sabersky & Allan J. Acosta
2. Theory of Turbo Machines   G.T. Canady
3. Hydrodynamics of Turbo Machinery   Cascades G.U. Stepanoff, Physmatgir
4. Turbo machinery Performance Analysis R.I. Lewis, Arnold

HYD532 WATER RESOURCES SYSTEMS

Introduction, river basin planning, distribution systems, water resources planning and development, system analysis techniques in water resources and applications, economic considerations in water resources systems.

References

1. Water Resources Systems   Subhas Chander and Rajesh Prasad.
2. Water Resources System Planning and Management   S.K.Jain and V.P.Singh
3. Water Resources Systems   S. Vedula and P. P. Majumdar
4. Water Resources System Planning and Analysis   D.P.Loucks,J.R.Stedingera
                                                         D.A.Haith

HYD533 MANUFACTURING PROCESS

Different materials used for manufacturing of water turbines components. Factors influencing their selection. Yield and fatigue strength considerations, resistance to corrosion, oxidation and erosion due to caviation, casting of metals, methods of melting, moulding machines, shell moulding, die casting alloys, centrifugal casting miscellaneous casting methods.

Powder metallurgy, methods of producing metal powders and methods of manufacture selection, mixing, pressing, briquetting, sintering sizing and finishing, application to runners affected by cavitation erosion,

Forging processes, application to large forging in water turbines, stamping and forming, blanking and shearing, drawing metal stretching.

Welding processes, applications to welding of spiral casing, draft tubes, runner, distributors, machining Processes, applications to machining

Reference
1. Fundamentals of Modern Manufacturing,: Material process and systems

Mickell P. Groover
2. Material Science in Manufacturing,   Rajeev Ashthana, A. Kumar and N. Dahotre,

HYD534 HYDRO POWER STRUCTURES
components of hydro power plant and their layout, type of power house, design and construction of storage dams and weirs, design of canals and fore ways, penstock and their design, overflow sections, head and tail race channels, surge tanks and their design, lay out of power house, sub-structure and super structure, draft tubes, turbine casing,

References
1. Hydraulic Structures   Novak and Narayanan
2. Irrigation Engineering and Hydraulic Structures   S.K. Garg
3. Concrete Dams   R.S. Varshney
4. Open Channel Hydraulics   R.H. French

HYD535 HYDRAULIC TRANSIENTS
Water Hammer: phenomenon, equations for elastic waves in simple and complex conduits, arithmetic integration and graphical methods of solution, Differential equations of water hammer and solution by method of characterstics.

Influence of water hammer on turbine speed regulation, transfer functions for the effect of water hammer on governing stability

Reflection and transmission of water hammer waves..

Allievie's equations and charts for uniform valve closure

Unsteady flow in canals: General differential equations of motion and continuity, shallow water equations and their solution using method of characteristics.

Surge Tanks**:** Functions, Different types, Design of surge tanks- Calame-Gaden equations, Johnsons method. Stability of surge tanks

References
1. Applied Hydraulic Transients   Hanif Choudhary
2. Hydraulic Transients   Streeter
3. Water Power Engineering   M.M.Desmukh
4. Hydraulic Transients   G.Rich

HYD536 DESIGN OF POWER HOUSE

Power House, classification and preliminary dimensions of power house, foundation investigation methods, foundation treatment, power house, sub structures, constructional form and sizes, design and constructional details, power house super structures, general planning, Steel structure, Reinforced concrete construction, Roof construction, wall construction.

Hydro dynamics of underground systems and types of underground stations, Economics of underground power stations. civil works of micro/mini hydro schemes.

References
1. Power House Design   J.F.C. Snell, Longman Series
2. Hydro Power Structures   R.S. Vasney,
3. Planning and Design of Hydro Electric Plants   Gilbert Gedeon, P.E.

HYD537 INDUSTRIAL HYDRAULICS

Fluid power systems, symbols, circuit diagrams, different type of power pumps and motors, type of pressure control valves, hydraulic fuse, pressure switch, type of flow and directional control valves, hydraulic coupling, torque converter

References

1. Industrial Hydraulics	John J. Pippenger and Tyler G. Hicks,
2. Oil Hydraulic Systems,-Principles and Maintenance,	S.R. Majmdar

HYD538 GOVERNING SYSTEMS

Need of governing of turbines, economic operation of power system, load flow analysis, Load frequency control, flow and load control governors, mechanical governors, electronic governors, Oil less governors, governor stability, Discrete time systems, Principle of optimality, performance of governors, dynamic response, load compensation and reliability, simulation of governing systems.

References

1. Hydro Turbine	GoverningZ. Shen,
2. PID Controllers: Theory, Design and Testing,	K. Astrom and T. Hagglund,
3. Operation and Control in Power Systems,	PSR Murthy

v)TRANSPORTATION ENGINEERING(M.Tech)

First semester

TRE511 ANALYSIS AND DESIGN OF PAVEMENT STRUCTURES

Introduction , importance and functions of various components of pavement structures, analysis of stresses in flexible and rigid pavements, Methods for design of Flexible and rigid Pavements design and construction of joints, evaluation and strengthening of pavements etc.

References

1. Highway Engineering	S.K.Khanna & C.E.G.Justo.
2. Pavement Deign	Yoder & Witezak.
3. Principles of Transportation Engineering	Chakroborti and Das

TRE512 TRAFFIC ENGINEERING AND MANAGEMENT

Introduction, traffic characteristics, traffic studies, Design and operation and control of traffic facilities, innovative techniques for traffic management. Road safety etc.

References

1. Traffic Engineering and Transport Planning	L.R. Kadiyali
2. Principles of Transportation Engineering	Chakroborti and Das
3. Traffic Engineering Matson,	Smith and Hurd

TRE513 TRANSPORT PLANNING

Hierarchical levels of planning, general concept and process, urban travel characteristics, travel demand estimation and forecasting, regional transport planning trip generation methods and there comparison, modal split analysis, behavioral approach, two stage model split models. trip distribution – growth factor method, gravity models, intervening opportunity and competing opportunity models, land use transport planning models, network assignment etc.

References

1. Traffic Engineering and Transport Planning	L.R. Kadiyali,
2. Principles of Transportation Engineering	Chakroborti and Das
3. Traffic Engineering	Matson, Smith and Hurd

TRE514 LAB PRACTICE 1

Testing of highway materials and pavement : testing of materials like aggregates, bitumen, bituminous mixes, modified bitumen, emulsion etc. Benkalman beam studies etc.

References

1. Highway materials and pavement testing	Khanna, Justo and Veeraragavan

TRE515 SEMINAR 1

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

Second semester
TRE521 HIGHWAY CONSTRUCTION AND MAINTENANCE
Subgrade analysis and design, type of highway construction: wbm, wmm, dlc, type of bituminous construction: construction techniques and quality control, type of cement concrete construction, joints etc. highway maintenance.
References
1. Principles & Practice of Highway Engg.   L.R. Kadiyali,
2. Highway Engineering   S.K.Khanna & C.E.G. Justo,
3. Principles of Transportation Engineering   Chakroborti and Das

TRE522 PUBLIC TRANSPORT SYSTEMS
Mass transportation characteristics, urban public transportation planning, terminals and their functions, basic concepts-analysis and design of public transport routes. economic evaluation methods,etc.
References
1. Traffic Engineering and Transport Planning L.R. kadiyali,

TRE523 HIGHWAY GEOMETRICAL DESIGN
Design controls and criterion, cross sectional elements, sight distance, horizontal and vertical alignment, intersection geometrics etc
References
1. Principles of Transportation Engineering   Chakroborti and Das,
2. Principles & Practice of Highway Engg.   L.R. Kadiyali,
3. Highway Engineering   S.K.Khanna & C.E.G. Justo,

TRE524 LAB PRACTICE 2 (TRAFFIC ENGINEERING AND FIELD STUDIES)

Traffic studies, speed studies, traffic volume studies, O&D studies, traffic capacity, parking and accident studies etc.
References
1. Traffic Engineering and Transport Planning   L.R. Kadiyali,
2. A Course in Traffic planning and Design   S.C Saxena,

TRE525 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department Electives

TRE531 GEOTECHNICAL INVESTIGATIONS AND FIELD TESTING OF SOILS
Introduction, methods of exploration, sampling, penetration tests, field testing of soils plate load tests, triaxial tests, planning of exploration and testing program for transport infrastructure projects
References
1. Basic & Applied Soil Mechanics   Gopal Ranian and A.S.R. Rao.,
2. Principles & Practice of Highway Engg.   L.R. Kadiyali,
3. Highway Engineering   S.K.Khanna & C.E.G. Justo*,*

TRE532 ANALYSIS AND DESIGN OF HIGHWAY INTERSECTIONS
General considerations of design, types of manouvres, conflict points, intersection geometrics, capacity and level of service concepts, design of traffic signal, grade separated intersections etc.
References

1. Traffic Engineering and Transport Planning   L.R. kadiyali,
2. A Course in Traffic planning and Design,   S.C Saxena,

TRE533 CONCRETE TECHNOLOGY

Introduction ,concrete making materials, types of concrete, properties and test of fresh and hardened concrete, concrete mix design methods, concrete paving mix etc.

References
1. Concrete Technology   M.S. Shetty
2. Concrete Technology   M.L. Ghambhir

TRE534 BRIDGE AND TUNNEL ENGINEERING

Bridge Engineering; Introduction, types of bridges, site selection, IRC and railway loadings, component parts of bridge structure, inspection and maintenance of bridges, testing and rehabilitation etc.

Tunnel engineering: Introduction, terminology, types of tunnels, tunnel lining, preliminary investigations, ground improvement techniques, ventilation and lighting, tunnels in difficult ground conditions etc.

References
1. Bridge engineering   S.P. Bindra,
2. Railway,Bridge and Tunnel   B.L. Gupta

TRE535 FUNDAMENTALS OF REMOTE SENSING, GIS AND GPS

Introduction of remote sensing and GIS, geographical concepts and terminology, essential components of GIS, various GIS packages and their salient features, application of remote sensing and GIS in urban transportation planning and infrastructure development. basic concepts of GPS etc.

References
1. Principles of remote sensing   Keifer,
2. Principles of GIS burough, Hofman-Wellenhof, Global positioning system: Theory and practice
3. Introduction to remote sensing   Londo.Gonzalez,

TRE536 HIGHWAY MAINTENANCE MANAGEMENT SYSTEM

Types of highway maintenance, distresses in flexible and rigid pavements and their remedial measures, maintenance management process, evaluation and performance, analysis and selection, prioritization, resource allocation, etc.

References
1. Pavement management System   Haas.
2. Principles & Practice of Highway Engg.   L.R. Kadiyali
3 . Highway Engineering   S.K.Khanna & C.E.G. Justo,

TRE537 ENVIRONMENTAL IMPACT ASSESSMENT

Nature of the problem, Impact analysis procedure for processing EIA and EIS, elements of EIA: air, water, noise etc, various methodology of EIA, case histories for transportation infrastructure projects.

References
1. Introduction to EIA   John Glasson,
2. Environment Engineering   P.V Rao

TRE538 PLANNING AND DESIGN OF AIRPORTS

Basic Principles and concepts of planning and design of Airports, air craft characteristics, runway design, modern evaluation techniques, airport marking and lighting, Air traffic control etc.

References
1. Airport Planning and Design   S.K Khanna, Arora and Jain,
2. Planning And Design of Airports   Robert Horonjeff And Francis X. Mc,
3. Airport Engineering   G.V . Rao

vi) WATER RESOURCE ENGINEERING (M..TECH)

MTH511A ADVANCED MATHEMATICS

Elementary conformal mapping, conformal transformations of harmonic functions and boundary conditions, , solution of linear and non-linear equations, Runge-Kutta method, relaxation method,

applications to problems of fluid mechanics, mathematical probability, probability distributions, quality control and acceptance sampling, estimation and testing hypotheses, variance analysis, collection and representation of experimental data, numerical solution of ordinary differential equations, statistical methods of experiments planning

References

1. Probability and Statistics for Engineers   R.A. Jhonson,
2. Numerical Methods for Scientist and Engineers   H.M. Anita

WRE512 ADVANCED FLUID MECHANICS

Ideal fluid Flow: Two- and Three dimensional flow; Kinematics including super-imposition of flow; Conformal mapping and Schwartz-Christoffel transformations. Real-Fluid Flow: Viscous incompressible flow; Navier-Stokes equations. Classification and characteristics of turbulent flows, Reynolds equations, statistical theories of turbulence, Flow Between Parallel plates and in a pipe, turbulence models. Laminar and Turbulent boundary layer, Turbulence and Coherent structure of flow; Reynolds stresses; Skin friction; Form drag and Lift.

References

1. Fluid Dynamics   Daily J.W. and Harlaman, D R F
2. Turbulent Flow   Garde R. J..
3. Engineering Fluid Mechanics Vol. I   Narasimhan S.
4. Fluid Mechanics for Hydraulic Engineers   Rouse H
5. Boundary layer theory   Schlisting H. and Gersten K. ,

WRE 513 APPLIED HYDROLOGY

Hydrological processes, Mechanism, Atmospheric water vapour, computation and measurement of precipitation, evaporation, evapotranspiration, abstraction from precipitation., spatial and temporal distribution of rainfall. Unsaturated flow models- Horton's equation, Philips equation and Green-Ampt model, Computation of excess rainfall hyetograph from observed flood hydrograph, Green-Ampt infiltration equation and SCS method. Unit hydrograph theory, derivation of instantaneous unit hydrograph and synthetic unit hydrograph. Design flood PMT storm transportation, Tech. PMP and FPF for project by using conceptual models. Lumped flow routing, distributed flow routing models and dynamic wave routing. Hydrologic statistics and flood frequency analyses.

References

1. Applied Hydrology   Chow V T, Maidment David R. and Mays Larry W
2. Applied Hydrology   Mutreja K.N
3. Rainfall atlas   IMD
4. Engineering Hydrology   Subramanya K,
5. Elementary Hydrology   Singh Vijay. P,

WRE 514 LABORATORY

Experiments in fluid mechanics

WRE 515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second semester
WRE 521 ADVANCED HYDRAULIC STRUCTURE
Planning and investigations of reservoir and dam sites. Forces acting on solid gravity dam, modes of failures, stability analysis, elementary and practical profile of gravity dam, internal stresses and stress concentrations in gravity dam, joints, seals, keys in gravity dams, dam safety and hazard mitigation. Homogeneous and zoned embankment dams, factors influencing design of embankment dams, criteria for safe design of embankment dam, steps in design of embankment dam, seepage analysis and its control through body and dam foundation, classification of rock fill dams and their design considerations. Arch and buttress dams. Capacity of spillways, components and profile of different types spillways, Non conventional type of spillways, selection and design of energy dissipaters. Components of diversion head works and their functions, design of weirs and barrages on permeable foundations Canal regulation structures and design of cross drainage works, canal drops, operation and maintenance of canals. River Training works: Objectives of river training, river training methods, design . EIA for water resources .Review of codes of practice

References
1. Design of gravity dams   USBR
2. Design of small dams   USBR
3. Engineering for dams   Creager W P, Justin J D and Hinds J
4. Hydraulics of spillways and energy dissipaters   Khatsuria R M
5. Hydraulic Structures   Novak P,

WRE522 WATER RESOURCES SYSTEM
Introduction: The nature of water resources systems.Water Resources Planning and Development: Steps of planning and development, Conjunctive use planning, planning for operation, Integrated planning and developments. System Analysis Techniques in Water Resources: Optimization, Linear programming, Dynamic programming, Simulation. Application of System Analysis in Water Resources: Applications of various optimization techniques to water resources engineering problems.Economic Considerations in Water Resources Systems: Basic principles of economics, Project feasibility and optimality, Cost allocation

References

1. Water Resources Systems   Subhas Chander and Rajesh Prasad

2. Water Resources System Planning and Management   S.K.Jain and V.P.Singh

3. Water Resources Systems   S. Vedula and P. P. Majumdar

4. Water Resources System Planning and Analysis   D.P.Loucks, J.R.Stedinger and D.A.Haith.

5. Design of Water Resources Systems   A.Masses et al. Macmillan.

WRE 523 OPEN CHANNEL HYDRAULICS
Review of open channel flow concepts.Concept of specific energy, computation of critical flow, channel transitions, critical flow venturi-flume, standing wave flume and broad crested weir in discharge measurement.Hydraulic jump in open channel and its characteristics.Gradually varied profile and its computations using direct step method, advanced numerical methods, Location of hydraulic jump in GVF profiles, Delivery of canal systems.Unsteady open channel flow: Wave celerity, classification of water waves according to relative depth, orbital motions, superposition, wave trains and wave energy, transformation of waves, dissipation of wave energy. Positive and negative surges in rectangular channel.Governing equation for one dimensional, two dimensional unsteady flows and their solution by

numerical techniques.Spatially varied flow: Basic principles and assumptions, dynamic equation and analysis of flow profiles, Numerical integration method, Isoclinal method, spatially varied steady and unsteady surface flows.

References

1. Open Channelflow   Chaudhary Hanif M.
2. Flow through open channel   Chow V T
3. Flow in open channels   Subrmanya K
4. Flow through open channels   Srivastava Rajesh,

WRE 524 LABORATRY

Experiments in openchannal flow

WRE525 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

WRE531 IRRIGATION & DRAINAGE ENGINEERING

Introduction, Kinds of soil water, Soil moisture constants, Measurement of Soil Water and Rooting Characteristics, Movement of Soil Water, Evapotranspiration, Estimation of Reference Crop Evapotranspiration from Climatological Data, Estimation of Crop Evaporatranspiration, Field Irrigation Schedules.Various methods of water application, Design criteria, Phases of Irrigation, Irrigation Efficiencies, Design of Basin, Border and Furrow irrigation methods. Sprinkler Irrigation System, Introduction, Type of sprinkler, Sprinkler irrigation system layout, Design and Evaluation of Sprinkler System. Drip Irrigation System, Introduction, Selection of emitter discharge and emitter spacing, Drip irrigation system layout, Design and Evaluation of Drip System.Principles of Drainage Engineering, Need and purpose of drainage, Surface drainage systems, Sub surface drainage systems, Water logging, Types of salt affected soils, Reclamation of salt affected soils, Drainage water use, conjunctive use. Soil Erosion and Conservation. Design of various types of soil conservation measures.

References

1. Irrigation and Water Resources Engineering,   G.L. Asawa
2. Irrigation theory and practices   A.M. Michael
3. Irrigation system design – An Engineering Approach   Richard H Cuenca
4. Hand book of Irrigation Technology   H.J. Finkel Vol.I,

WRE532 WATER SUPPLY DISTRIBUTION SYSTEM

Type of distribution systems, equivalent pipe, parameters in distribution system analysis, parameters interrelationship, formulation of equation. Gravity and Rising main, location and design principles. Analysis of water distribution system. Methods of analysis : (i) Hardy – Cross method (ii) Newton Raphson method and (iii) Linear theory method. Design and optimization of water distribution system: Design: Trial and error method of design, cost- head loss ratio method. Optimization using linear programming techniques.Surge analysis in water distribution systems, Pump duty stations and detailing valves.

References

1. Analysis of Flow in Water Distribution Network   Bhave P R,
2. Optimal Design Of Water Distribution Networks,   Bhave P R
3. Fluid Transients   Streter V L and Wylie E D,

WRE 533 GEOTECHNICAL INVESTIGATIONS IN WATER RESOURCES PROJECTS

Problems and phases of foundation investigations; Methods of exploration, geophysical and conventional methods; Sounding, drilling and boring technique; Ground water table determination; Field tests – penetration tests, vane shear tests, pressuremeter test, plate load test, field permeability test, critical evaluation of different tests; Preservation and transportation of samples; Selection of type of laboratory tests, analysis and interpretation of results, Site evaluation and reporting.Suitability of soils for different water resources projects, Study of various relevant I.S. codes. Application of Remote sensing in geotechnical investigation.

References

1. Soil Mechanics & Foundation Engineering   K.R. Arora.
2. Engineering for Embankment Dams,   Bhart Singh & R.S. Varshney.
3. Soil Machines & Foundation Engineering   V.N.S. Murti.

WRE534 INTEGRATED WATERSHED MANAGEMENT

Principles of watershed management through distributed hydrological modelling, soil water conservation practices, integrated planning, multidisciplinary approach, management of agricultural land, structural and non structural measures, erosion and soil salinity problems and controlling techniques, gully control, landslide and correction techniques, watershed modeling Application of remote sensing in water resources mapping, area assessment and watershed management Preparation of land drainage scheme, types and design of surface drainage as well as subsurface drainage in coastal and interior basins, types and design of water conservation and water harvesting structures for different types of catchments

References

1. Watershed management and Field manuals   FAO
2. Watershed Management – Guidelines for Indian conditions   Tideman, E. M.,

WRE 535 HYDRAULIC MEASUREMENT SYSTEMS

General characteristics of a measurement system, measurement system and stages, sensors and transducers, transmitters, converters, input-output relationship of measuring instruments, classification of errors and methods for reducing errors, calibration, sensitivity, hysteresis, resolution, drift, linearization, choice of instrument for a specific application. mechanical pressure sensors, electrical pressure measuring devices, pressure transmitters and vacuum measurement systems. Variable head flow meters, variable area flow meters, positive displacement flow meters, hot wire anemometer, open channel flow meters, mass flow measurement, liquid level, solid level and continuous level measurement. Elastic elements for force measurement, torque measurements, electrical resistance. strain gauges and measuring circuit, temperature compensation, strain gauge rosettes, standard test procedures, ISO 9000 requirements for calibration procedures, recent developments in process measurements.

References

1.   Instrumentation, Analysis and Measurement,   Nakra and Choudhary
2.   Industrial Instruments   A.L. Seutko, Thomas Delmer
3.   Measuremnt and Instrumentation Systems   W. Bolton

WRE 536 FLOOD CONTROL AND RIVER TRAINING WORKS

Alluvial streams and their hydraulic geometry, bed level variation of alluvial streams, variation in plan form of alluvial streams, Analytical models of river morphology, Numerical models for morphological studies, flood plain analysis, morphology of some Indian rivers.Computational of peak floods, flood frequency analysis, Floods in major Indian river basins, types and design of flood forecasting and protection systems, operational hydrology, reservoir operation for flood control and management, flood

damage estimation models.Guide lines for planning and design of river training works, Planning, design, construction and maintenance of river training works and bank protections for alluvial rivers. Application of Geo- synthetics in river training works.

References

1. Applied Hydrology   Chow V T, Maidment David R and Mays Larry W
2. Mechanics of sediment transportation and alluvial streams problems

                              Garde R J and Ranga Raju K G ,
3. River Morphology   Garde R J Mays Larry W.,
4. Hydraulic Design Handbook   Garde R J ,

WRE 537 GROUND WATER ENGINEERING

Introduction : Occurrence of ground water, geological formations as aquifers; types of aquifers, ground water movement, Darcy's law, permeability and its measurement, tracing of ground water movement, fundamental equations for steady and unsteady ground water flow, flow nets. Well hydraulics: Steady and unsteady flow in confined, semi-confined and unconfined aquifers, radial flow, superposition; multiple well system. Different methods of well construction; construction of well casings and screens, natural and artificial gravel packed wells. Safe yields, estimation, pumping and recuperation tests.Infiltration galleries, Ground-water replenishment, recharge of ground water, different methods. Groundwater modeling techniques: porous media models, analog models, electric analog models, digital computer models.Salt water intrusion: Concept; interface and its location; control of intrusion. Pollutant transport ; Plume Transport, source identification, tracer methods.

References

1. Groundwater Hydrology   David Keith Todd,
2. Hydraulics of Groundwater   Jacob and Bear
3. Applied Hydrology   Mutreja K.N.,
4. Groundwater & Well Hydraulics   Raghunath,

WRE538   HYDRAULIC ENERGY DISSIPATORS

Introduction, mechanism & types of energy dissipators, hydraulic jump, outlet works control mechanism, stilling basins for small outlet works and low and medium-high spillways , Various aspects of stilling basins,types of stilling basins and different appurtenances.

References

1.Hydraulic Energy Dissipators   Edward A. Elevatorski,

2 Energy Dissipators and Hydraulic Jump,   W.H.Hager,

WRE539 WATER RESOURCES PROJECT PLANNING, ECONOMICS & MANAGEMENT

Principles of economic planning and decision making, price theory and resource allocation-Project Optimality conditions, cost- benefit studies: role of benefit-cost parameter in project selection. Economic feasibility tests. Involvement of risk and other variables, tangible and intangible benefits; Cost-benefit studies of single and multipurpose water resources projects; Economic planning: Capacity expansion and project scheduling, multiobjective planning models, international developments on water transfer, preparation of feasibility reports.

References

1 Principles Of Water Resources Planning,   Alvin.S.Goodman,

2 Economic of Water Resources Planning,   James L. D. and Lee R. R.,

WRE 541 SEDIMENT TRANSPORTATION ENGINEERING

Nature of sediment problems, Origin and formation of sediments, individual and bulk properties of sediments, competent velocity, lift force and critical tractive stress concept on cohesion less and cohesive soils; regimes of flow; Resistance to flow in alluvial streams, resistance relations based on total resistance and division of resistance into grain and form resistance, preparation of stage discharge curves for alluvial streams, velocity distribution in alluvial channel.Bed load computation by empirical equations, dimensional considerations and semitheoritical equations, saltation.Mechanism of suspension, general equations of diffusion. Integration of sediment distribution equation. Differences between actual and theoretical exponents, prediction of reference concentration, Method of integrating curves of concentration and velocity. Simple relations for suspended load, Effect of temperature on suspended load, Wash load, Nonequilibrium transport of suspended load.Microscopic, macroscopic methods. Approximate methods of total load determination, sediment yield from catchments. Hydraulic geometry of alluvial streams, bed level variation of alluvial streams, aggradations and degradation models, reservoir sedimentation, local scours.

References

1. River Mechanics" Vol. I & II,   Hsieh Wen Shen
2. Mechanics of sediment transportation and alluvial stream problems

                                        Garde R. J. and Ranga Raju K. G.,
3. River morphology   Garde R. J
4. Loose boundary hydraulics   Raudkivi, A. J .

WRE 542 STOCHASTIC HYDROLOGY

Statistical methods in hydrology, probability distribution of hydrologic variables, hypothesis testing and goodness of fit, flood frequency analysis, single and multiple regression analysis, classification of time series, characteristics of hydrologic time series, statistical principles and techniques for hydrologic time series modelling, time series modelling of annual and periodic hydrologic time series (including AR, ARMA, ARIMA, and DARMA models), multivariate modelling of hydrologic time series, practical considerations in time series modelling applications

    Books Recommended

  1   Stochastic Hydrology   P.Jayrami Reddy
  2   Applied Stochastic Hydrology   Y.K. Zhang

WRE 543 ECOHYDROLOGY

Origin and scope of ecohydrology.Ecohydrological processes: Interactions between physical, chemical and biological processes at basin scale - soil water dynamics, land surface energy budgets; scales of interactions; ecohydrological optimality theory; ecohydrological controls on nutrient cycle. Techniques in ecohydrological measurements**:** Measuring energy and water fluxes in atmosphere, soil and vegetation; atmosphere – latent, sensible and CO_2 fluxes, distribution of wind, temperature and humidity; soil – soil moisture, soil respiration and soil heat flux; vegetation – leaf area index, stomatal conductance and transpiration. Ecohydrological modelling**:** Governing equations; mathematical models - stochastic and deterministic models; process based and empirical models; calibration and validation of models; scale issues in ecohydrological modelling. Applications of ecohydrology*:* Use of ecohydrogical principles in paleohydrology and climate change studies; ecohydrological approach for sustainable management of floods and droughts; case studies from tropical river basins and dryland ecosystems.

13.0 DEPARTMENT OF MECHANICAL ENGINEERING

vii) THERMAL ENGINEERING (M. Tech)

MTH511B ADVANCED MATHEMATICS

Complex Variables, Differentiation, analytic functions, Cauchy-Raimann equations, Conjugate functions and their application to two dimensional potential problems, Conformal transformation. Integration, Cauchy's theory, Zero's and poles residues, applications of residue theorem in integration. Differential Equations, Partial differential equations, solution by separation of variables. Diffusion equation. Heat flow in a bar, Wave Equation, Vibration of strings, vibration of circular membrane, Numerical Methods in Engineering, Solution of Polynomial Equation, Newton Raphson, Graffes's Braistow methods for nearly equal roots. Solution of Differential Equations: Runge –Kutta method for first and second order equations. Adam Bash forth methods for corrator and predictor. Numerical methods for partial differential equations of parabolic and hyperbolic type. Applications. FEM, Variational Functionals, Euler Lagranges equation, Variational forms, Ritz method, Glarkin's method, discretization. Finite elements method for one dimensional problems. Laplace Transforms, Elementary Laplace Transforms and theorem, solution of linear differential equations with constant coefficients. Heavyside unit functions, Direc delta function, their Laplace transforms and application to practical problems, Fourier integrals.

References

1. Engineering Maths   Shrivastava & Dhavan
2. Engineering Maths   B.S. Grewal

TH 512 ADVANCED THERMODYNAMICS

Laws of Thermodynamics, Differential Equations of Thermodynamics, Changes in States of Gases at their Transferences, Throttling process. Joule Thomson effect. Temperature of braking. Mixtures of ideal & real gases. Equilibrium of Thermodynamic System, Equations of states for real gases Vanderwaal's equation of state. Clayperon equations. Gibbs phase rule. Law of corresponding states. Fundamentals of Chemical Thermodynamics, First law of thermodynamics in thermochemistry. Heat effects of reaction. Hess's law. Kirchhoff's law. Chemical equilibrium. Bond energy

References

1. Engineering Thermodynamics   Wan Wylen
2. Engineering Thermodynamics   G. Rogers & Y. Mayhow

TH 513 ADVANCED HEAT & MASS TRANSFER

Transient Heat Conduction, Convection, Heat Transfer by Radiation, Boiling and Condensation, nucleate pool boiling and empirical correlations for pool boiling heat transfer, factors affecting pool boiling film coefficients, high heat flux boiling. Laminar film condensation on a vertical plate, turbulent film condensation, drop wise condensation. Numerical Solution of Conduction problems and Mass Transfer, Finite difference equations method of energy balance, finite difference formulation of unidirectional for Cartesian cylindrical coordinate of various kind of boundary conditions, heat conduction problems, numerical methods of solutions, numerical solution of transient heat diffusion problems. Convective mass transfer, equations for convective mass transfer, boundary layer mass transfer empirical correlations for convective mass transfer.

References

1. Principles of Heat Transfer   Kreith Bohn
2. Heat Transfer   J.P. Holman

TH 514 THERMAL ENGINEERING LABORAYORY
Experiments in heat transfer and IC engines.

TH515 SEMINAR 1
Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second semester

TH 521 - INSTRUMENTATION AND CONTROL
Theory and Experimentation in Engineering, Fundamentals of Measurement System, Performance Characteristics of Instruments:

Dynamic performance characteristics: dynamic response, system transfer function and frequency response. Elements of Measurement Systems, Signal conditioning, Data presentation systems, Pneumatic and Hydraulic systems, Applied Mechanical Measurements, Determination of count, events per unit time and time intervals, Measurement of stress and strain, Pressure, Temperature, fluid flow, motion, Humidity, Torque and power measurements.

References
  1. Industrial Instrumentation   Al Seutko, Jenny D Frank
  2. Instrumentation Measurements and Analysis   B.C. Nakva K. K. Chandhary

TH 522 - THERMAL   ENVIRONMENTAL   ENGINEERING
Thermodynamic properties of moist air, psychrometric chart and its applications. Thermal exchanges of body with environment. Physiological hazards resulting from heat exposure. Environmental requirements for various components (e.g. men, material, machinery, and processes) for a few important heavy industries. Various systems of refrigeration and their application to environmental control. Vapour compression refrigeration system, Multi evaporator multi compressor systems, Vapour absorption system, Evaporative Cooling, Desiccant cooling systems. Various system of ventilation for industry. Air conditioning load calculations, various systems of air conditioning for industries. Recommendations of ISO 140000 for thermal environment.

References
  1. Refrigeration and Air Conditioning   Arora and Domkundwar
  2. Refrigeration and Air Conditioning   C.P. Arora

TH523 - THEORY AND DESIGN OF HEAT EXCHANGERS
Classification, temperature distribution for parallel flow, counter flow, cross flow, heat exchanger, evaporators and condensers, concept of LMTD and overall heat transfer coefficient. Fouling of heat exchangers, NTU method for gauging exchanger performance, LMTD for parallel, counter and cross flow heat exchangers, effectiveness for parallel and counter flow exchangers. Important design considerations: material selection and optimization of heat exchangers, analysis of regenerative heat exchangers. Vibrations induced by flow, International Standards for heat exchangers.Thermal and Mechanical Design of Shell & tube heat exchangers, Double pipe, Extended surface, Condensers & evaporators, Boilers & feed water heaters, Air preheaters, Dictators, Heat exchanger for nuclear application.

References
  1. Design of Heat Exchanger   Kern
  2.   Principles of Heat Transfer   Kreith Bohn

TH524 THERMAL ENGINEERING LABORATORY 2

Experiments in heat transfer and IC engines.

TH525 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

TH 531 NUMERICAL HEAT TRANSFER

Introduction, Chemical thermodynamics and chemical kinetics. Conservation equations for multi-component systems. Premixed systems,

Detonation and deflagration, laminar flames, effects of different variables on burning velocity, methods for measuring burning velocity, flammability limits, ignition and quenching turbulent pre-mixed flames. Non-premixed systems, Laminar diffusion flame jet, droplet burning. Combustion of solids, Drying, devolatilization and char combustion. Practical aspects of coal combustion.

References

1. Combustion   Irvin Glassman
2. Intoduction to combustion   Stephen Turns

TH 532 EXPERIMENTAL STRESS ANALYSIS

Stress and Strain, Principle stresses, Mohr's stress circle, Isoclinic, Isostatic, Isochromatic, Isopachic, stress strain relationship. Whole field method, laws, plane polariscope, circular polariscope, white light illumination, analysis of photoelastic data, stress coat and membrane analogy, Electrical wire resistance strain gauges. Strain Gauge Rosette, Types of rosette, four element rectangular rosette, Tee-delta rosette, rosette analysis. Application, Design of turbo machinery components such as steam turbine rotor, L.P. and H.P. cylinder diaphragm value rotary compressors and its parts. Fatigue testing and vibration studies.

References

1. Experimental Stress Design   Daly and Reilly
2. Experimental Stress Design   Sadhu Singh

TH 533 MAINTENANCE OF THERMAL   POWER PLANT EQUIPMENTS

Maintenance Management, Maintenance strategies, maintenance schedule, emergency maintenance procedure spare part management, Diagnostic Maintenance and Machine Health Monitoring, practical application of diagnostic maintenance to specific industrial machinery and plants. Various techniques of condition monitoring wear analysis, vibration and noise signature, thermography etc. Mechanism of Lubrication & Lubricants, Lubrication Regimes: Lubrication regimes, analysis and modes of lubrication in different bearings, squeeze films, fluid film, elasto-hydrodynamic and boundary lubrication. Failure Mechanisms and Analysis, Material failure and failure due to environmental effects, Design faults, analysis of engineering failures, failure due to abuse of machinery, failure of seals & packing, failure of bearings, failure of gears, fatigue failure, failure due to time – temperature effects (creep) corrosion etc. Maintenance of Power Plant Machinery, Predictive and preventive maintenance of steam turbine and its components. On load and off load cleaning of condenser tubes. Maintenance scheduling of cooling water plants, cooling towers.

References

1. Maintenance & Spare Parts & Management   P. Gopal Krishnan
2. Modern Power Station Practice10 Volumes in Reference British Electricity Int. Ltd

TH 534 REFRIGERATION SYSTEM AND COMPONENT DESIGN

Introduction to various components. Thermal design of reciprocating, centrifugal and screw compressors. Capacity control methods. Thermal design of different evaporators–DX, flooded, etc. Thermal design of condensers–water-cooled and aircooled. Sizing of capillary. Selection of expansion valves and other refrigerant control devices. Components balancing. Testing and charging methods. Design of absorber and generator of vapor absorption systems. Design of cold storages, mobile refrigeration, refrigerators, commercial appliances.

References

1. Refrigeration and Air Conditioning   C.P. Arora C.P.
2. Principles of refrigeration   R.J. Dossat

TH535 THEORY AND DESIGN OF GAS TURBINES

Gas Turbine Plants, Axial Flow Compressor, Principle of operation, velocity triangles. Design procedure for single and multistage compressors. Three dimensional effect compressor performance. Description and problems of transonic and supersonic compressors. Impulse turbine. Single and multiwheel turbine efficiency, Number of stages blade passages, Vortex design of turbine blades. Blade design & manufacture blade material and blade cooling, limiting factors in turbine design. Combustion in Gas Turbine and Turbine Characteristics

References

1. Gas Turbine   Cohan Rogers
2. Gas Turbine   Ganesan

TH 536   COMBUSTION

Introduction: Mathematical Background, Survey of Numerical Methods Used in Heat Transfer, Finite Difference Methods, Finite Element Methods, Simulation of Transport Process, Conduction Heat Transfer, Steady and unsteady state one & two dimensional problems. Explicit, Implicit and Crank-Nicolson scheme, ADI and ADE methods. Convection Heat Transfer, Boundary Layer Flows, Similarity solutions, Derived Variables, Patankar/Spalding Methods for two-dimensional flows.Elliptic Solutions**,** Control Volume formulation. Energy and other scalar equations, Momentum equations, Segregated Solution method; SIMPLE & SIMPLER schemes, Stream Function – Vorticity Transport method. Turbulence, Examples of turbulent flows, Stress relations, Reynolds stresses, turbulence model computations, Analogy between Heat Transfer and Momentum, Linearization of source terms.

References

1. Computational Fluid flow and Heat Transfer   K. Muralidhar, T. Sundarajan
2. Numerical Heat Transfer   S.V. Patankar

TH 537 VIBRATIONS AND ITS APPLICATION FOR DESIGN OF TURBO MACHINERY

Differential equations of motion for first order and second order linear systems. Transverse vibration of beams. Damped free vibration, viscous, coulomb damping dry friction logarithmic decrement. Forced vibration of single degree of freedom linear systems. Response of first order systems to harmonic excitation. Frequency response. Response of second order systems to harmonic excitation. Rotating unbalance, whirling of rotating shafts. Harmonic motion of the base, vibration isolation, transmissibility, force transmission to foundations. Vibration measuring instruments eg Seismic mass, vibrometer, Accelerometer. Energy dissipation. Forced vibration with coulomb hystersis or structural & viscous damping. Equation of motion for a two degrees of freedom system. Torsional vibration of one, two and three rotor system. Equivalent shafting. Torsional vibration of a geared system. Torsional vibration with harmonic excitation, Critical speed of a shaft having a single disc with damping.

References

    1. Mechanical Vibrations   G.K. Grover

    2. Theory of Vibration with Application   Thomson

TH538 THEORY AND DESIGN OF BLOWERS AND COMPRESSORS AND INDUSTRIAL STEAM TURBINES

Energy interchange in fluid machinery, momentum-principle, streamline theory, momentum and circulation. Theory of centrifugal impeller for incompressible fluid, velocity triangle - impeller for approach and prerotation vortex theory. Blower casing volute, vaned and vaneless diffuser, thermodynamics of turboblowers. Dimensionless characteristic of turboblowers. Axial Flow Compressors. Two dimensional Cascade: Theoretical analysis of performance and experimental works. Howell's and Cartter's correlations for low speed. Effect of Reynolds and Mach numbers. Pitch line design of axial flow compressor. Radial equilibrium. Calculation of losses and stage efficiencies. Stresses in the discs and blades - interstage traversing, measurements of total and static pressures and vane angles.

Transonic and supersonic compressors. Industrial Steam Turbines. Type of Industrial Steam Turbines.

References

1. Turbines Fans and Compressors   S.M. Yahya

2. A Practical Guide to Steam Turbine Technology - Heinz P. Bloch

TH 539 GAS DYNAMICS AND FLOW THROUGH TURBOMACHINES

Fundamental Equations of Steady Flow, Euler's equation, Bernoulli's equation, Energy equation, Stream Function and Velocity Potential Potential Flow, Elementary potential flows, Uniform flow, Source, sink, vortex and doublet. Superposition of flow patterns. Flow over immersed bodies. Development of the aerofoil-lift and drag, Kutta-Joukowski Profile, pressure distribution over aerofoil blading. Viscous Flow, Navier Stoke's equation and exact solutions of steady flow problems. Flow through pipes, flow over flat plates. Laminar and turbulent boundary layers. Dimensional analysis. Compressible Flow of Gases, Fanno line and Rayleigh line flows. Flow with normal shock waves governing equations, Prandtl Meyer and Rankine Hugoniot relations, Moving normal shock waves. Cascade Tests, Fundamental equation of flow through turbo machinery. Radial equilibrium equation. Vortex flow through turbo machines. Surging and choking.

References

    1. Fundamentals of Compressible Flows   Yahya

    2. Compressible Fluid Flow   Michel A. Saad

viii) INDUSTRIAL DESIGN (M.Tech)

ID 511 COMPUTATIONAL METHODS

Various approaches in FEM, direct stiffness method, energy approach and Galerkin's approach, detailed method for structural analysis problems, various elements, development of element stiffness matrices. Applications to bar, beam, truss, spring, shaft problems. Two dimensional elements. Plane stress and plane strain problems. Three dimensional elements and their applications. Iso-parametric elements, plate bending and shell elements, Axi-symmetric problem, vibration problem,

Applications to fluid flow and heat transfer problems. Softwares such as IDEAS, ANSYS, Nastran used in FEM. Nonlinear FEA

References

1. Finite element method   O.C. Zienciwicz.
2. Finite element method   C.S. Krishnamurthy
3. Finite element method   Logon
4. Finite element method   Heubner

ID 512 MECHANISM & SYNTHESIS

Mechanism, link, linkage and mechanism planar and spatial mechanisms, grubler's criteria for degree of freedom, equivalent mechanisms, inversions of four link chain, slider crank chain and double slider crank chain. Mechanism analysis: Relative velocity method, instantaneous' center methods of velocity, acceleration analysis including coriolis component of acceleration. Application to slider crank chain four bar chain, stone crusher mechanism sewing machine mechanism, quick return mechanisms wrapping m/c mechanism etc klein's construction, computer aided analysis of synthesis of mechanisms. Pole, relative pole, inversion overlay freudenstein and block methods least squire technique. Application to four link mechanism and slider crank mechanism function generation, modification of timing of cam mechanism. Limit & dead center positions transmission angle, cognate linkages, coupler curves, euler savory equation.

ID 513 RELIABILITY ENGINEERING

Basic Concepts of Reliability, Design for reliability, Component Reliability & Hazard Models, System Reliability Models, Redundancy technique, System Design, Maintainability and Availability Concepts. Reliability problems & measures of reliability. Reliability of non-maintained & maintained systems with & without redundancy allocation of failure & repair rates. Maintenance policies.

ID 514 DYNAMIC OF MACHINES LABORATORY

1. Rotor Balancing On Dynamic Balancing W/C
2. Hydrodynamic Journal Bearing Pressure Distribution.
3. Natural Frequency of Simple, Compound & Torsional Pendulums

ID515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second semester

ID 521 ADVANCED COMPUTER AIDED GRAPHICS

Introduction to application of computer graphics for visualizing concepts, introduction of hardware including operating systems, file management and hardware limitations introduction to the concepts of programming through by per media. Exploration of various packages for illustration, drawing, desk top publishing page composition and animation.

References

1. Mars Bell G.R. Computer Graphics In Application Prentice Hall
2. Kerlow L.V. And Rosebush J. Computer Graphics For Designers And Artists.
3. Grieman A. The Fusion of Technology And Computer Graphic Design – Hybrid Imagery Architecture, Design And Technology Press.

ID 522 STRESS & VIBRATION ANALYSIS

Introduction, Types of Strain Gauges, Selection of Various Compensations, Installation, D.C & A.C. Systems. Steady & Transient Vibration of Single & Multi – Degree Freedom Systems. Systems with Distributed Mass & Elasticity Structural Damping. Dynamics of Rotating & Reciprocating Machinery.

Response of Systems to Random Vibrations. Vibration of Multi Rotor System Holzer's Method, Self Excited Vibration, Criteria Of Stability.

ID 523 Advanced Product Design

The emphasis of the course is on individually planned design projects in different product areas. Selection of these projects is based on consideration like close human interaction with product, wide range or requirements of different users and possibilities of formal and structural innovations. Projects and with a comprehensive presentation through working mock up models design drawing and a report. This project work is supported by theoretical information and short supporting assignment in following topics: Role of creativity in problem solving, study of inhibitions, conformity and vertical thinking: assignments on using techniques like brain storming. Synectics to develop creative attitude and open mind. The development of modem design methods from craft evolution. Detailed discussion on stages in design process. Complimentary nature of systematic and creative thinking in various stages of design processes. Discussion on nature of synthesis. Methodology for visual analysis of products. Principles of value analysis, use esteem, time and exchange values and definition of function.

References

1. Jones J.C: Design Methods, Interscience
2. Buhl H.R. Creative Engineering Design Lowa State Univ. Pres.
3. Hill Percy H: The Science Of Engineering Design, Holt, Rinehart And Winston Inc,
4. De Bono Edward: Lateral Thinking Penguin 1972 William J.J. Gordon: Sysnectics, Collie Books 1968.

ID 524 CAD LABORATORY.

1. Two Dimensional Drawings.
2. Three Dimensional Model of Product.
3. Working Drawings of Components and Assembly.
4. Mechanical and Aesthetic Design of Products.
5. Trying Various Aesthetic Shapes, Shapes, Colours Etc. of the Product by CAD.

ID525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

ID 531 BEARING DESIGN & SELECTION

Lubrication, hydrostatic bearings, hydrodynamics lubrication full journal bearing, friction, pressure distribution, load carrying capacity thermal equilibrium, partial journal bearings influence of end leakage on behaviour of bearings, maximum oil pressure with end leakage, practical considerations in bearing design. Bearing – design, selection of ball & roller bearings

ID 532 DESIGN & DEVELOPMENT OF PROTOTYPE PRODUCT

Marketing: forecasting & market research for a new product. Purchasing and sales procedure. Demand analysis for new product. Intellectual property right :introduction to ipr laws, nature, types of property intellectual property, ip as an economic entity, development of ipr copyright, patents, design, trademarks, forms, global ip structure and iprs in india, infringement and remedies available, patent search, contractual agreements involving patents, case studies.

ID 533 COMPUTER AIDED FACILITY & PROCESS PLANNING

Element of plan design systematic layout planning, industrial component and its consideration. Objectives types, goal, design process and techniques of facility planning. Schematic technique, travel charting,

sequence analysis systematic layout – planning mathematical models, optimizing heuristics algorithm, branch and board technique, quadramatic assignment techniques, traveling salesman problem, single goal improvement type models, single goal construction type models. Multiple facility design problem and construction type existing improvement type, multiple goal models and modifications, design problem solving technique. Estimation of distribution parameters. Empirical models, computer aided models. Estimation of distribution parameters in multi goal facilities design problem, computer aided techniques for finding optimum and sub optimum and sub optimum facilities design problem solution.

ID 534 ACCELERATED PRODUCT DESIGN & DEVELOPMENT

Introduction to rapid prototyping and manufacturing, photo polymerization, cationic photo polymerization, stereo lithography, lasers for rapid prototyping and manufacturing, solid modeling, slice process post processing – part removal, part cleaning, post curing and part finishing, case studies. Concurrent engineering: product design and product manufacturing merger is an intimate way to response competitiveness in design and manufacturing. Model of concurrent engineering correlating manufacturing, sales and distribution, market analysis, product design and production system design. Designing for lifetime use (life cycle engineering). Manufacturing decision and life cycle cost. Careful design decision in the area like material selection, selection of features, ease of assembly, product. Concurrent engineering beyond reducing manufacturing cost. More engineering effort. Rapid product development through concurrent engineering. Venders of suppliers a part of design team, Communication skill

ID 535 ELECTRONICS PACKAGING DESIGN

Electronics packaging introduction -packaging levels, mechanical packaging aspects of electronics packaging connectors, materials for electronics packaging, substrates sealing materials, packaging electronics, pcs, back panel, wire wrap bands cable connectors, wire insulation, electronic enclosures. Thermal management, vibration and shock analysis, noise and control, emi/rfi/esd shielding, reliability & testing, packaging case studies.

ID 536 COMPLEX MECHANISM & GRAPH THEORY

Equivalent planar mechanisms, complex mechanisms of lower and higher degree of complexity and their analysis, basic concepts in graphs. Graph theory Application to detect isomorphic kinematic chains, graph representation of kinematic chain, adjacency, degree and distance matrices, string method, characteristics polynomial computerized methodology. Application to simple, multiple jointed and sliding pair kinematic chains. Detection of distinct mechanism of a kinematic chain: velocity graph method and other methods, complex mechanics & of graph theory for selection of interactive chains, mechanics, fixed input & output link location in multi-degree freedom linkages: mechanism selection and link location, application to partial, fractionated and total degree of freedom linkages.

ID 537 NATURE OF MATERIALS AND PROCESSES

Properties and usage of thermoplastic, thermosetting plastics, selection and use of plastics for engineering and consumer products. Design limitations and specific advantages of molding processes. Properties and use of rubber, ceramics and glass. Ferrous and non ferrous metals-various processes and assembly techniques. Concepts of structure and costing. Properties of natural materials like wood, bamboo cane leather cloth jute and paper and their use at craft and industrial levels.

References

1. Producation Engineering Series. Plastic Forming.   John D, Beadle,
2. Product Treatment And Finishes   Macmillan
3. Basis Wood Working Process.   Heman H.Jorth,

ID 538 DETAILED DESIGN OF ROTATING MACHINES

Component & assembly design, use of cad procedure for designing, application of optimization techniques, modeling and evaluation of components & assembly, specific examples to be taken such as centrifugal pump, wind turbines, machine tools etc. calculation of stresses and strengthening of blades.

ID 539 ADVANCED MACHINE DYNAMICS

Gear design: Spur, bevel, worm, balancing & vibration analysis. Gyroscope applications: Motor cycle, four wheel vehicle, aero plane, Naval ship rotor bearing system. Cam dynamics: analysis of an eccentric cam, jump speed analysis of cam, unbalance, spring surge & windup.

 Reference
1. Dynamics of Machinery , Farazdak Haideri
2. The theory of machines: a text-book for engineering students, Thomas Bevan
3. Mechanics of mechanism Ghosh and Mallick
4. Theory of Machines S S Rattan
5. Kinematics and dynamics of machines, George Henry Martin

ix) MAINTENANCE ENGINEERING (M.Tech.)

First Semester

MTH 511C STATISTICS AND PROBABILITY

Collection & Tabulatory data. 2Measures of central Tendency, Mean, Median, Mode. Dispersion, range, Deviation, Coefficient of Dispersion , Moments. Probability: Additive law of probability, Compound events, Use of multinomial Expansion, theorem. Probability density function. Probability Distribution, Binomial, Poisson's and Normal weibill, experimential etc.

Sampling: Simple Sampling, Sampling distribution the sampling of variables, estimation, distribution, chi-square distribution. Interpolation: Newton's Forward and Back ward interpolation formula, central difference interpolation formulae, Interpolation with unequal intervals. Numerical Differentiation Numerical integration Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8 rule, weddlesrule. Solution of Algebraic and Transcendental Equations, Method of false position, Newton Rap son method, Bisection method.

References
1. Engineering Reliability Fundamental and Application R. Rama Kumar
2. Mechanical Survival J.H. Bampas – Smith
3. Mathematical Statistic M. Ray
4. Mathematical Statistic Fruend

MT 512 MAINTENANCE MANAGEMENT: POLICIES, STRATEGIES & OPTIONS

Introduction : Maintenance,Need of Maintenance Management, Maintenance Policies, Strategies and options in Maintenance management.   Maintenance forms/actions and their   inter relationships, Brief descriptions of   various   Maintenance actions. Maintenance Organisations: Prerequisities, factors determining effectiveness of a Maintenance organization, objectives of organization design, types of organization.

Maintenance Planning   and   Control: Establishing a Maintenance Plan-Preliminary considerations, Systematic method of Maintenance Plan and schedule planning and schedule of Plant shut downs

Maintenance practices on production machines- Lathe,Drilling,Milling,Welding,ShaperUse of computer in maintenance,Machine Reconditioning. Evaluation of Maintenance Management: Need for evaluation a to z objectives, criterion of   evaluation.   Spare Parts Management: Capacity utilization, cost

reduction approach to spares, reliability and quality of spares, spare parts procurement, inventory control of spare parts.

References:
1. Maintenance Management
   Policies, Strategies and   Options:July 27–29 , 2000, Lecture notes MACT, Bhopal.
2. Maintenance & Spare Parts
    Management.   :P. Gopal Krishnan & A.K. Banerji
3. Hand Book of   Reliability
   Engineering & Management   :W. Grant Ireson and   Clyde F – McGraw Hill
4. Maintenance Planning & Control:Anthony   Kelley – East West Press.

MT513   LUBRICATION MANAGEMENT AND PRACTICES

Introduction: friction, wear and lubrication, Historical background, Purpose of lubrication, Lubrication regimes, Characteristics of lubricants - viscosity, viscosity index, oxidation stability, flash point and fire point, pour point and cloud point, carbon residue, ash content, iodine value, neutralization number, dielectric strength, Composition and classification of lubricants, Lubricating oils – oil refining, types, categories, grading, Grease - composition, function, characteristics, thickeners and additives, soap and its complexes, selection and its practices, solid lubricants, Functional additives – surface, performance enhancing, lubricant protective , Lubricants applications – tribological components and industrial machinery, Lubricants testing and test methods, Organisation and management of lubrication, lubricant storage and handling, Safety and health hazards, Environmental regulations.

References:
1. CRC Hand Book of Lubrication and Tribology Vol. I – Vol. III   CRC Press Inc.
2. Maintenance Engineering Handbook   L.R.Higgins,
3. Basic Lubrication Theory   A Cameron

MT514 MAITENANCE ENGINEERING LABORATORY

Experiments in Preventive maiteneance and digonstic engineering

MT515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second semester

MT521 RELIABILITY AVAILABILITY AND MAINTAINABILITY ENGINEERING

Introduction to Reliability   Availability and   Maintainability (RAM), Development of   RAM Engineering, Reliability Availability and Maintainability utilization factors, down time   consequences. Reliability   engineering   fundamentals and applications, Historical perspectives, Definition of Reliability, Role of Reliability evaluation, Reliability assessment, relationship between different Reliability functions, typical   Hazard functions, Mean time to failure, Cumulative Hazard function and average failure rate,

Application of Probabilitydistribution function in Reliability evaluation combinational Aspects of Reliability, Markov models optimization of system Reliability,   Heuristic Methods applied to optimal system Reliability. Maintainability :

  Definition   and application of Maintainability Engineering, Factors   affecting   Maintainability. Maintainability design criteria,operating and down   time categories, Maintainability and its qurantification, Mean time to activity restore anequipment, Mean Maintenance man houurs,

Mean time for corrective and Preventive Maintenance, Replacement Policies. Availability, types of Availability, approaches to increase equipment Availability.

References:
1. SERC School on RAM Engineering for Manufacturing servicing and Process Industries.
2. Reliability Engineering Fundamentals   R. Ramakumar
3. Maintainability, Availability and   Dimitri Kececelogu
4. Reliability Engineering   Govil
5. Reliability Engineering   Balguruswamy

MT522 FAILURE ANALYSIS & PREVENTION

Introduction:Engineering aspects of failure & failure analysis

Defects:Types and characteristics, Effects of defects on service properties General Procedures for Failure Analysis Basic Failure Mechanisms:Distortion Failures,Overload Failures, Fatigue Failures,Wear Failures,Corrosion Failures,Elevated Temperature Failures,Fractures.

Failure Analysis Techniques and Preventive Measures: Non Destructive Testing Techniques and Metallographic Techniques.

ComponentFailures: Bearings,Chain and Belt Drives,Gears,LiftingEquipments,Mechanical Fasteners,Pressure Vessel,Seals, Shafts, Springs

Failure Modes and Effect Analysis:Failure Modes,Catagories of Failure Modes,Failure Effects,Sources of Information about modes and effects, failure consequences, Case Studies on failure Analysis

References
1. Metals Hand Book 9th Edition,Vol. 11,Failure Analysis and Prevention.
2. Failure of materials in Mechanical Design:Analysis,Prediction and Prevention Jacks A. Collins.
3. Metallurgy of Failure Analysis.   A.K. Das.
4. CRC Hand book of lubrication Vol.I Application and maintenance.   E.R.Boosy

MT523 TPM, CBM AND RCM

Introduction: Definition concept of TPM, characteristics of TPM, Benefits of TPM, losses of TPM, implementing TPM. Philosophy of TPM. Indications of TPM.

TPM Development: Preparation phase, TPM introduction education, TPM Promotion organization, TPM policies and goods, TPM Master Plan TPM initiatives, Implementation phase; consolidation phase.

Measuring TPM effectiveness: Philosophy of setting goals Measuring TPM effectiveness Indicators topes, Plant effectiveness quelling and Energy saving Maintenance Measuring TPM Benefits.

Application of TPM in Process Industries Administrative & Support departments and other Industrial enterprises

Reliability Centred Maintenance (RCM): Introduction its place in Maintenance policies & Hierarchy aims of RCM, steps in RCM implementation, steps in RCM analysis, system selection, RCM effectiveness indicators. Maintenance informer and efficiency.

RCM tasks Proactive Maintenance, Preventive and Predictive tasks. Scheduled restoration and scheduled discard . The P-F interval and P-F curves, linear as non linear PF curves , Default actions, RCM Decision diagrams. Implementation of RCM. Condition Based Maintenance: Machine signatures, various techniques of signature analysis, temperature noise, vibration and wear particle analysis, on line and off line techniques.

References
1. Seichi Nakajima TPM development   Productorly Press 1989. Programme
2. Total Productive Maintenance   Vikas Bhaduri

3. Industrial / Maintenance & Management   S.K.Shrivastava.
4. Introduction to TPM – Total.   S Nakafiurea Productivity Productive Maintenance

MT524 MAITENANCE ENGINEERING LABORATORY

Experiments in Preventive maiteneance and digonstic engineering

MT525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

MT 531 MAINTENANCE   AUDIT

A Methodology for auditing the industrial maintenance function. The purpose and procedures of such auditing. An outline with examples of a full audit, a snapshot audit and a fingerprint audit. Information gathering strategy. Information gathering techniques: models, questionnaires, survey forms. An outline of an aide-memoire based on the audit methodology Methods of interviewing. Analysis of data: the analysis procedure, identification of problem areas, developing improved organisations and systems. Reporting: the report structure, the audit section, the proposal section. A major part of the course will be devoted to the discussion and analysis of actual audit reports. This will include use of audit data to identify problems, their causes and solutions.

References

1. GIP Quality Audit Manual   Milton A. Anderson
2. ISO 14000 EMS Audit Hand book   Gregory P Johnson

MT 532 RISK ANALYSES AND SAFETY

Risk management and analysis during operation. Risk analysis and management during   system procurement   and installation. Role of maintenance and   inspection   in risk   management. Risk minimization through operation and maintenance feed back in design. Strategies for safety of equipment and personnel and emerging trends in design of power plants to reduce fire risk. Risk and hazards in chemical industries. Risk and safety assessment in defence equipment. Rish management in EHV transmission systems. Risk man & Risk management in steel cord conveyors.

References

1. Risk Analysis and Security Survey   John F. Border
2. Fundamentals of Risk Analysis and Risk Management   Vlasta Molar

MT533 CONCURRENT ENGINEERING

Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team. Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools.

Quality by design: Quality Function Deployment methodology, Taguchi methods of robust design, Design for manufacturability: Virtual manufacturing, , Introduction to Value Engineering, Value Engineering analysis and techniques, Design for assembly : Introduction to various DFA technologies.

Rapid Prototyping: Need and use of RP, various RP technologies, Design for Reliability: Reliability fundamentals and design for reliability principles, Design for Serviceability: Factors affecting serviceability, serviceability evaluation, Design for Maintainability and Economics.

References

1. Concurrent Engineering, shortening lead times, raising quality & lowering costs
                                                        John. R. Hartley, Susmu Okamato.
2. Total quality development, a step by step guide to world class concurrent engineering
                                                        Don Clausing,
3. Concurrent engineering, what every engineer should know about series Thomas A. Salomone

MT 534 MAINTENANCE AWARENESS IN DESIGN

Design activity: design modules, what makes for good design, design levels. Systems engineering. M+R parameters that can be usefully used in design. Design reviews. Design evaluation. Creative design. Design detail. Design contractual agreements. Decision analysis. Ergonomic considerations. Industrial case studies.

References

1. Parking Structures Planning ,Design ,Construction,Maintenance and Repair   A.P.Chrest,Mary S. Smith
2. Asset Maintenance ManagementAguide to developing strategy and improving performance A.Wilson

MT 535 MAINTENANCE OF AGRICULTURAL AND EARTH MOVING   MACHINERY

Maintenance scheduling, predictive and preventive maintenance, machine health monitoring systems, spare parts – inventory and maintenance.

Fault diagnosis, rectification servicing and repairs of various components/systems of agricultural equipments and earth moving machinery, fault diagnosis and manuals.

Special problems associated with heavy earth moving equipments and their solutions. Planning and design

References

   1.Hand book of Maintenance: Lindley R. Higgins

MT 536 BULK SOLIDS AND HANDLING

Nature of Bulk Solids, Flow of bulk solids – gases/solid flow in pipelines, Mechanical Handling – Screw Conveying, Belt Conveying, Bucket Elevators, Vibratory Conveyors, Components of Pheumatic Conveying Systems – Feeding devices, Pipiline, Engaging and Disengaging, Devices, Pneumatic Conveying System Design, Operational Problems, -- Erosive wear, Product Degradation, Moisture.

References:

1. HandBook of Pneumatic Conveying Vol. 1   D.Mills,Mark G.Jones,V.Agarwal
2. A Practical Guide to Pneumatic Conveying Problems   V.Agarwal

MT537 MAINTENANCE OF ELECTRICAL MACHINES

Principals and planning of maintenance, heating and ventilation of electrical machines, mechanical features of electric motors, lubrication system, possible faults, their causes and repairs in A.C. single phase induction motors and D.C. motors, transformers, installation and commissioning of transmission lines and distribution lines, under ground cables, switch gears, house installation maintenance, importance of earthing, its testing and maintenance, fire fighting equipments, batteries.

References

   1. Parameter Estimation,Condition Monitoring and Diagonosis of Electrical Machines   P.Vas

MT538 MAINTENANCE OF POWER PLANT MACHINERY

Introduction to various systems of power plant e.g., boilers, fuel and ash handling equipments, steam turbine, condenser and feed heaters etc. Operation and maintenance of piping, plant, stokers, oil burners. Boiler tube corrosionand its prevention, maintenance of furnace and boiler accessories and mountings. Emergency actions, Boiler regulation/ inspection. Boiler operations and safety precautions.

Operation and maintenance of coal handling, oil handling and ash handling plants. Predictive and preventive maintenance of steam turbine and its components. Erosion of blades and its prevention. Lubrication of bearings, valves etc. Steam path deposits, vibration monitoring, performance monitoring. Planned overhauls, general purpose steam turbine maintenance and repair, maintenance overview. Maintenance scheduling methods of detection of leaking and its prevention in the condensers, Condenser fault systems and its causes. On load and off load cleaning of condenser tubes, Maintenance scheduling of cooling water plants, cooling towers etc.

References
1. Plant Service and Operation Handbook   A.L. Kohan
2. Practical Machinery Management for   H.P. Bloch & F.K. Geitner
3. Maintenance Engineering hand Book   Lindley & Higgins
4. Steam turbine -Operation & Maintenance   Kearton

MT539 MAINTENANCE OF TRANSPORT MACHINERY

Introduction and classification – Passenger vehicles, heavy load carriers, moderate capacity vehicles. Light motor vehicles.

Fault diagnosis, rectification, servicing and repair of various components/system of transport vehicles e.g. engine fuels system lubrication, transmission, supervision and electrical system, fault diagnosis charts and service manuals. Maintenance scheduling predictive and preventive maintenance, machinery health monitoring systems, spare parts, inventory and maintenance, Social problems connected with public transport system.

Reference
1. Journal of Institute of Rail Transport : Institute of Rail Transport (India)
2. Handbook of National Accounting Tackling Transport :H.TrischlerS.Zeilinger

MT541 MECHATRONICS AND NDT IN MAINTENANCE ENGINEERING

Introduction, Mechatronic systems, closed and open loop measurement systems, The Mechatronics approach, Sensors microprocessors and transducers, displacement, position and proximity pickups. Mechanical and Electrical activation systems.

Measurement Systems: Measurement errors, modelling measurement systems, system Reliability, signal conditioning & processing, Data acquisition and processing systems, Data presentation.

Applied Instrumentation : Measurement of mechanical and process parameters. Measurement of force, torque, temperature, pressure and flow. Measurement of displacement velocity and acceleration. Measurement of noise and vibration.

Non Destructive Testing: Visual inspection, crack detection techniques like magnetic crack detection, dye peneterant, radio graphy, oil analysis, wear particle analysis, strain gauge technology, ultra sonic crack detection, Thermography.

Machine Health Monitoring: Signature analysis and their significance, machine signatures, temperature, vibration, wear particle and noise monitoring, acceptable standards, online and offline techniques, performance trending, potential failure (Pf) curves.

References
1. Handbook of Condition Monitoring   BKN Rao
2. Non-Destructive Examination   K.G. Bowing
3. Non-Destructive Testing   R. Halmshaw
4. Mechatronics   W. Bolton
5. Mechanical Measurements   T.G. Beckwith, , R.D. Marangoni and J.H. Lienhard

MT542 MAINTENANCE OF CNC MACHINES

Introduction to DNC,FMS,CNC systems, failure in CNC systems, causes diagnosis and remedies. Failure in hydraulic systems, monitoring strategies, fluid contaminent monitoring techniques, particle characterization, lubricant analysis, operational parameters.

Electropneumatic systems – advantages of electropneumatic systems, valve failure, diagnostic displays. Introduction to Robotics, Maintenance of Robots. Black – out Industries.

References

    1. Handbook of condition monitoring   BKN Rao

    2. Maintenance Engg. Handbook   Lindley R.Higgins

MT 543 RESTORATION REPAIRS & RETROFITTING

Restoration: . Scheduled restoration and scheduled discard tasks. . Restoration techniques for industrial equipments: Gear transmissions, key fittings, splines fitting, coupling & clutches, lead screw & nut, belt ,chain & sprocket wheels, bush bearing ball & roller bearings their shank & housings. . Restoration of parts by welding metallisation, chromium plating,maintainability for given restoration time with weibull times to restore distribution, time to restore for given maintainability with a weibull time to restore distribution,steady state mean times to actively restore, repair and /or replace components in an equipment,equipment restoration time, efficiency & consistency.

Repair: Repair cycle, repair complexity, Assembly & dessembly of machine& omponents, repair of cracks, reclamation of worn & damaged parts, economics of reconditioning, reconditioning Vs replacements. Repair of Industrial equipments: Machine spindle, Hydraulic machines, tailstock, three jaw chucks, repair of cracks in C.I. Body , special features of the repair of cranes, hammers power press.

Retrofitting: Retrofitting, objectives, classification of retrofitting, scope of retrofitting, Cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features &selection for retrofitting.

References

    1. Industrial maintenance   H.P.Garg

    2. Maintenance engineering hand book   Lindley R Higgins

    3. Reliability centered maintenance   John moubray

    4. Maintainability, availability & operational readiness engineering   Dimitri Kececioglu

MT 544 MACHINERY VIBRATION MONITORING ANALYSIS

Vibration of Rotating Machinery. Machine Faults And Frequency Range Of Symptoms. Localised and Distributed Faults. Impact Excited Resonance. Vibration Level Classification. ISO Standards. Peak and RMS Levels. Constant Percentage Bandwidth Spectra. Use of Phase. Cepstral Analysis. Envelope Detection. Time Domain Averaging.Rolling Element Bearings. Rotor Dynamics.Orbit Analysis. Static And Dynamic Balancing. Gearbox Vibration. Induction Motors. Reciprocating Engines and Compressors.

References:

    1.Machinery Vibration –Measurement and Analysis   W. Victor

    2. Rotating Machinery Vibration   Maurice L.Adams

MT 545 MAINTENANCE OF CHEMICAL PLANT MACHINERY

Maintenance scheduling, predictive and preventive maintenance, machine health monitoring systems, spare parts – inventory and maintenance.

Corrosion and corrosion problems in process equipments such as piping, pressure vessels, heat exchangers, process towers, chimneys, boilers etc. Corrosion and erosion control.

Maintenance problems associated with moving machinery such as blowers, pumps, gear drives, conveyors, electrical machines etc. And their rectification identification of special problems with different chemical plants and their solution.

 Reference Books:
    1. Fault Diagnosis in Complex Chemical Plants   J.C.Hoskins

x) ENGINEERING MATERIALS (M.TECH)

MTH511D ADVANCED ENGINEERING MATHEMATICS & OPTIMIZATION TECHNIQUES

Numerical Methods: Solution of algebraic and transcendental equations, Solution of linear simultaneous equations, finite differences, Interpolation and Extrapolation, Inverse Interpolation, Numerical differentiation and integration, Numerical solution of ordinary and partial differential equations.

Introduction to optimization by linear programming, solution by graphical and simplex method, concept of degeneracy and duality, artificial variable techniques-Big-method, transportation and assignment problem.

References
    1. Numerical Methods for Engineers   Stevan C. Chapra and Raymond P Canale.
    2. Numerical Methods for Engineers   Iyengar and M.K.Jain.
    3. Operation Research   S.D.Sharma.
    4. Numerical Optimization Techniques with Applications   Suresh Chandra.

EM512 MATERIAL SCIENCE

Crystal structure and characterization of materials, Bragg's law, X ray diffraction.

Crystal imperfections, frank reed source of dislocation, elastic & plastic modes of deformation, slip & twinning, strain hardening, seasons cracking, Bauschinger's effect, yield point phenomenon, cold/hot working, recovery, recrystallisation, and grain growth, strengthening of metals.

Electrical properties of materials, resistivity, conductivity, semiconductors: intrinsic/extrinsic semiconductors, insulating materials, dielectric materials, piezoelectricity.

Magnetic properties of materials, classification of magnetic materials, description of magnetic material, effect of temperature, heat treatment and grain direction on magnetic properties of materials, effect of impurities and alloying elements, Losses.

Diffusion in solids, fick's law, factors affecting diffusion.

 References
    1. Material Science and Engg.   V. Raghvan
    2. Material Science   G.K.Narula
    3. Physical Metallurgy Principles   Robert E. Reed Hill
    4. Engineering Material   R.K.Rajput

EM513 BEHAVIOUR OF MATERIALS

Mechanical behaviour of materials under Tension and Compression, Nominal/True stress-strain properties in elastic and plastic range and their application in design, maximum instability load.

Mechanical behaviour of materials under Shear, torque-twist diagram, static shear properties using solid circular and thin-walled circular torsion specimen. Static stress-strain properties in bending, load-deflection diagram. Utilization of shear/bending properties in design.

Static stress-strain properties for combined stresses, theories of yield strength, stiffness, resilience, ultimate strength, fracture strength, ductility and toughness. Comparison of results.

Griffith criterion, LEFM, fracture toughness, crack opening displacement, J integral, Mechanical behaviour of materials under Fatigue, fatigue strength, factors affecting fatigue strength, influence of superimposed static stresses, stress concentration, notch sensitivity.

Mechanical behaviour of materials under Creep, Creep testing, creep parameters. Impact toughness, Notch bar impact test, Material Damping and its determination.

References

1. Behaviour of Material   Joseph Marin
2. Mech. Behaviour of Materials   Norman E. Dowling
3. Mech. Behaviour of Materials   K.K.Chawla
4. Mech. Behaviour of Material   Thomas H Courtney

EM 514 BEHAVIOR OF MATERIALS LABORATORY

Experiments on mechanical, thermal and electrical properties of materials, Studies of crystal structures, Corrosion.

EM515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second semester

EM 521 MATERIALS PROCESSING

Solid solutions, phase diagrams, gibb's phase rule, construction of phase diagram, lever rule, phase transformation, nucleation and growth.

Iron-carbon equilibrium diagram, microconstituents, transformations in steel, TTT diagram.

Heat treatment processes, Chemical treatment of steels, Surface hardening, Quenching media and their characteristics. Heat treatment of Aluminium and its and alloys.

Powder metallurgy, Manufacturing Process, Compacting, Sintering, Vacuum processing, Properties of Powder processed materials, high energy compaction, HIP, Explosive forming. Metal matrix composites, preparation properties and uses. Fiber reinforced resin plastics.

Corrosion, coatings, diffusion in solids.

References:

1. Heat treatment Priciples & Techniques   T.V.Rajan & Sharma
2. Material Science and Engg.   V. Raghvan
3. Physical Metallurgy Principles   Robert E. Reed Hill
4. Engineering Materials Technology   Kilduff & Jacobs

EM522 MATERIALS MANAGEMENT

Importance of material management system-integrated concept. Planning and Organization, store codification, standardization and variety reduction, waste management.

Purchase management-Forecasting of material for Purchase and Sales, source selection, pricing theory, negotiation, purchasing for public agencies, make or buy, budget, vender evaluation rating forward and speculation buying and purchase research, how much to buy, when to buy.

Stores management-sores function, receipts and inspection, storage of material, presentation and warehouse design, issues, stores records and stores accounting, stock taking, overstock surplus and cracks.

Inventory management- introducing inventory, relevant costs, selection controls, replenishment inventory, project inventory. cost reduction, 5-S, JIT.

Computer applications and evaluation- cost reduction through material management, value analysis, computer applications in material management, evaluation of material management and performance and starting of material management organization in large and new undertaking. ABC analysis and classification.

References
1. Materials Management   P.B. Pandey
2. Materials Management   H.C. Sharma
3. Operation Research   Heera Gupta

EM523 TRIBOLOGY & WEAR ANALYSIS

Introduction: Background, Historical development, striebeck curve, Tribology over view friction wear & lubrication, economic significance, Peter jost committee report, impact of tribology on maintenance, plant life, energy conservation, material conservation, safety & pollution.

Friction & wear: Laws of friction, sliding & rolling friction, dry & lubricated

friction, contribution to force of friction, concept of friction coefficient. Wear, its significance, wear regimes, adhesive, abrasive, corrosive, erosive & fatigue wear, effect of surface film, control of wear.

Lubrication: Lubrication types, Shiebeck curve, boundary, lubrication, surface film formation & failure, elasto hydrodynamic lubrication, hydrodynamic & hydrostatic lubrication. Fluid dynamics in lubrication, Newtonian fluid, compressible &incompressible fluids, theory of hydrodynamic lubrication.

Lubricants: function, types of lubricants, solid, liquid, semi solid & gaseous lubricants, mineral, natural & synthetic lubricants, greases, aditives, special purpose lubricants, lubricant properties, testing of lubricants.

Triboelements: Bearings types, Journal bearing, babbitts, important steps in design, rolling element bearing, selection, comparison of journal & rolling element bearings, Gears, gear lubrication, gear failure, seals, elastomers, synthetic and natural, their behaviour, seal failures.

References:
1. Basic lubrication theory   A. Cemeron
2. Introduction to Tribology of bearings   B.C. Majumdar
3. Maintenance Engineering Handbook   Ed. Lindley R. Higgins
4. Friction & Wear of Materials   Rabinowicz
5. ASM Handbook on friction, wear & lubrication

EM 524ADVANCED MATERIALS LABORATORY

Experiments related to advances materials

EM525 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department Electives

EM531 BIO MATERIALS

Studies of biomaterial interactions with the human body, bio-compatibility, interfacial and interaction problem.

Biomaterials-Biocompatible materials having high degree of wearing resistance such as medical grade 18-8 stainless steel, Teflon, Silastics, Siloconized rubbers, Acrelic cements for dentures and Bine setting cements. Biodegradable materials such as polymers, high concentrated protein compounds with a short life time. Impact failure fields and degradation of implants biosensors, bioreacters. Bioprocess instrumentation and control system.

Biomechanical behaviour under biological and/or medical condition such as fracture toughness, fatigue, plasticity, viscoelasticity, rheology, tribology and wear and behaviour under impact. Mechanics and device for promotion of physical strength.

Biomechanics: Mechanics of forces and movements of joints. Fracture mechanics of the human skeleton with special reference to dynamic impact. Effect of vibration on human skeleton, Mechanical and biological properties of membrane biomaterials, cellular and tissue engineering.

Standardization problems on biomaterials and related products. Assessment of reliability and safety of biomedical materials and man-machine systems. Product liability of biomaterials and related products. Bioengineering and materials technology as applied to decontamination against environmental problems.

References

1. Bioengineering Materials   R.S.Sharma
2. Engineering Materials   R.L.Timings.

EM532 NUCLEAR MATERIALS

Structure of a power plant, requirements of reactor materials, fuel materials, plutonium uranium and thorium and their alloys and compounds, core materials, beryllium, graphite, control and shielding materials, magnesium and its alloys, aluminum and its alloys, zirconium and its alloys, austenitic stainless steel materials for reactor vessel and other components, pearlitic steels, ferritic, chromium stainless steels, copper alloys, titanium and its alloys, coolants used in reactors, radiation embrittlement , corrosion of reactor materials, mechanical properties of materials.

EM533 AEROSPACE MATERIALS

Carbon- carbon composites, production, properties and applications, inter metallic matrix composites, ablative composite based on polymers, ceramic matrix, metal matrix composites based on aluminum, magnesium, titanium and nickel based composites for engines, super alloys, aluminum alloys, magnesium alloys and titanium alloys, materials for plasma engines, inter-metallic aluminides, ceramics and polymeric materials.

EM 534 POLYMER ENGINEERING

Introduction, Plastic today, Automotive applications of plastic, Environmental considerations, Structure of the molecule, Structure of polymeric solids, elastic properties of rubber.

Viscoelasticity, Nature of viscoelasticity, Theory of linear viscoelasticity, Stiffness, Yield and fracture, yeilding, Crazing, linear elastic fracture mechanics, Brittle fracture of polymers rubber toughening, High strength polymer, Water soluble polymer.

Metal polymer combination, Polymer composites, FRP, mechanics of fibre reinforcement, reinforced rubbers, Forming, flow properties of polymers melts, cooling and solidification, extrusion.

Mechanical, Electrical and Barrier Properties, Conducting polymer, High temperature polymer, Rheological behaviour of polymer.

Design and Analysis,   materials selection, designing for manufacture, designing for stiffness, strength, testing of polymers.

References

1. Engineering Polymer   R.W. Dyson
2. Principles of Polymer Engg.   N.G. McCrum

EM535 CORROSION ENGINEERING

Electrochemical and thermodynamic principles, Nernst equation and electrode potentials of metals, EMF and galvanic series, merits and demerits; origin of Pourbaix diagram and its importance to iron, aluminium and magnesium metals.

Exchange current density, polarization - concentration, activation and resistance, Tafel equation; passivity, electrochemical behaviour of active/passive metals, Flade potential, theories of passivity.

Atmospheric, pitting, dealloying, stress corrosion cracking, intergranular corrosion, corrosion fatigue, fretting corrosion and high temperature oxidation; causes and remedial measures.

Purpose of testing, laboratory, semi-plant and field tests, susceptibility tests for IGC, stress corrosion cracking and pitting, sequential procedure for laboratory and on-site corrosion investigations, corrosion auditing and corrosion map of India.

Corrosion prevention by design improvements, anodic and cathodic protection, metallic, non-metallic and inorganic coatings, mechanical and chemical methods and various corrosion inhibitors

References

1. An Introduction to Metallic Corrosion and its Prevention   Raj Narayan
2. Corrosion Engineering   Fontana M. G., Greene N. D.
3. Denny Jones, "Principles and Prevention of Corrosion", Prentice Hall of India, 1996

EM536 METAL FORMING

Classification of metal forming processes, hot, cold and warm working, flow curve for materials, effect of temperature, strain rate and microstructural variables; residual stresses, experimental techniques, yielding theories, processing maps

Classification of forging processes, forging equipment, forging defects, plane strain forging analysis, open die forging and close die forging operations, force calculations

Classification of rolling processes, rolling mills, cold rolling, hot rolling, rolling of bars, billets and shapes, defects in rolled products, gauge control systems, process variables in rolling

Types of extrusion, process variables, extrusion defects, force calculation, wire, rod, and tube drawing, lubrication processes

Shearing, blanking, bending, stretch forming, deep drawing, defects in formed products, explosive forming, electro-hydraulic and magnetic forming processes, formability diagrams

References

1. Mechanical Metallurgy   Dieter G. E,
2. Engineering Metallurgy, Volume II,   Higgins R.A,
3. Mechanical Working of Metals-Theory and Practice   Harris J.N
4. Metal Forming Technology   Narayanasamy R,

EM-537 THEORY OF PLASTICITY

Nature of plasticity, Differential equations of equilibrium, 3D stress analysis, infinite deformation, finite deformation,Von Mises, Tresca's and anisotropic yield criteria, halgh-Westerguard stress space representation of yield criteria, experimental verification of yield criteria, subsequent yield surfaces, Elastic and Plastic stress strain relations and stress strain rate equations, Prandtle-Reuaa equations, Generalised plastic stress strain relations, Anisotropy and instability.

Plane plastic flow, Slip-Line field, Application of slip-Line field theory to plain strain metal forming processes, Plain plastic stress and pseudo plane stress analysis and its applications, Extremum principle for rigid perfectly plastic material, surfaces of stress and velocity discontinuity, Upper bound and lower bound theorems and applications.

References

1. The Mathematical Theory of Plasticity   R Hill
2. Applied Plasticity   Chakrabarty
3. Plasticity theory   Jacob Lubliner

EM538 ADVANCED MATERIALS

Nanomaterials: Carbon nanotubes, structure and properties, chemistry of carbon nanotubes, graphite whiskers, cones and polyhedral crystals, nanocrystaline diamond, carbide derived carbon nanotubes in multifunctional polymer nano composites, nanostructred materials for field emission devices, nanotextured carbons for electrochemical energy storage.

Composites: Introduction, reinforcements, matrix materials, processing, interface, micromechanics, monotonic behaviour, cyclic fatigue, creep, wear, applications, shape memory alloys (SMAs), metallic foam, recemat metal foam etc.

Plastics: Introduction to plastics, polymeric materials (molecular viewpoint), microstructures in polymers, mechanical properties (macro view point) chemical and physical properties (macro view point), designing with plastics,, thermoplastic materials (commodity plastics), thermoplastic materials (engineering plastics), thermoset materials, elastomeric (rubber) materials, extrusion, injection moulding, blow moulding, thermoforming, rotational moulding, casting, foaming, compression moulding, transfer moulding, and related processes, radiation, finishing, adhesion and assembly operations and management, Environmental aspects of plastics.

References

1. Materials, their Nature, Properties and Fabrication   Sukh Dev Sehgal, Lindberg R.A.
2. Light alloys: Metallurgy of Light Metals   Polmear I. J.

EM539 PRODUCT DESIGN AND DEVELOPMENT

Elements of successful product design in their specialist market place. Study of Engineering / Marketing relationship. The buying motivation and perception of industrial buyers. Individual customers, industry and government departments. Presentation of designs to potential customers. Acclerated product development. Variety proliferation. Differential product "fast to market".

Forecasting and market research for a new product. Purchasing and sales procedure. Demand analysis for new product. Intellectual property right. Introduction to IPR laws, nature, types of intellectual property, IPPP as an economic entity. Ddevelopment of IPR copyright, patents, design, trademarks, forms, global IP structure and IPRS in India, Infringement and remedies available, patent search, contractual agreements involving patents. Case studies

EM541 INTELLECTUAL PROPERTY RIGHT

Introduction to IPR, Importance, need of IPR, Intellectual Property protection.Patents and methods of application of patents, Trade secret copyrights, Trademarks. Legal implications, Historical development of International Intellectual Property, Protection of IC layout designs. Intellectual Property Issues in Cyber Space – Domain Names and Related Issues.

Cyber laws: Scope of Cyber Laws – Nature of Cyber Space, Cyber Property, Cyber Personality, Cyber Transactions, Cyber Jurisprudence – Concepts of Historical, Analytical and Ethical , Jurisprudence,

Relationship between Meta Society Laws and Cyber Laws, How Cyber Laws need to be developed. Law of Digital Contracts – Digital Contract – Definition; Formation of Digital Contracts, System of Digital Signature, Role and Function of Certifying Authorities, Legal implications.

Patent: Patents and methods of application of patents, The Science of Cryptography, Indian Patent act and rules,Pantentable and non-patentable inventions including product vs process patent. Traditional and indigenous knowledge.

Trade secret copyrights, Trademarks, Copyright and related rights under existing and prospective treaties and conventions (particularly Berne, WIPO Treaties, TRIPs). The challenges of the internet, Intellectual property over technology: scope of patent systems, biotechnology, access to medicines, limitations on patent rights.

WTO: Introduction to WTO, International institutions concerned with Intellectual Property: World Intellectual Property Organisation and the conventions it administers; World Trade Organisation: dispute settlement and TRIPs; European Union and other regional bodies. Intellectual property and global marketing: International arrangements concerning trade marks and unfair competition; Geographical and other denominations of origin, including types of collective marks.

EM542 FRACTURE AND FAILURE OF MATERIALS

Application of fracture mechanics in analysis of fracture, elastic – plastic fracture mechanics, plain strain fracture toughness test, crack opening displacement test, Ductile – brittle transition, method of determination of transition temperature, factors affecting ductile – brittle transition temperature.

Objectives of Failure Analysis, Stages of analysis: collection of background data & selection of samples, preliminary examination of failed part (visual examination and record keeping), non destructive testing, mechanical testing, selection, presentation and cleaning of fracture surface, macroscopic examination of fracture surface, microscopic examination of fracture surface, scanning electron microscopy.

Fracture modes: Shear mode, cleavage mode, other fracture modes, factors affecting, the ductile-brittle relationship, stress systems related to fracture of ductile and brittle metals: Pure loading systems, Tension loading, Torsion loading, Compression loading, Bending, Fatigue, effect of stress concentration, study of fractograph of some common metals.

Determination of fracture type : Ductile and brittle fracture, Fatigue fracture, Distortion failure, Wear failure, Corrosion failure, liquid – erosion failure, stress – corrosion cracking, elevated temperature failure, liquid – metal embrittlement, hydrogen embrittlement, creep and stress rupture failures, complex failure, chemical analysis, simulated service testing.

Case studies of different failures: Failure of steel castings and weldments, Failure of Gears and shafts, Failure of pressure vessels and pipes, Failure of bridge components, Failure of fiber reinforced composites, ceramics and polymers, Failure of integrated circuits.

References:
1. Fundamentals of Fracture Mechanics   J.F. Knott
2. Engineering Fracture Mechanics   D. Broek
3. Mech. Behaviour of Materials   K.K. Chawla
4. Elements of Fracture Mechanics   Prashant Kumar
5. Fracture & Fatigue Control in Structure   Rolfe & Barson

EM543 COMPOSITE MATERIALS

Types of Composites, Reinforcements, Whiskers, Laminar composites, Flake composites, Filled composites, Particulate reinforced composites, Cremates, Micro-spheres, Solidification of composites.

Economics of Composites and Reinforcements, Design of Composite Materials, Mechanics of composites, Applications of Composites.

tress – strain relations for arthotropic, anisotropic materials, Plane stress problems, strength theories, mechanics of laminates, symmetric and non symmetric laminates. Unidirectional fiber composites, Critical volume fraction, Discontinuous fiber composites, Rule-of mixtures equation, Critical angle, Analysis of composite plates and shells.

Interfacial bonds, interfacial strength, Laminated metal composites, Ceramic materials, Ceramic-metal systems, Ceramic glass system, Geometric relationships, Ceramic-ceramic systems, Thermal conductivity, Thermal expansion.

Metal Matrix Composites, Reinforcement, Reinforcement selection, Matrix selection, effects of reinforcements, Properties, Fabrication, Whisker reinforcement, Whisker composite properties. Al-composite foam, functionally gradient composite materials. Composite material for automobile, aerospace and general Engineering applications.

Ceramic Matrix Composites: Particulate reinforced composites, Continuous fiber reinforced composites, Chopped fiber and whisker reinforced composites, Fabrication processes, Properties.

Reference
1. Composite Materials   Lawrence J. Broutman
2. Composite Materials   R.M. Jones

xii) STRESS AND VIBRATION ANALYSIS (M.Tech)
MTH 511E ADVANCED ENGINEERING MATHEMATICS & OPTIMIZATION TECHNIQUES

Numerical Methods: Solution of algebraic and transcendental equations, Solution of linear simultaneous equations, finite differences, Interpolation and Extrapolation, Inverse Interpolation, Numerical differentiation and integration, Numerical solution of ordinary and partial differential equations.

Introduction to optimization by linear programming, solution by graphical and simplex method, concept of degeneracy and duality, artificial variable techniques-Big-method, transportation and assignment problem.

References
1. Numerical Methods for Engineers   Stevan C. Chapra and Raymond P Canale.
2. Numerical Methods for Engineers   Iyengar and M.K.Jain.
3. Operation Research   S.D.Sharma.
4. Numerical Optimization Techniques with Applications   Suresh Chandra.

SV512 THEORY OF ELASTICITY

State of stress and strain at a point in two and three dimensions, stress and strain invariants, Generalized Hooke's law, Plane stress and plane strain problems, equations of equilibrium, boundary condtions, compatibility equations, two dimensional problems in Cartesian coordinates, solution by Airy's stress function, Saint Venant's principle, solution of beam problems, two dimensional problem in polar coordinates, general equations, stress distributions symmetrical about an axis, pure bending of curved beam, stress concentration, problem of torsion, membrane analogy method.

References
1. Theory of elasticity   Timoshenko & Goodier
2. Theory of elasticity   Sadhu Singh
3. Structural Analysis   L S Negi and R S Jangid
4. Structural Analysis   P Dayaratnam
5.

SV 513 THEORY OF VIBRATIONS 1

Elements of a vibrating system. Free vibration of single-degree of freedom linear systems. Methods of vibration analysis: Energy method, Newton's method & Rayleigh method. Differential equations of motion for first order and second order linear systems. Transverse vibration of beams. Damped free vibration, viscous, coulomb damping dry friction logarithmic Decrement.

Forced Vibration of single degree of freedom linear systems. Response of first orders systems to harmonic excitation. Frequency response. Response of second order systems to harmonic excitation.

Harmonic motion of the base, vibration isolation, transmissibility, force transmission to foundations. Vibration measuring Instruments eg. Scismic mass, vibrometer, Accelerometer. Energy dissipation. Forced vibration with coulomb hystersis or structural & viscous damping.

Torsional vibration of one, two and three rotor system. Equivalent shafting. Torsional vibration of a geared system. Torssional vibration with harmonic excitation. Critical speed of a shaft having a single disc and multiple disc with damping. Rotating unbalance, whirling of rotating shafts.

  References:
    1. Theory of Vibration with Application   Thomson.
    2. Mechanical vibration   V.P.Singh
    3. Mechanical vibration   Schaum Series.
    4. Mechanical Vibrations   G.S. Grover & Nigam

SV 514 VIBRATION ANALYSIS LABORATORY

Uses of pick-ups, oscillator and amplifiers for measurement of vibration and acceleration. Recording instruments. Studies in damping behaviour. Mechanical models.

SV515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second Semester

SV 521: EXPERIMENTAL STRESS ANALYSIS

Types of strain gauges, resistance   wire   strain gauges, materials and cementing methods, temperature compensation, circuits and measuring techniques, strain gauge rosettes, testing and selection of gauges, mounting and installation of electrical resistance gauges

Photoelasticity, polariscope and its elements, isoclinics and isochromatics, stress optic law, compensation techniques, methods to evaluate principal stresses, photoelastic materials, three-dimensional photoelasticity, stress freezing and slicking method.

Brittle coating methods and its application in evaluation of stresses

 References:
    1. Experimental Stress Analysis   Dally and Riley.
    2. Experimental Stress Analysis   J. Srinath.
    3. Experimental Stress Analysis   A. Mubeen.

SV 522 THEORY OF PLATES

The Differential equation of bending of a thin plate, boundary conditions for simply supported, fixed and free edges, Rectangular plates with different boundary conditions, Navier solution, Levy's solution, solution for different loading conditions such as UDL, hydrostatic, point load and partially loaded plates. Thin plates with built-in edges, Strain energy stored in plate, energy method for solution,   Numerical methods- Finite difference method for stress analysis of plate. Bending   of circular plates,differential

equation in polar coordinates and boundary conditions. Solution of symmetrical loaded circular plates.

References:
1. Theory of plates & shells   Timoshenko
2. Stresses in plates and shells   U.C. Ugural

SV 523: THEORY OF VIBRATIONS 2

Transient & self-excited vibrations, Numerical methods for multidegree of freedom systems. Influence coefficients Dunkerlay's method, matrix iteration method. Orthogonality of principal modes. Comparison of behaviour between linear & non-linear systems. Eigen value & eigen vector. Holzer method for three and multi rotors and branched torsional systems. Mykelstad method, Stodola Method, Effect of shear deformation and rotary inertia.

Vibration of continuous, longitudinal transverse and torsional systems. Vibrations of plates and shells. Static and dynamic balancing of Rotors. Balancing of thin discs. Field balancing of long rotors. Vibration Analysis by FEM.

References:
1. Vibration Problems in engineering   S.Timoshenko & Young
2. Elements of Vibration-Analysis   L.Meirovitch.
3. Mechanical Vibration   F.S. Tse, Morse & Hinkle
4. Theory of Vibration   Thomson

SV524 EXPERIMENTAL STRESS ANALYSIS LABORATORY

Use of strain gauges for determination of stress and forces. Load cells, strain indicators, CRO, Oscillograph and recorders for dynamic strain measurements. Photoelasticity-determination of isoclinics and isochromatics and photography. Material calibration. Reflection polariscope. Brittle coating and Moire's fringes studies. NDT methods

SV525 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department Electives

SV531 ADVANCED MACHINE DESIGN

General consideration for design of machine elements. Types of loadings. Criteria for failure. Distinction between design approaches for static and fatigue loading and their influences on design criteria. Designing against fatigue, creep and impact loading.

Stress concentration and stress concentration factors. Residual stresses and their determination.

Types of drives. And their relative merits. Belt drives – design and performance. Chain drive. Gear drives. Strength of gear tooth surface. Beam strength. Strength, deflection and design of shafts.

Selection of bearings. Gear drive housing. Fluid power systems, pumps and accessories, circuit design and applications. Step less drives, P.I.V. drives. Power transmission in machine tools.

Stress intensification in presence of sharp notches and cracks. Design of machine elements in presence of cracks.

References
1. Advanced Machine Design   Mubeen
2. Mechanical Engineering Design   Shigley

SV 532 THEORY OF ELASTIC STABILITY

Differential equations for beam-columns, beam-column with concentrated lateral load, beam column with built-in ends, beam-columns with elastic restraints Elastic buckling of bars under axial loading, Energy method, Alternate form of the differential equation for determining critical loads.

Inelastic buckling of bars, Inelastic bending, Inelastic buckling of bars with end condition. Buckling of rings & curved bars. Bending of thin curved bar with a circular axis. Effect of uniform pressure on bending of a circular ring Buckling of thin plates. Methods of calculation of critical loads. Buckling of simply supported rectangular plates. Buckling of shells, symmetrical buckling of a cylindrical shells.

References

1. Theory of Elastic Stability   Timoshenko and Gere

SV533 THEORY OF PLASTICITY

Plastic behavior, true stress and true strain, temperature and strain rate effects, Mechanism of plastic deformation, stress invariants, deviatoric stress, Elastic plastic stress-strain relations, yield and flow conditions, Von Mises yield criterion and determination of constants, flow rule, Generalized stress and generalized strain increment, Tresca yield criterion, Hill yield criteria

Plastic Anisotropy, slip line field theory, α and β lines, stress equations, Hencky's first and second theorems, stress discontinuities, Interface with sliding friction, construction of hodograph, Application of slip-line field technique   Limit theorem, principle of virtual work, principle of maximum plastic work, lower bound theorem, upper bound theorem

References

1. Introduction to Engineering Plasticity   G.K. Lal and N. Venkata Reddy
2. Finite Elements in Plasticity: Theory and Practice   D.R.J. Owen and E. Hinton

SV 534 PRODUCT DESIGN & DEVELOPMENT

Elements of successful product design in their specialist market place. Study of Engineering / Marketing relationship. The buying motivation and perception of industrial buyers. Individual customers, industry and government departments. Presentation of designs to potential customers. Acclerated product development. Variety proliferation. Differential product "fast to market".

Forecasting and market research for a new product. Purchasing and sales procedure. Demand analysis for new product. Intellectual property right. Introduction to IPR laws, nature, types of intellectual property, IPPP as an economic entity. Ddevelopment of IPR copyright, patents, design, trademarks, forms, global IP structure and IPRS in India, Infringement and remedies available, patent search, contractual agreements involving patents. Case studies

References

1. Product design and development   Karl Ulrich and Steven D Eppinger

SV 535 EARTHQUAKE ENGINEERING

Elements of seismology: Definitions of the basic terms related to earthquake (magnitude, intensity, epicenter, hypocenter and earthquake waves), measurement of ground motions, Seismic regions, intensity and isosismals of an earthquake, seismic zoning, strong ground motion arrays.

Earthquake effects on structures: Sources of vibration, types of vibrations, degree of freedom (SDOFS/ MDOFS), equation of motion of single and multiple degrees of freedom, dry friction damping and negative damping, forced vibrations of a damped system, system subjected to transient forces

Continuous systems: Free vibration-frequencies and mode shapes, numerical techniques, forced vibration-earthquake excitations.

Earthquake motion and response: Strong motion earthquakes, numerical method for spectra, elastic spectra, concept of response spectra/ average response spectra/ design response spectra, inelastic spectra, evaluation of earthquake forces, IS Code 1893: 2002, effect of earthquake on different types of structures Concepts of earthquake resistant design: Structural Systems/ Types of buildings, causes of damage, Earthquake resistant design of masonry buildings, Strength and structural properties of masonry, Design consideration Guidelines, Earthquake Resistant Design of R.C.C. Buildings, Material properties, Lateral load analysis, Design and detailing (IS:13920: 1993)

Aseismic design of structures: Design data and philosophy of design, seismic coefficients, multistory buildings, ductility provisions in reinforced concrete construction, water towers, bridges, gravity dams and retaining walls etc.

Reference

1. Elements of Earthquake Engineering   Jai Krishna and Chandrasekaran
2. Earthquake Engineering   A.K. Chopra
3. Earthquake Resistant of structures   Pankaj Agrawal and Manish Shrikande

SV 536 NON-LINEAR & RANDOM VIBRATIONS

Definition of non-linear systems and comparison between the behavior of linear and non-linear systems. Undamped and damped free and forced vibrations. Self excited oscillations, singular points, analytical methods. Stability concept, phase plane plots, limit cycle.

Probability density functions, characteristic functions. Stationary and non stationery random process, ergodic random process. Auto-correlation function. Power spectral density function.

References

1. Non-linear Oscillations   N. Minorsky.
2. Advanced theory of vibrations   J.S. Rao
3. Non linear vibrations   Stoker
4. Random Vibration   J.D. Robson
5. Application of Random Vibrations   NC Nigam & S.Narayana

SV 537 STRESS & VIBRATION ANALYSIS IN TURBO-MACHINERY

Stresses in rotating discs and blade, disc of uniform strength, temperature stresses, general blade stress equation, blade design for strength. Determination of blade natural frequencies. Coupling of torsional and bending vibrations due to pre-twist and eccentricity of shear center. Effects of rotor speed, disc-coupling, shrouding, lacing wires and geometry on natural frequencies of blades. Root fixing of blades to the disc.

Analysis of aerodynamic forces acting on the blades of gas turbines. Vibration of low aspect ratio blades. Vibration of aircraft wings.

Aerodynamic analysis of wind turbines. Load calculations in wind turbine design. Stress and Vibration analysis of blades, hub and axle and tower in wind turbine.

References

1. Mechanics of Materials Vol.II   E.J.Hearn
2. Theory of Vibraations   Thomson
3. Advanced Theory of Vibrations   J.S.Rao
4. Blaade Vibrations   J.S.Rao
5. Wind Engineering Design   Eaglestone

SV 538 ROTOR DYNAMICS AND BALANCING

Dynamic of rotating machinery: Critical speeds of rotors, Factors effecting the critical speeds such as gyroscopic action internal damping unequal moments of inertia of shaft section, bearing elasticity and oil film cushioning. Torsional frequencies of multi-mass rotors. Vibration of discs, blades and propeller which affect the rotor motion.

Stability of rotors under various influences: stability of rotors on elastically mounted supports and combined effect of bending and torsion. Resonance vibration of rotors with non-linear factors taken into account stability of rotors in flow medium. Sources of unbalance in rotors, balancing machines, machines, balancing criteria, specification and tolerances. Balancing in two planes correction methods used in industries, cradle balancing of rigid rotors, automatic balancing field balancing of rotors

   References
         1.   Rotor Dynamics   J.S. Rao.

SV539: ANALYSIS & DESIGN OF SHELLS

Terminology related to theory of shells. Construction of shells of single and double curvature, shells of translation or rotation. Equation of bending of shells, equilibrium and compatibility equations. Stress, strain and displacement equations. Solution of cylindrical shells. Software for shells. Design aspects of shells

   References
         1.   Theory of plates and shells   S.Timoshenko.
         2.   Stresses in plates and shells   U.C. Ugural

SV 541 ANALYSIS OF COMPOSITE STRUCTURES

Equations of anisotropic elasticity. Kinematics, Kinetics, thermodynamic and constitutive equations. Thermo elasticity, Electro elasticity and hygro thermal elasticity. Virtual work principles and variational methods. Classification of structural theories for composite plates. Classical Laminated Plate Theory. Lamina constitutive relations. Laminate constitutive equations. First order laminated plate theory. Shear correction factor, laminate stiffness, symmetric and anti symmetric laminates. Quasi isotropic laminates. One dimensional analysis of laminated plates. Analysis of laminated beams.

Analysis of specially orthotropic plates. Bending of rectangular plates with various boundary conditions. Vibrations of composite plates. Transient analysis. Analytical solutions of rectangular plates using CLPT and FSDT. Finite Element Analysis of Composite plates. Refined theories of laminated composite plates.

References
   1.   Mechanics of laminated composite plates   J.N.Reddy

SV542 Computer Aided Design

Computer aided design, hardware and software in CAD, solid modeling in CAD, computer graphics, generation of lines, curves, surfaces, two and three dimensional transformations, optimization methods, Integration of CAD and CAM, robotics, computer integrated systems, production management, NC programming, computer control, CAE systems and project management, computer aided project planning

 References
   1.   CAD/CAM   Mikell P.Groover & E.W. Zimmers, Jr.
   2.   Optimization for Engg. Design   Kalyanmoy Deb

SV543 MECHANICS OF COMPOSITE MATERIALS

Classification and characteristics of composite materials, Mechanical Behaviour of composite materials. Lamina and Laminates. Manufacture of Laminated fiber – reinforced. Composite Materials.

Macromechanical behaviour of lamina, stress strain relations for anisotropic, orthotropic and isotropic materials. Engineering constants. Stress strain relation for plane stress in orthotropic materials. Invariant properties.

Strength of an orthotropic lamina, Experimental determination of strength, Biaxial strength theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory and Tsai-Wu theory.

Classical Lamination theory. Special cases of laminate, stiffnesses, strength of Laminates. Design of Laminates.

Bending buckling and vibration of laminated plates. Governing equation. Deflection & buckling. Vibrations.

References:
   1. Mechanics of Composite Materials   R.M. Jones.

14.0 DEPARTMENT OF ELECTRICAL ENGINEERING

xii) ELECTRICAL DRIVES (M. Tech.)

ED511 POWER CONTROLLER

Review of power semiconductor devices, series-parallel operation, Heat sink calculations, various firing/driving circuit, Analysis of 1-ϕ / 3-ϕ AC/DC bridge converter with and without freewheeling diode, source impedence, consideration of power factor improvement techniques, pulse width modulated converters, dual converters. Analysis & design of voltage commutated, current commutated and load commutated choppers, Detailed analysis of 1-ϕ & 3-ϕ VSI (180° mode, 150° mode & 120° mode of conduction), harmonic reduction techniques, PWM inverters, 1-ϕ and 3-ϕ CSI. Circulating current and scheme, non-circulating current operation of 1-ϕ to 1-ϕ & 3-ϕ to 3-ϕ cycloconverter. Analysis of various 1-ϕ / 3-ϕ ac-ac regulator circuit.

Reference
   1. Thyristorised Power Controllers   G.K.Dubey, Doradla, Joshi, Sinha
   2. Power Electronics   C.W.Lander
   3. Power Electronics   Rashid M.H.
   4. Thyristorised power controlled converters & cycloconverters   B.R.Pelly

ED 512 ELECTRICAL DRIVES

Basics of Electrical Drives, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multiquadrant operation, Components of load torques. Selection of motor power rating, Energy conservation in ED. D. C. Drives: Speed control. Starting & Braking. Controlled Techniques, Transient Analysis. IM Drives: Analysis and performance. Operation with Unbalanced, Analysis of I.M. fed from Non-sinusoidal voltage supply. Starting, Braking, Transient analysis, Speed Control, Multi-Quadrant Drives and Field Oriented Control, Slip Power Control, Mathematical Modeling of IM Drives, Transient Response and Stability Analysis, Single Phase I.M., Close Loop Control of I.M. Drives. SM Drives, Cylindrical Rotor Wound Field Motor, Salient Pole Wound Field Motor, SRM, Hysteresis Synchronous Motor, Operation from Fixed Frequency Supply, Starting, Braking, SM Variable Speed Drives.

Reference
   1. Power semi conductor controlled drives   G.K.Dubey
   2. Fundamentals of Electrical Drives   G.K.Dubey
   3. Electrical Machine & Power Electronics   P.C.Sen
   4. Electrical Drives   S.A. Nasar

ED- 513 MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Review: Primitive machine, voltage and torque equation, Concept of transformation change of variables & m/c variables and transform variables. Steady state and transient analysis, equation of cross field commutator m/c. Induction Machine: Analysis of 1-ϕ & 3-ϕ Induction Motor. Synchronous Machine: Detail analysis,

Operational Impedances, Reactances and Time Constants. Approximate Methods for Generator & System Analysis: The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis & Applications.

Reference Books:
1. Analysis of Electric Machinery   P.C.Krause
2. The General theory of Electrical Machines   B.Adkins
3. The General theory of AC Machines   B.Adkins & R.G.Harley
4. Generalised theory of Electrical m/c   P.S.Bhimbra

ED514 MACHINE DRIVE LABORATORY
Experiments in power drives

ED515 SEMINAR
Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

ED-521 : ADVANCED POWER ELECTRONICS
Review of 1-phase and 3-phase Controlled Converters, Harmonics and Power Factor Calculations, High Power Factor Converters, DC-DC Switch Mode converter, Power Supplies, Switching Mode Inverters, Multilevel Inverter, Resonant Converters, Design and selection of components.

Reference
1. Power Electronics : Converters, Applications & Design   N. Mohan
2. Power Electronics : Circuits Devices and Application   M. H. Rashid
3. Power Electronics   Joseph Vithythal
4. Power Electronics   Philip Kranes

ED-521 : ADVANCED CONTROL SYSTEM
Basic comparators, cascade compensation in time domain and frequency domain, feedback compensation, Different types of controllers, State variables, state space representation, Transfer matrix, state model for linear continuous time systems. Eigen values, eigen vectors, Diagonalization, Solution of state equation, concept of controllability and observability. Pole placement by state feedback, Time domain, representation & transformation analysis of discrete time systems, time domain approach and z domain approach. Pulse transfer function, Controllability and observability of discrete time systems stability analysis in z plane, Different types of nonlinearities, limit cycles, singular points, Basic non linear components phase plane methods, Describing functions, popov criterion, Liapunov functions, Introduction to adaptive control system, Principle of optimality, Linear optimal regulator problem, Hamilton Jacobi equation, Riceati equation (Algebraic & differential), steady state solutions (LQR), optimal state estimation, Kalman filter, Output feedback control (LQG).

Reference
1. Digital Control Engineering   M.Gopal
2. Adaptive and Optimal Control   A.P.Sage & Landue
3. Optimal Control   A.P.Sage
4. Discrete Time Control System   Katsuniko Ogata

ED-523: DSP & ITS APPLICATIONS
Architectural Overview & Central Processing Unit, Memory map, CPU Architecture of TMS320F2812, Details of CPU Registers & Accumulator, Introduction to Interrupts of TMS320F2812, Emulation Logic, CPU Interrupts Overview, CPU Interrupt Vectors and Priorities, Maskable Interrupts, Nonmaskable Interrupts, Pipeline: Pipelining of Instructions, Instruction-Fetch Mechanism, Address Counters FC, IC, and PC, Pipeline Protection, Avoiding Unprotected Operations, Addressing Modes: Types of Addressing Modes, details of various Addressing Modes, Alignment of 32-Bit Operations. Assembly Language Instructions and emulation: Instruction Set Summary (Organized by Function),

Register Operations, Overview of Emulation Features, Debug Interface, Applications of DSP for Power Electronics & Drives Control

Reference

1. Reference manual from Texas Instruments
2. www.ti.com
3. Digital Signal Processing   W.D.Stanley
4. Analog & Digital Signal Processing   Ashok Ambardar
5. Digital Signal Processing   S. Mitra

ED524 PLC AND MICRO CONTROLLER LABORATORY

Experiments in PLC and micro controller

ED525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department elective

ED-531 POWER QUALITY

Understanding Power quality, Sources of harmonics, Standards and Regulations, Causes and effects of harmonics, elimination/suppression of harmonic, passive and active solutions, topologies and their control methods, EMI Issues,

Reference

1. Power Quality   R.C. Duggan
2. Power system harmonics   A.J. Arrillga
3. Power electronic converter harmonics   Derek A. Paice

ED-532 TRACTION DRIVES

Introduction to Electric Traction Systems, preliminary investigations of energy consumption, Traction Drives rating, Traction Motors, Conventional DC & AC traction drives, Semiconductor converter controlled drives, Polyphase AC motors for traction drives, Battery operated vehicles for city service, Diesel-Electric Traction systems Conservation of Electrical energy.

Reference

1. Electric Traction   A.T.Dover
2. Thyristorised Power Controllers   G.K.Dubey, Dorodla, Joshi& Sinha.
3. Modern Electric Traction   Prakash.

ED-533 ADVANCED ELECTRICAL DRIVES

Introduction to Electrical Drives: Their dynamics & control, Induction Motor Drives. Starting & braking, VSI control, CSI control, Synchronous Motor and Brushless Dc Motor Drives, Brushless dc drive, Permanent Magnet SM Drive, control fundamentals, converter configuration, synchronization, trapezoidal and sinusoidal drive control structure, performance, Switched Reluctance Motors, performance characteristics, Stepper motor and switch reluctance motor drives, solar and battery powered drives.

Reference Books :

1. Power semi conductor controlled drives   G.K.Dubey
2. Fundamentals of Electrical Drives   G.K.Dubey
3. Power electronics and variable frequency drives   B. K. Bose

ED-534 MICROCOMPUTER AND IT'S APPLICATIONS

Programmable Peripheral Devices: PPI 8255, various operating modes, fixing diagram, PIT 8253, programming and modes of operation, PIC 8259, operating modes. Interfacing:
Interfacing of peripherals, A/D & D/A converters, 8255, 8253, 8259 with 8/16 bit microprocessor/Data Acquisition system. Microcontroller - 8051 Architecture, Counter/Timers, Instructions, Programming, Interfacing, Applications, Comparison of 8085, 8086, 8057 etc. Programmable logic controller: PLC

Architecture, programming, Counter/Timers and its applications. Applications of Microcontroller and PLC for Drives Control

Reference

1. Microprocessor Architecture programming & applications   Gaonkar
2. Microprocessors & interfacing   D.V.Hall
3. The 8051 Microcontroller   K.J.Ayala
4. Introduction to programmable logic controller   Gary Dunning

ED-535 REACTIVE POWER CONTROL AND FACTS

Fundamental concepts in Reactive Power, basic theory of power transmission, long distance reactive power transfer and difficulties, system and load compensation, uncompensated and compensated transmission lines, reactive power compensation, reactive power markets and pricing mechanism, reactive power management in distribution systems, static compensators, control strategies, Principle of operation, configuration and control of SVC, STATCOM, TCSC, SSSC and UPFC

Reference

1. Reactive Power Control in Power Systems   T J E Miller
2. Power system Stability and control   Prabha Kundur
3. Understanding FACTS   N G Hingorani and L Gyugyi
4. Flexible ac Transmission Systems (FACTS)   Y.H. Song and A.T. Johns
5. Operation of market oriented power systems   Yong-Hua Song and Xi-Fan Wang

ED-536 EVOLUTIONARY TECHNIQUES

Optimization: single objective, multi-objective and constraint problem, linear, non-linear and NP hard problem, combinatorial optimization, Conventional optimization method (lambda and differential). greedy optimization technique. Simple genetic algorithm, Multi-objective genetic algorithm. Artificial neural network. Fuzzy logic. Ant colony optimization. Particle swarm optimization. Basic simulated annealing. Basic tabu search method. Bacteria forging and Fish schooling optimization. Bee flying optimization.

Reference

1. Introduction to Artificial Neural System   J.M.Zurada,
2. C++ Neural Networks and Fuzzy Logic   V.Rao & H.Rao,
3. Ant Colony Optimization   Marco Dorigo and Thomas Stutzle
4. Genetic Algorithm in Search Optimization and machine learning,   D.E. Goldberg,

ED-537 MICROCOMPUTER CONTROLLED DRIVES

DC Drives- Converters, Microcontroller hardware circuit, Performance characteristics of DC drive. Chopper fed DC Drives, hardware, circuits and waveforms. Performance Characteristic of AC Drives - Description and Performance behavior of 3-phase IM drive, Microcomputer controlled inverter fed AC drive Waveforms for 1-phase, 3-phase non PWM and 3-phase PWM inverter fed induction drives, Sampling techniques for PWM inverter. Mathematical modeling of frequency controlled induction drive, mathematical model of the system for steady state and dynamic behavior, Study of stability based on the dynamic model of the system. Close loop control of microcomputer based Drives.

Reference

1. Power semiconductor controlled drives   Dubey G.K
2. Power electronics and variable frequency drives   Bose B.K
3. Control of electric drives   Leonard W
4. Microcomputer control of power electronics and drive   Bose B.K.
5. Adjustable AC drive   Bose B.K.
6. Thyristor control of Electronic drive   V. Subramanyam.

ED538 INSTRUMENTATION IN ELECTRICAL DRIVES

Transducers - Measurement of Displacement. Resistive potentiometers, strain gauges, differential transformer, synchros, induction potentiometers, piezoelectric, optical, Digital displacement transducers, Magnetic, speed, torque, voltage, current, power, frequency, power factor and phase angle measurement.

Signal Conditioning - Necessity, Instrumentation amplifiers, chopper stabilized amplifiers, Impedance converters, Noise problems, shielding and grounding, Active & Passive filters, Dynamic compensation, Linearization, Concept of A/D and D/A Converters, Sample/hold amplifiers, Microprocessor applications in signal conditioning, Data Transmission & Recording, Microprocessor Based Measurement of Electrical Quantities, Computerized Data Acquisition System.

Reference Books:
1. Measurement systems, Application and Design   Ernest O.Docbelin.
2. Electrical and electronic measurement   A.K.Shawney.
3. Fundamental of microprocessor and microcomputers   B.Ram.

ED-539 SPECIAL MACHINES
Review of adjustable speed drives, permanent magnet materials and circuits. Square-wave, Sine-wave P.M. brushless motor drives - Principle, construction, operation and drive application. P.M. & synchronous-reluctance based motors - Principle, construction, operation and drive application. Switched reluctance motors, Linear induction motors, Stepper motors - Principle, construction, operation and drive application. Energy efficient motors.

Reference
1. Power electronics control of AC machine   J.M.P. Murphy.
2. Brushless Permanent-magnet and reluctance motor Drives   T.J.E. Miller
3. Power electronics and variable frequency drives edited   B.K.Bose
4. Linear induction machine   S.A.Nasar
5. Energy efficient electric motors   J.C. Andreas.

ED-541 EHV AC & DC TRANSMISSION
Long line theory, corona power loss and audible noise. Reactive Power compensation of EHV AC lines, FACTs devices, Sequential impedances of AC systems EHVAC transmission overvoltages, insulation design of lightning and switching over voltages. High voltage testing of AC equipments, Comparison of EHV AC & DC transmission HVDC system configuration and components conversion and inversion, Analysis of three phase bridge converter and Performance equations, Control of HVDC system, Principle of DC link control, current and Extinction angle control, Transmission power control, alternative inverter control modes, Harmonics and AC/DC filters, Interaction responses to DC and AC system faults. Modelling of HVDC system.

Reference
1. EHVAC Transmission Engineering   Begemudre R.D
2. Power System Stability and Control   P.Kundur
3. HVDC Transmission   Arrillaga J
4. EHV AC & HVDC Transmission Systems   Rao S
5. HVDC Power Transmission Systems   Padiyar K.R

xiii) POWER SYSTEM (M.Tech)
PS511 POWER SYSTEM ANALYSIS
Power system components and their representation & modelling, Power System studies, Optimal load flow studies and comparison of different methods , Demand Side Load Management & Load Forecasting, Introduction of Optimal system operation, Power system management under normal & abnormal conditions, Transmission issues and Effect in the New Market Environment, State Estimation & Contingency Analysis, Power system optimization.

Reference
1. Computer Methods in Power System Analysis   Glenn W. Stagg & Ahmed H. El-Abiad
2. Computer Methods in Power System Analysis   M.A. Pai
3. Computer Aided Power System Analysis   George L.Kusic
4. Electrical Energy Systems   O. Elgard

PS-512 ADVANCED POWER SYSTEM PROTECTION

Protective Relays : Relaying review, different types of electromagnetic and static relay characteristics, operating equations and their applications, comparators, generator protection, transformer protection, bus bar protection and transmission line protection. Features of 500 KV relaying protection, Modern trends in power system protection, Microprocessor based relays, auto-reclosures and frequency relays

Reference
1. Power System Protection and Switchgear   B.Ram
2. Switchgear and Protection,   M.V.Deshpande
3. Power System Protection and Switchgear   R.Ravindra Nath and M.Chander
4. Computer Relaying for power system   Arun G. Phadke and James S.Thorp

PS-513 EVOLUTIONARY TECHNIQUES

Optimization: single objective, multi-objective and constraint problem, linear, non-linear and NP hard problem, combinatorial optimization, Conventional optimization method (lambda and differential). greedy optimization technique. Simple genetic algorithm, Multi-objective genetic algorithm. Artificial neural network. Fuzzy logic. Ant colony optimization. Particle swarm optimization. Basic simulated annealing. Basic tabu search method. Bacteria forging and Fish schooling optimization. Bee flying optimization.

Reference
1. Introduction to Artificial Neural System   J.M.Zurada,
2. C++ Neural Networks and Fuzzy Logic   V.Rao & H.Rao,
3. Ant Colony Optimization   Marco Dorigo and Thomas Stutzle
4. Genetic Algorithm in Search Optimization and machine learning   D.E. Goldberg,

PS514 POWER SYSTEM LABORATORY

Experiments in Power system control

PS515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

PS521 MODERN TRENDS IN POWER SYSTEM OPERATION

Distribution automation: Supervisory Control and Data Acquisition (SCADA), Consumer Information systems (CIS), Geographical Information Systems (GIS), Advances in online control of Power System – Application of Internet and GPS in power system control, Deregulation of Electric Utilities, new environment, Competitive electricity market, Application of Artificial Neural Networks, Fuzzy, Neuro-fuzzy, Genetic Algorithms and Experts systems in Power System Control.

Reference Books:

1. Power System Restructuring and Deregulation: Trading Performance and Information Technology'

                                   Loi Lei Lai

2. Proceedings of IEEE   February 2000
3. Power System Economics   Steven Stoft

PS-522   ADVANCED CONTROL SYSTEM

Basic comparators, cascade compensation in time domain and frequency domain, feedback compensation, Different types of controllers, State variables, state space representation, Transfer matrix, state model for linear continuous time systems. Eigen values, eigen vectors, Diagonalization, Solution of state equation, concept of controllability and observability. Pole placement by state feedback, Time domain, representation & transformation analysis of discrete time systems, time domain approach and z domain approach. Pulse transfer function, Controllability and observability of discrete time systems stability

analysis in z plane, Different types of nonlinearities, limit cycles, singular points, Basic non linear components phase plane methods, Describing functions, popov criterion, Liapunov functions, Introduction to adaptive control system, Principle of optimality, Linear optimal regulator problem, Hamilton Jacobi equation, Riceati equation (Algebraic & differential), steady state solutions (LQR), optimal state estimation, Kalman filter, Output feedback control (LQG).

Reference

1. Digital Control Engineering   M.Gopal
2. Adaptive and Optimal Control   A.P.Sage & Landue
3. Optimal Control   A.P.Sage
4. Discrete Time Control System   Katsuniko Ogata

PS523 POWER SYSTEM STABILITY AND CONTROL

Power System Structure and Operating states, Governors, Excitation system, Effect of exciter and governor, Control of Power and Frequency, Control of voltage and Reactive Power, Power system stability, Dynamic and transient stability analysis of single machine and multi-machine systems, Power system stabilizer design and analysis for stability problem, Techniques for the improvement of stability

Reference Books:

1. Power system stability and control   Prabha Kundur
2. Power System Voltage Stability   Taylor C.W
3. Power System Engineering   Nagrath IJ, Kothari D.P.
4. Electric Power System   Weedy B.M.

PS524 POWER SYSTEM LABORATORY

Experiments in Power system control

Ps525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

PS-531 EHV AC & DC TRANSMISSION

Long line theory, corona power loss and audible noise. Reactive Power compensation of EHV AC lines, FACTs devices, Sequential impedances of AC systems EHVAC transmission overvoltages, insulation design of lightning and switching over voltages. High voltage testing of AC equipments, Comparison of EHV AC & DC transmission HVDC system configuration and components conversion and inversion, Analysis of three phase bridge converter and Performance equations, Control of HVDC system, Principle of DC link control, current and Extinction angle control, Transmission power control, alternative inverter control modes, Harmonics and AC/DC filters, Interaction responses to DC and AC system faults. Modelling of HVDC system.

Reference

1. EHVAC Transmission Engineering   Begemudre R.D
2. Power System Stability and Control   P.Kundur
3. HVDC Transmission   Arrillaga J.
4. EHV AC & HVDC Transmission Systems   Rao S.

PS532 POWER CONTROLLER

Review of power semiconductor devices, series-parallel operation, Heat sink calculations, various firing/driving circuit, Analysis of 1-ϕ / 3-ϕ AC/DC bridge converter with and without freewheeling diode, source impedence, consideration of power factor improvement techniques, pulse width modulated converters, dual converters. Analysis & design of voltage commutated, current commutated and load commutated choppers, Detailed analysis of 1-ϕ & 3-ϕ VSI (180° mode, 150° mode & 120° mode of conduction), harmonic reduction techniques, PWM inverters, 1-ϕ and 3-ϕ CSI. Circulating current and scheme, non-

circulating current operation of 1-φ to 1-φ & 3-φ to 3-φ cycloconverter. Analysis of various 1-φ / 3-φ ac-ac regulator circuit.

Reference

1. Thyristorised Power Controllers   G.K.Dubey, Doradla, Joshi, Sinha
2. Power Electronics   C.W.Lander
3. Power Electronics   Rashid M.H.
4. Thyristorised power controlled converters & cycloconverters   B.R.Pelly

PS-533 ECONOMICS OF REGULATION AND RESTRUCTURING OF ENERGY INDUSTRIES

Introduction to economic regulation, principles of regulation, Monopoly, competition and its Regulation, Traditional regulation, rate of return regulation, problems with rate of return regulation, restructuring options and understanding restructuring issues, Transmission Network and Wholesale Market Institutions, Retail Competition and Customer Choice, The Economics and Politics of Government Ownership, Concept of economic regulation of energy industries.

Reference Books:

1. Making competition work in electricity   Hunt, S.
2. Competition and Choice in electricity   Hunt, S. and G. Shuttleworth
3. Privatisation, restructuring and regulation of network Utilities   Newbery
4. Economics of Regulation and Anti-trust,

           W. K. Viscusi, Viscusi, WK, JM, Vernon and JE Harrington,

PS534 COMPUTER AIDED POWER SYSTEM ANALYSIS

Digital computers in power system simulations, Electric supply industry structure under Deregulation, Regulatory and policy developments, Power system components, Transformers, Concept of graph theory, Methods of load flow solutions, Thermal power plants, Transmission losses, Electric utility Restructuring, Transmission pricing and Congestion Management in Deregulated Market, Role of FACTS devices in competitive Power Market.

Reference

1. Electrical Energy Systems Theory   O.I.Elgerd
2. Computer Methods in Power system Analysis   A.H.El.Abiad
3. Understanding FACTS concept and Technology   Hingorani N.L.
4. Power System Restructuring and Deregulation Trading Performance and n IT   L.L. Lai

PS-535 MICROCOMPUTER AND IT'S APPLICATIONS

Programmable Peripheral Devices: PPI 8255, various operating modes, fixing diagram, PIT 8253, programming and modes of operation, PIC 8259, operating modes. Interfacing:
Interfacing of peripherals, A/D & D/A converters, 8255, 8253, 8259 with 8/16 bit microprocessor/Data Acquisition system. Microcontroller - 8051 Architecture, Counter/Timers, Instructions, Programming, Interfacing, Applications, Comparison of 8085, 8086, 8057 etc. Programmable logic controller: PLC Architecture, programming, Counter/Timers and its applications. Applications of Microcontroller and PLC for Drives Control

Reference

5. Microprocessor Architecture programming & applications   Gaonkar
6. Microprocessors & interfacing   D.V.Hall
7. The 8051 Microcontroller   K.J.Ayala
8. Introduction to programmable logic controller   Gary Dunning

PS-536 POWER QUALITY

Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances, Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics, Radio interference, supply standards, elimination/suppression of harmonics, classical solutions & their drawbacks, passive input filters, high power factor pre-regulator, switching control circuit, transformer connections, Elimination/suppression of

harmonics using active power filters – topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter, Electro-magnetic compatibility

References

1. Power Quality   R.C. Duggan
2. Power system harmonics   A.J. Arrillga
3. Power electronic converter harmonics   Derek A. Paice

PS-537 INSTRUMENTATION

Transducers - Measurement of Displacement. Resistive potentiometers, strain gauges, differential transformer, synchros, induction potentiometers, piezoelectric, optical, Digital displacement transducers, Magnetic, speed, torque, voltage, current, power, frequency, power factor and phase angle measurement. Signal Conditioning - Necessity, Instrumentation amplifiers, chopper stabilized amplifiers, Impedance converters, Noise problems, shielding and grounding, Active & Passive filters, Dynamic compensation, Linearization, Concept of A/D and D/A Converters, Sample/hold amplifiers, Microprocessor applications in signal conditioning, Data Transmission & Recording, Microprocessor Based Measurement of Electrical Quantities, Computerized Data Acquisition System.

Reference

1. Measurement systems, Application and Design   Ernest O.Docbelin.
2. Electrical and electronic measurement   A.K.Shawney.
3. Fundamental of microprocessor and microcomputers   B.Ram.

PS-538 ADVANCED POWER ELECTRONICS

Review of 1-phase and 3-phase Controlled Converters, Harmonics and Power Factor Calculations, High Power Factor Converters, DC-DC Switch Mode converter, Power Supplies, Switching Mode Inverters, Multilevel Inverter, Resonant Converters, Design and selection of components.

Reference

1. Power Electronics : Converters, Applications & Design   N. Mohan
2. Power Electronics : Circuits Devices and Application   M. H. Rashid
3. Power Electronics   Joseph Vithythal
4. Power Electronics   Philip Kranes

PS-539 MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Review: Primitive machine, voltage and torque equation, Concept of transformation change of variables & m/c variables and transform variables. Steady state and transient analysis, equation of cross field commutator m/c. Induction Machine: Analysis of 1-ϕ & 3-ϕ Induction Motor. Synchronous Machine: Detail analysis, Operational Impedances, Reactances and Time Constants. Approximate Methods for Generator & System Analysis: The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis & Applications.

Reference

1. Analysis of Electric Machinery   P.C.Krause
2. The General theory of Electrical Machines   B.Adkins
3. The General theory of AC Machines   B.Adkins & R.G.Harley
4. Generalised theory of Electrical m/c   P.S.Bhimbra

PS-541 POWER SYSTEM PLANNING AND MANAGEMENT

Introduction of power planning, Electricity Regulation, Electrical Forecasting, Generation planning, Transmission and distribution planning, Power system Economics, Power supply Reliability, online power flow studies, Computer aided planning, wheeling, Environmental effects, Optimal power system expansion planning.

Reference

1. Modern Power System Planning Edited   X Wang, J R MCDonald
2. Electrical Power System Planning   A.S.Pabla
3. Power System Restructuring Engineering and Economics   M. Tllic, F.Faliana and L Fink,

4. Power system Restructuring and Deregulation   L.L. Lie

PS-542 POWER SYSTEM TRANSIENTS

Origin and nature of transients and surges, Current chopping in circuit breakers, Control of transients, Lightning phenomena, Travelling waves in distributed parameter multi-conductor lines, Simulation of surge diverters in transient analysis, Bergeron methods of analysis and use of EMTP and EMTDC/PSCAD package, Insulation Coordination.

Reference
1. Power System Transients   Vanikov
2. Power System Transients   C. S. Indulkar and D.P. Kothari
3. Power Circuit breaker theory and design   Flurscheim C.H.
4. EMTP Rulebook

PS-543 DSP & ITS APPLICATIONS

Architectural Overview & Central Processing Unit, Memory map, CPU Architecture of TMS320F2812, Details of CPU Registers & Accumulator, Introduction to Interrupts of TMS320F2812, Emulation Logic, CPU Interrupts Overview, CPU Interrupt Vectors and Priorities, Maskable Interrupts, Nonmaskable Interrupts, Pipeline: Pipelining of Instructions, Instruction-Fetch Mechanism, Address Counters FC, IC, and PC, Pipeline Protection, Avoiding Unprotected Operations, Addressing Modes: Types of Addressing Modes, Details of various Addressing Modes, Alignment of 32-Bit Operations. Assembly Language Instructions and emulation: Instruction Set Summary (Organized by Function), Register Operations, Overview of Emulation Features, Debug Interface, Applications of DSP for Power Electronics & Drives Control

Reference
1. Reference manual from Texas Instruments
2. www.ti.com
3. Digital Signal Processing   W.D.Stanley
4. Analog & Digital Signal Processing   Ashok Ambardar

PS-544 ADVANCED ELECTRICAL DRIVES

Introduction to Electrical Drives: Their dynamics & control, Induction Motor Drives. Starting & braking, VSI control, CSI control, Synchronous Motor and Brushless Dc Motor Drives, Brushless dc drive, Permanent Magnet SM Drive, control fundamentals, converter configuration, synchronization, trapezoidal and sinusoidal drive control structure, performance, Switched Reluctance Motors, performance characteristics, Stepper motor and switch reluctance motor drives, solar and battery powered drives.

Reference
1. Power semi conductor controlled drives   G.K.Dubey
2. Fundamentals of Electrical Drives   G.K.Dubey
3. Power electronics and variable frequency drives   B. K. Bose

PS-545 REACTIVE POWER CONTROL AND FACTS

Fundamental concepts in Reactive Power, basic theory of power transmission, long distance reactive power transfer and difficulties, system and load compensation, uncompensated and compensated transmission lines, reactive power compensation, reactive power markets and pricing mechanism, reactive power management in distribution systems, static compensators, control strategies, Principle of operation, configuration and control of SVC, STATCOM, TCSC, SSSC and UPFC

Reference
1. Reactive Power Control in Power Systems   T J E Miller
2. Power system Stability and control   Prabha Kundur
3. Understanding FACTS   N G Hingorani and L Gyugyi
4. Flexible ac Transmission Systems (FACTS)   Y.H. Song and A.T. Johns

PS-546 POWER SYSTEM ECONOMICS

Deregulation in Electricity market, Transmission Pricing, Economics and reliability, concept of customer worth of supply, Regulation approaches, revenue recovery and pricing of distribution services

Reference

1. Power System Economics Designing Markets for Electricity   Steven Stoft
2. Fundamentals of Power System Economics the nordic electricity market   Wangensteen, Ivar
3. Power System Economics   Daniel S. Kirschen and, Goran Strbac

15.0 DEPARTMENT OF MATERIAL SCIENCE AND METALLURGICAL ENGINEERING

xiv) MATERIALS SCIENCE AND TECHNOLOGY (M.Tech)

First semester

MSME511CONCEPT OF MATERIALS SCIENCE

Phase rule, lever rule; Binary isomorphous systems -Equilibrium solidification, non-equilibrium, Cu-Ni alloys and Zone refining; Theory of nucleation -Kinetics of homogeneous, transient and heterogeneous nucleation; Diffusion controlled growth, Interface instability and Widmanstatten growth

Solidification -Nature and growth of solid-liquid interfaces, Rapid solidification, Glass transition, metallic glasses; Precipitation and Particle Coarsening; Binary Eutectic and Peritectic Systems -solidification of eutectic, hypo-eutectic, and hyper- eutectic alloys; solidification of peritectic, hypo-peritectic, and hyper-peritectic alloys; Binary Monotectic and Syntectic Systems

Ternary phase diagrams -Gibbs triangle, isothermal and vertical sections, poly-thermal projections, two-phase equilibrium, concept of tie lines, rules for construction of tie lines, four phase equilibria; Eutectoid growth, Massive transformation; Transformation Kinetics -Johnson-Mehl equation, Avrami model, Martensitic transformation - Nature of martensitic transformations, Bain distortion, Nucleation, and growth of martensite, A thermal, isothermal and burst transformations, Thermo-elastic martensitie; Spinodal Decomposition.

MSME512 THERMODYNAMICS AND KINETICS IN MATERIALS

Introduction, First law of thermodynamics, Heat capacity, Enthalpy and Heat of Reaction, Second law of thermodynamics, Entropy, Free energy and third law of thermodynamics, Fugacity, Activity and Equilibrium constant, Inter-relation between thermodynamic variables, Solutions and Partial molar Quantities, Phase rule and Phase Diagrams, Free energy –Temperature diagrams. Pourbaix diagrams, Thermodynamics of interfaces, Defect structures in solids, Reaction Kinetics, Reaction rate, order and rate constant, Reaction rate of Homogeneous and Heterogeneous systems, Diffusion and mass transfer concepts. Electrochemical Concepts, Activation and Concentration polarization, Tafel's equation, over potential and limiting current.

MSME513 MECHANICAL BEHAVIOR OF MATERIALS

Stiffness, Strength, and Toughness, Types of mechanical behavior, Relevance, Macroscopic, continuum behavior, Physical mechanisms controlling behavior, Elasticity: Introduction, Stress, strain, compliance and stiffness tensors, Physical origin of elastic moduli, Theoretical shear strength, Dislocations and Burger's vector, Elastic properties and energy of dislocations, Partial dislocation and stacking faults, Dislocation-dislocation interactions, The Peierls-Nabarro Stress, Crystallography of Slip and Independent Slip systems, Slip plane rotation, Twinning and twin geometry, Twinning in HCP crystals, Work hardening, Solid solution strengthening, Point defect–dislocation interaction energy, Yield point phenomenon, Precipitation hardening, Dislocation-precipitate interactions

Fracture: Importance of Fracture Mechanics, Griffith Fracture Theory, Crack Driving Force & Energy Release Rate, Modes of fracture, Stress intensity factors, Similitude, Role of Crack-tip Plasticity--Plastic Zone Size & Shape, K-dominance, Fracture Toughness-Micro-structural Issues,

Fatigue: Total life approaches, Fatigue design approaches, HCF and LCF, Fatigue crack inhibition, Fatigue crack growth, Paris law and models, Threshold, Damage tolerant approach, Striations, Different stages of fatigue crack growth.

Creep: Characteristics of creep curve and steady-state creep, mechanisms and creep

MSME 514 MATERIALS CHARACTERIZATION   LABORATORY
Experiments on material proerty study

MSME515 SEMINAR
Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second semester

MSME521 NANO MATERIALS
Definition and Classification of Nanomaterials, Fundamental Properties of various primary material classes (Metals, ceramics and Polymers), isotropic, amorphous materials, Semiconducting materials,

TGA, DTA Size dependent properties and various characterization techniques of Nanomaterials, XRD, Neutron diffraction. Electron diffraction. ESBD and their applications. Principles of microscopic techniques like TEM, HRTEM, SEM, OIM, SPM etc., and their applications. Nanometer scale design and fabrication using STM and AFM. Fundamentals of EPMA, ESCA, AES, SIMS, EELS etc., and applications.

Up and bottom process, Synthesis/Consolidation routes to produce Nanomaterials, Mechano-chemical synthesis to produce nano-sized precursor powders,

Mechanical Properties, Thermal properties, Tribological Properties, Biological Properties (Biomedical applications), Applications of bulk nanomaterials, Optical Properties, Electronic and electrical properties Critical issues related to understanding properties of nanomaterials.

MSME522 ADVANCE MATERIALS PROCESSING
Fundamentals of materials processing: deformation processing, fundamentals and application of plasticity, yielding, operations specially conditioned by friction, flow instability, draw ability, anisotropy, Thermally activated processes, dynamic recovery and recrystallization, modeling of materials processing, applications of deformation processing. Processing methods involving consolidation and sintering of powders .Structural size and its importance, bulk a nano-structured materials by Severe Plastic Deformation (SPD), unique features of SPD and properties, nano-structured materials prepared by solid state processing, properties, benefits and application of nano-crystalline microstructures in structural materials

MSME523 RESEARCH TECHNIQUES IN MATERIAL SCIENCE
Brief Revision of computer programming, Algorithm, Flow chart, type of data variable, Flow control operations, Functions pointers, and storage classes. Computation and data Analysis by use of dedicated software such as Mat lab, mathematic etc. Work sheets, Cells, Formats, Sorting Functions, Formulas, Conditional formulas, References, Charts, Regression analysis, using macros, Annova technique. Study and solve the materials related problem in different fields such as structure of materials, Thermodynamic, Deformation of materials, fracture Mechanics, Properties comparison etc., and Application of Numerical methods in Problem solving.

Computer aided Drawing and Designing: Basic Operation in Drawing Orthographic Projections, Dimensioning, scale, Plotting; Application in Casting mathoding from Component Drawing to Mould and Pattern Design; Application in Dies for casting, Forging.

MSME524 MATERIAL PROCESSING   LABORATORY

Experiments in material processing

MSME525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

MSME531EXPERIMENTAL TECHNIQUE IN MATERIAL SCIENCE

X-ray diffraction, basic principle and application, XRF, EPMA, SEM, TEM, EDX, AFM, IR spectroscopy, Mossbauer spectroscopy, Spectro photometry, TG-TDA-DSC, particle size analysis, surface area analysis, zeta potential measurement

MSME532 X-RAY DIFFRACTION AND ELECTRON MICROSCOPY

Introduction to X-rays filters. Atomic scattering factors and structure factor. Intensity calculations. Reciprocal lattice. Ewald spehre construction. Techniques for structure determination. Point groups. Space groups. Systematic absences due to symmetry elements. Wyckoff notation. Fourier series methods. Phase problem. Patterson function. Heavy atom methods. Anomalous scattering. Finite size effects. Intensity distribution in reciprocal space. Particle size determination for polycrystalline samples. Introduction to electron microscopy, electrons and their interactions with the specimen, electron diffraction. TEM-construction, contrast mechanisms and some applications. Analytical microscopy. SEM.

MSME533 SCIENCE AND TECHNOLOGY OF MAGNETIC MATERIALS

Magnetic units: Magnetic moments: Dia, para and pauli-para magnetism: Molecular field: Ferro, antiferro and ferrimagnetisms: Alloying effect on transition metals and intermetallics: Stability of domain structure: Origin of magnetic anisotropy and its application: Effect of inclusions, internal stress, magnetostriction and preferred orientation on magnetization: Susceptibility and coercivity calculations: Magnetic thin films-amorphous and crystalline, soft and permanent magnets: Technological aspects of magnetic materials

MSME534 ADVANCED PHYSICAL AND MECHANICAL METALLURGY

Microstructure & Properties: solidification and solidification structures, interfaces, crystallographic texture, Residual stress, structure-property relations. Plasticity and work hardening: fundamentals, stress-strain behavior, fracture, creep & deformation mechanisms. Recovery, recrystallization, grain growth. Phase transformation: thermodynamic basics, nucleation and growth, spinodal decomposition, martensitic transformations

MSME535 PLASTIC DEFORMATION AND MICROSTRUCTURE EVOLUTION

Molecular theory of deformation kinetics. Rate theory of plastic deformation. Micro-mechanistic approach for deformation behavior of single crystals and polycrystals. Low temperature deformation of metals and other crystalline solids. Dynamic strain ageing, creep, internal stress. Deformation of intermetallic compounds. Substructural evolution at large strains. Recovery, recrystallization and grain growth during high temperature deformation. Formation of cell boundaries, slip in a cell structure and composite model of time dependent flow

MSME536 ORDER-DISORDER TRANSFORMATION

Occurrence of different types of ordering in metals and alloys, property changes due to ordering, statistical theory of ordering: Bragg-Williams and Bathe theories of LRO and SRO, thermodynamics of order-disorder transformation, detection of order by X-ray, electron and neutron diffraction, anti-phase domains, long periods super lattices, kinetics of order-disorder transformation

MSME 537 SOLID STATE TRANSFORMATIONS

Classification of transformation based on thermodynamics, mechanism and kinetics: Homogeneous transformation: Nucleation and growth phenomena: Spinodal decomposition: Crystallographic features of transformation.

MSME 538 WELDING SCIENCE AND TECHNOLOGY

Overview of welding processes, study of welding arc characteristics, metal transfer during arc welding, heat flow during welding, gas-metal and slag-metal reactions, weld pool solidification, effect of welding process parameters on the macro- and micro-structure of weld metal. Thermal cycles in the heat affected zone. Phase transformations in the weld metal and the heat affected zone. High power density processes such as laser and electron beam welding. Welding metallurgy under high cooling rates. Phenomena of hot-cracking and cold cracking. Residual stresses and distortion during and after welding. Application of above principles to welding of carbon and alloy steels, cast irons, stainless steels, aluminium and titanium alloys. Fatigue and fracture of weldments.

MSME 539 CORROSION AND ITS PREVENTION

Advanced theory of electro-chemical kinetics and corrosion, theory of electro deposition and allied processes, stress corrosion behavior of materials (important- metals, alloys etc.) in various environments, corrosion testing: Metal-gas reaction at high temperatures, corrosion by liquid metals. Polymer degradation

Introduction experimental techniques: Oxide and defect structure: Thermodynamics, Ellingham diagrams, vapor species diagrams, isothermal stability diagrams: kinetics, rate laws, Wagner's theory of parabolic rate laws, mechanism of oxidation: Oxidation of pure metals, multiple scale formation, scale cracking, oxygen dissolution: Oxidation of alloys, internal oxidation, catastrophic oxidation, stresses in oxides: Hot corrosion, acid fluxing, basic, fluxing, High temperature materials, super alloys, intermetallics: Protection against oxidation, coatings, atmospheric control

MSME 541 STRUCTURAL MATERIALS FOR AEROSPACE APPLICATIONS

Design of gas turbine aero-engines: Creep, fatigue and corrosion as limiting factors for high-temperature application of materials: Development of Ni and Co based super alloys, special steels, Ti alloys, intermetallics, ceramics and their composites, New high strength-high modulus materials, ablative materials.

MSME542 POWDER METALLURGY

Basic powder metallurgy processing, advances in metal powder production, powder characterization, modern powder compaction methods, cold isostatic pressing, powder injection moulding, powder rolling, and sintering behavior of ferrous and non-ferrous materials, case studies, microwave sintering of materials

MSME543 SUPERCONDUCTIVITY, MATERIALS AND APPLICATIONS

Introduction to superconductivity, Meissner effect, Type-I and type-II superconductors, Correlation between TC , JC and BC. Basic concepts, Coherence length and penetration depth. Alloy and high TC oxide superconductors. Mono- and multi- layered cuprates. Structure, processing, properties and

applications. Organic superconductors. Superconducting magnets. Josephson junctions. SQUID. Magnetic levitation.

SOFT TECHNOLOGY DIVISION
16.0 DEPARTMENT OF CHEMICAL ENGINEERING

xv) DESIGN OF PROCESS PLANTS

MTH511F OPTIMIZATION TECHNIQUES

Introduction: Maximization and minimization problems- examples. Basic concept of optimization – Convex and concave functions, Necessary and sufficient conditions for stationary points. Degree of freedom.

Formulation: Economic objective function. Formulation of various process optimization problems and their classification.

Optimization of unconstrained and constrained search: Optimization of one dimensional function, unconstrained multivariable optimization direct search methods. Indirect first order and second order methods, constrained multivariable optimization - necessary and sufficient conditions for constrained optimum.

Linear programming and applications: Geometry of linear programs, Simplex Algorithm its applications.

Non- linear programming with constrained and its applications: Quadratic programming, Generalized reduced gradients methods, Successive linear and successive quadratic programming, Dynamic programming, Integer and mixed integer programming.

Application of optimization in chemical engineering: Optimization of staged and discrete processes, Optimal shell-tube heat exchanger design, Optimal pipe diameter, Optimal design of an Ammonia reactor. Nontraditional optimization techniques: Introduction and application areas.

References

1. Optimization of Chemical Process   Edger T. F. and Himmelblau D. M
2. Optimization Theory and Practice   Beveridge G. S. and Schechter R. S .
3. Engineering Optimization Methods and Applications
                                Rekllaities F. V., Ravindan A. and Ragsdell K. M.
4. Engineering Optimization   Rao S.

CH512 ADVANCED TRANSPORT PHENOMENA

Summary of vector and tensor Notation: Vector operations from a geometrical view point. Vector operation from an analytical view point, the vector differential operations, second order tensors, vector and tensor components in curvilinear coordinates, differential operations in curvilinear coordinates. Momentum Transport: Viscosity and the mechanism of momentum transport, Newton's law of viscosity Energy Transport: Thermal Conductivity and the Mechanism of Energy Transport: Fourier's Law of heat conduction

Mass Transport: Definition of concentrations, velocities and mass fluxes, fick's law of diffusion, theory of ordinary diffusion in gases at low density, theory of ordinary diffusion in liquids. Turbulence Phenomena: Basic theory of turbulence, time averaging, intensity and correlation coefficients, isotropic turbulence. Equations of continuity, motion and energy for turbulent condition. Reynolds stresses. Phenomenological theories of turbulence, velocity profile in circular conduits. Convective Transport: Free and forced convective heat transfer and mass transfer, interphase mass transport, mass transfer coefficients-individual and overall, mass transfer theories-film, penetration and surface renewal.

Macroscopic studies: momentum and heat balance equation, Kinetics energy calculation. Constant area and variable area flow problems. Flow through bends. Time determination for emptying of vessels.

References

1. Transport Phenomena   Bird R B, Stewart W E and Light fort R N,
2. Fundamentals of Momentum, Heat and Mass Transfer   Welty J R, Wilson R E and Wicks C E
3. Momentum, Energy and Mass transfer in continua   John C Slattery

CH-513 HETEROGENEOUS CATALYSIS AND REACTOR DESIGN

Solid Catalyst: Role of catalyst components and other constituents, characterization of catalyst and its support. Heterogeneous Catalysis: Mechanism and kinetic models of surface reactions, determination of kinetics parameters through experiments, analysis of complex reactions, synthesis of kinetic structure. External and Internal Transport Processes: Effect of heat and mass transfer, internal effectiveness factor, generalized effectiveness factor, point effectiveness, multiple reactions, transport criteria. Deactivation of Catalyst: Physical deactivation, surface diffusion. Sintering-mechanism and kinetics, chemical deactivation-types and kinetics, regeneration of catalyst. Selectivity and Stability: Effect of transport processes and deactivation on selectivity and stability of a single pellet Multiphase Reactions: Mass transfer coefficients, effect of transport and global rates. Design of Catalytic Reactors: Design and analysis of fixed bed reactors, autothermic operation and stability, fluidized bed reactors, two phase and multiphase models. Introduction to slurry reactors and trickle-bed reactors.

Reference

1. Heterogeneous Reactor Design   Lee H. H
2. Chemical Reaction and Reactor Engineering   Carberry J. J. and Verma A.
3. Heterogeneous Reactions", Vol. 1 and 2   Doraiswamy L. K. and Sharma M.M.,
4. Three – Phase Catalytic Reactors   Gordon and Breach.
5. Chemical Reactor Analysis and Design   Froment G. F. and Bischoff K. V.
6. Chemical Reactor modeling: Multiphase Reactive Flows   Jakobsen H. A.

CH514 ADVANCED CHEMECAL ENGINEERING LABORATORY

Experiments are:

1. Determination of organic compounds using HPLC
2. Determination of heavy metals using AAS
3. Determination of microstructure using SEM
4. Determination of pollutant concentration using UV Spectro-photometer & other.

The course demands development of new methodology, experimental setup, and related theoretical background.

CH515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

CH 521 ADVANCED PROCESS DYNAMICS & CONTROL

Review of Systems: Review of first and higher order systems, closed and open loop response.Response to step, impulse and sinusoidal disturbances. Control valve types-linear, equalpercentage and quick opening valve. Design of valves. Transient response. Block diagrams.Stability Analysis: Frequency response, design of control system, controller tuning andprocess identification. Zigler-Nichols and Cohen-Coon tuning methods, Bode-Nyquist Plots -Process modelling.

Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, selective controls, computing relays, simple alarms, Smith predictor, internal model control, theoretical analysis of complex processes.

Multivariable Control Analysis of multivariable systems, Interaction, examples of storage tanks. Review of matrix algebra, Bristol arrays, Niederlinski index - Tuning of multivariable Controllers.

Sample Data Controllers: Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers.

Reference

1. Process Systems analysis and Control   D.R. Coughanour,
2. Process Dynamics and Control'   D.E. Seborg, T.F. Edger, and D.A. Millichamp,
3. 'Principle and Practice of Automatic Process Control   C.A. Smith and A.B. Corripio,
4. Process Modelling Simulation and Control for Chemical Engineers   W.L .Luyben,

CH 522 ADVANCE HEAT & MASS TRANSFER

Conduction: Steady and unsteady state heat conduction, Transient heating and cooling of solid objects.

Convection: Heat transfer coefficient, Dimensional analysis in convective heat transfer, Heat transfer during laminar and turbulent flow in closed conduits, empirical correlation, Heat transfer in laminar and turbulent flow over a flat plate, Heat transfer in liquid metals, Analogy between momentum and heat transfer, Heat transfer with phase change: Boiling and condensation heat transfer.

Recent developments in heat exchangers: Heat Transfer Augmentation, Recent developments in the design of compact heat exchangers, Introduction to Heat exchanger networks and Pinch technology.

Characteristic of Equilibrium stage and Flash calculations, Study of different types of equilibrium cascade configurations and its degrees of freedom analysis, Algebraic method to determine the number of equilibrium stages, Calculation of stage efficiency, tray diameter, pressure drop and mass transfer, Rate based method to design a packed column, Scale up of a column from laboratory data, Estimation of distillation column efficiency using performance data and to develop its empirical correlation, Scale up of distillation column, Rate based method for packed distillation column, Approximate methods for Multicomponent, multistage separations, Use of residue curve for the conceptual design of distillation columns, Pressure swing and azeotropic distillation, Rate based models for distillation, Modeling of batch distillation, Modeling and simulation of absorption and leaching processes.

Diffusion in non-ideal system and evelopment of generalized Maxwell-Stefan formulation, Study of Generalized Fick's law, Estimation of binary and multicomponent Diffusion Coefficients, Study of interphase mass and energy transfer.

Reference

1. Separation Processes and principles   J.D Seader, E. J. Henly,
2. Multicomponent Mass Transfer   R. Taylor, R. Krishna.
3. Principles and Modern Applications of Mass Transfer Operations   Jaime Bendaitez
4. Biological and Bioenvironmental Heat and Mass Transfer   Ashim K. Datta,

CH 523 ADVANCED THERMODYNAMICS IN CHEMICAL ENGINEERING

Review of Basic Postulates, Maxwell's relations, Legendre Transformation, Pure Component properties, Theory of corresponding states, real fluids Equilibrium, Phase Rule, Single component phase diagrams Introduction to Multicomponent Multiphase equilibrium, introduction to Classical Mechanics, quantum Mechanics, Canonical Ensemble, Microcanonical Ensemble, Grand Canonical Ensemble, Boltzmann, Fermi-dirac and Bose Einstein Statistics, Fluctuations, Monoatomic and Diatomic Gases,

introduction to Classical Statistical Mechanics, phase space, liouville equation, Crystals, Intermolecular forces and potential energy functions, imperfect Monoatomic Gases, Molecular theory of corresponding states, introduction to Molecular Simulations, Mixtures, partial molar properties, Gibbs Duhems equations, fugacity and activity coefficients, Ideal and non-ideal solutions, Molecular theories of activity coefficients, lattice models, multiphase Multicomponent phase equilibrium, VLE/SLE/LLE/VLLE, Chemical Equilibrium and Combined phase and reaction equilibria.

Thermodynamics of irreversible processes. Exergy analysis of Chemical Engg Processes.

Reference

1. Thermodynamics and an Introduction to Thermostatics,   H. B. Callen,
2. Molecular thermodynamics of fluid-phase Equilibria
                              J.M. Prausnitz, R.M. Lichtenthaler and E.G. Azevedo,
3. Introduction to Chemical Engineering Thermodynamics
                              J.M. Smith. H.C.V. Ness and M.M. Abott,

CH524 SOFTWARE LABORATORY

Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB

CH525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

CH-531POLYMER SCIENCE AND ENGINEERING

Chemistry of Polymerisation Reaction: Functionality, polymerization reactions, polycondensation, addition free radical and chain polymerization, copolymerization, block and graft polymerizations, stereo specific polymerization.

Polymerisation Kinetics: Kinetics of radial, chain and ionic polymerization and co-polymerisation systems.

Molecular Weight Estimation: Average molecular weight, number average and weight average, theoretical distributions, methods for the estimation of molecular weight

Polymerisation Processes: Bulk, solution, emulsion and suspension polymerization. Thermoplastic composites, fibre reinforcement fillers, surface treatment, reinforced thermoset composites-resins, fibers additives, fabrication methods.

Rheology: Simple rheological equations, simple linear viscoelastic models-Maxwell, Voigt; materials response time, temperature dependence of viscosity.

Reference

1. Fundamentals of Polymer Engineering   Kumar A. and Gupta R
2. Textbook of Polymer Science   Billmayer Jr., F. W.
3. Fundamentals of Polymer Science   Fried J.

CH532 NANO TECHNOLOGY

Supramolecular Chemistry: Definition and examples of the main intermolecular forces used in supramolecular chemistry. Self-assembly processes in organic systems. Main supramolecular structures.

Physical Chemistry of Nanomaterials: Students will be exposed to the very basics of nanomaterials; a series of nanomaterials that exhibit unique properties will be introduced.

Methods of Synthesis of Nanomaterials. Equipment and processes needed to fabricate nano devices and structures such as bio-chips, power devices, and opto-electronic structures. Bottom-up (building from molecular level) and top-down (breakdown of microcrystalline materials) approaches.

Biologically-Inspired nanotechnology basic biological concepts and principles that may lead to the development of technologies for nano engineering systems. Coverage will be given to how life has evolved sophisticatedly; molecular nanoscale engineered devices, and discuss how these nanoscale biotechnologies are far more elaborate in their functions than most products made by humans.

Instrumentation for nanoscale characterization. Instrumentation required for characterization of properties on the nanometer scale. The measurable properties and resolution limits of each technique, with an emphasis on measurements in the nanometer range.

Reference

1. Supramolecular Chemistry   Jean-Marie Lehn,
2. Supramolecular Chemistry   Jonathan Steed & Jerry Atwood
3. Intermolecular and Surface Forces   Jacob Israelachvil,

CH533 BIOPROCESS TECHNOLOGY

Introduction: Fermentation processes general requirements of fermentation processes – An overview of aerobic and anaerobic fermentation processes and their application in industry - Medium requirements for fermentation processes - examples of simple and complex media Design and usage of commercial media for industrial fermentation. Sterilization: Thermal death kinetics of micro-organisms - Batch and Continuous Heat-Sterilization of liquid Media - Filter Sterilization of Liquid Media and Air.

Enzyme technology, Enzymes: Classification and properties -Applied enzyme catalysis - Kinetics of enzyme catalytic reactions - Microbial metabolism - Metabolic pathways – Protein synthesis in cells.

Stoichiometry and Kinetics of substrate utilization and Biomass and product formation: Stoichiometry of microbial growth, Substrate utilization and product formation-Batch and Continuous culture, Fed batch culture Recovery and purification of products.

Bioreactor and product recovery operations: Operating considerations for bioreactors for suspension and immobilized cultures, Selection, scale-up, operation of bioreactors – Mass transfer in heterogeneous biochemical reaction systems; Oxygen transfer in submerged fermentation processes; oxygen uptake rates and determination of oxygen transfer rates and coefficients; role of aeration and agitation in oxygen transfer. Heat transfer processes in biological systems.

Introduction to Instrumentation and Process Control in Bioprocesses: Measurement of physical and chemical parameters in bioreactors - Monitoring and control of dissolved oxygen, pH, impeller speed and temperature in a stirred tank fermenter.

Reference

1. Bio-process engineering   M. L. Shuler and F. Kargi,
2. Biochemical Engineering Fundamentals   J. E. Bailey and D. F. Ollis,
3. Principles of Fermentation Technology   P. Stanbury, A. Whitakar and S. J. Hall,

CH 534 PINCH TECHNOLOGY

Pinch Location: Locating the pinch, significance of pinch, pinch in grid representation, Threshold problems, capital cost implication of the pinch.

Targeting: Heat exchanger networks, energy targeting, area targeting, unit targeting, shell targeting, cost targeting, super targeting, continuous targeting.

Pinch Methodology: Problem representation, temperature enthalpy diagram, simple match matrix. Heat content diagram, Temperature interval diagram, Heuristic approach & PDM, weighted flow rate specific heat method ((WFCPM), Tree searching.

Pinch Design and Optimization: Networks for maximum energy recovery, Pinch design method, Flexibility criteria of the pinch, cp table, the tick of heuristic, case studies, optimization of heat exchanger network optimality for a minimum area network, Sensitivity analysis.

Energy and Resource Analysis of various processes and Mass Exchange Network: Batch process, flexible process, distillation process, evaporation process, reaction process, process using mass separating agent. Heat pipes and Heat pumps, MEN Network, Waste minimization by using mass separating agents.

Reference

1. Heat Exchanger network synthesis   V. Uday Shenoy
2. User Guide on Process Integration for the efficient use of Energy D.W. Linnhoff et al.
3. Conceptual Design of Chemical Process   James M. Douglas
4. Chemical Process Synthesis and Engineering Design   Anil Kumar,

CH 535 ADVANCED FLUID DYNAMICS

Properties of fluids and multiphase flow, fluids and fluid properties, Kinematics: Motion, streamlines, pathlines and streaklines, Newtonian, non- Newtonian and non-viscous fluids, Continuity equation in Cartesian, cylindrical and spherical coordinates, Derivation of general momentum equation for Newtonian fluids in Cartesian coordinates, Eulers equation, principles of rotational and irrotational flow, velocity potential, Bernoulli‟s equation, Laplace equations, stream function, vorticity, Cauchy –Rieman equation, Analytical solutions for simple two dimensional incompressible, irrotational fluid flows: flow along two inclined plates, point source or sink in an infinite fluid. Stokes law of viscosity, Navier-stokes equation, creeping flow around a solid sphere, expression for total drag, Turbulent flow: Transition to turbulence, Prandtl‟s mixing length, Turbulence models. Boundary layer on immersed bodies, two dimensional boundary layer equation, laminar boundary layer on flat plate (Blasius‟ exact solution), Von-Karmann‟s integral momentum equation, boundary layer separation flow and pressure drag, Flow of compressible fluids, thermodynamic considerations, continuity and momentum equation for one dimensional compressible flow, one dimensional normal shock, flow through fluidized beds. Navier-Stokes equation and various approaches of simulation (stream velocity, primitive variable).

Reference

1. Introduction to Fluid Mechanics   R.W. Fox, A.T. Mc Donald, P.J. Pritchard,
2. Fluid Dynamics and Heat Transfer   J.G. Knudsen and D.L. Katz,
3. Transport Phenomena   R.B. Bird, W.E. Stewart, and E.N. Lightfoot,

CH 536 BIOENERGY ENGINEERING

Biomass Sources, Characteristics & Preparation: Biomass Sources and Classification. -Chemical composition and properties of different biomass materials and bio-fuels – Sugar cane molasses and other sources for fermentation ethanol-Sources and processing of oils and fats for liquid fuels- Energy plantations -Preparation of woody biomass: Size reduction, Briquetting of loose biomass, Drying, Storage and Handling of Biomass.

Biogas, Technology: Feedstock for biogas production, Aqueous wastes containing biodegradable organic matter, animal residues. Microbial and biochemical aspects- Operating parameters for biogas production. Kinetics and mechanism - Dry and wet fermentation.

Digesters for rural application - High rate digesters for industrial waste water treatment. Bio-Ethanol and Bio-Diesel Technology: Production of Fuel Ethanol by Fermentation of Sugars. Gasohol as a Substitute for Leaded Petrol. - Trans-Esterification of Oils to Produce Bio-Diesel.

Pyrolysis and Gasification of Biomass: Thermo-chemical conversion of ligno-cellulose biomass - Biomass processing for liquid fuel production - Pyrolysis of biomass – Pyrolysis regime, effect of particle size, temperature, and products obtained. Thermo-chemical gasification principles: Effect of pressure, temperature and of introducing steam and oxygen.

Design and operation of Fixed and Fluidized Bed Gasifiers. Combustion of Biomass and Cogeneration Systems: Combustion of Woody Biomass: Theory, Calculations and Design of Equipments. Cogeneration in Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration.

Reference

1. Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes ,
   Chakraverthy A,
2. Principles of Solar Engineering D. Yogi Goswami, Frank Kreith, Jan. F .Kreider,
3. Biogas Systems: Principles and Applications   Mital K.M,
4. Biogas Technology   Nijaguna, B.T.

CH 537 FOOD PROCESSING & TECHNOLOGY

Food Process Engineering - Fundamentals: Raw material and the process-Geometric, Functional and Growth properties of the raw material, Mechanization and the raw material, cleaning - contaminants in food raw materials, function of cleaning and cleaning methods, sorting and Grading of Foods.

Unit Operations in Food Processing: Fluid flow, thermal process calculations, refrigeration, evaporation and dehydration operations to food processing. Heat processing of foods – modes of heat transfer involved in heat processing of foods.

Food Canning Technology: Fundamentals of food canning technology, Heat sterilization of canned food, containers - metal, glass and flexible packaging, Canning procedures for fruits, vegetables, meats, poultry and marine produces.

Separation And Mixing Process In Food Industries: Conversion operations. Size reduction and screening of solids mixing and emulsification, filtration and membrane separation, centrifugation, crystallization, extraction.

Food Biotechnology: Food Biotechnology. Dairy and cereal products. Beverages and food ingredients. High fructose corn syrup. Single cell protein.

Reference

1. Fundamentals of Food Process Engineering   R. T. Toledo ,
2. Fundamentals of Food Canning Technology   J.M. Jackson & B.M. Shinn
3. Food Engineering Operations   J.G. Bernnan, J. R .Butters, N.D. Cowell & A. E. V. Lilley

CH 538 ADVANCE SEPARATION TECHNOLOGY

Introduction: Separation processes in chemical and biochemical industries, categorization of separation processes, equilibrium and rate governed processes.

Bubble and Foam Fractionation: Nature of bubbles and foams, stability of foams, foam fractionation techniques, batch, continuous, single stage and multistage columns.

Membrane Separation: Physical factors in membrane separation, osmotic pressure, partition coefficient and permeability, concentration polarization, electrolyte diffusion and facilitated transport, macro-filtration, ultra-filtration, reverse osmosis and electro-dialysis, gas separation using membrane structure and production.

Special Processes: Liquid membrane separation, critical extraction, pressure swing adsorption and freeze drying, pervaporation and permeation, nanoseparation.

Reference

1. Separation Processes   King C. J.,
2. Separation Process Principles   Seader J. D. and Henley E. J.
3. Mass Transfer and Separation Processes: Principles and Applications   Basmadjian D.,
4. Multistage Separation Processes   Khoury F. M.,
5. Separation Process Engineering   Wankat P. C.

CH539 TEXTILE TECHNOLOGY

Classification of fibres: Natural fibres of vegetable origin: jute; hemp; sunn; Urena. The leaf fibres : Sisal, Abaca (manila); seed and fruit fibres; cotton. Natural fibres of animal origin: Wool; Mohair; Cashmere; Persion goat hatosilk; vicuna; fur fibres; Man made fibres; Rayon's Polyamide fibres; polyester fibres, polyvinyle derivative fibres; polyolefin & Polyurethane fibres.

Weaving: Various steps in weaving manufacturing for fibres, design and construction, and weaving fundamentals to the various modern methods of weaving slashing process calculations; woven fabric construction and weaving process calculation & problem solving.

Physical Testing of textiles : Introduction: Reasons for textile standardization of testing sampling, measurement errors; Effect of atmosphere on physical properties; Fibre tests; Fibre fitness; Fibre length; yarn tests; Linear density twist, yarn evenness; Hairness, friction, Strength tests; Definition; Load elongation curve.

Recycling Textile Wastes: Recycling and recovery strategies turning environmental concern into real profit Re-claimed fibres, the sources and usage; Industrial wastewater minimization and treatment. The fibre industry and water management; Production of high tenacity tapes from polyprophyene. The role of process stabilizers in recycling polyoefins.

Modern Textiles: Challenges for Textile research & development in the 21st century; fibres textiles and materials for future military use; Development in man made fibre technology-airbages, Textiles in filterations; Textiles in medicine, defence, transport and geotextiles

Reference

1. Handbook of Tesxtile Fibres Vol-I Natural Fibres, Vol-II Man-made fibres.   Gardon Cook

2. Handbook of waving .   Adanur S

3. Weavers Handbook of Textile Calculation

                           Dan J. Mc. Geight, James B. Bradshow, Everett E. Back & Michael .

4. Physical Testing of Textieles.   B.P. Saville

CH541 PETROLEUM ENGINEERING & TECHNOLOGY

Origin of Petroleum: Origin and occurrence of petroleum crude, status of petroleum refining in India, composition classification and physical properties of petroleum, evaluation of crude oil and petroleum products, future refining trends. Introduction to petroleum and petrochemical industries, structure of petrochemical industry, product profile of petrochemicals, profile of Indian petrochemical industries, basic building blocks for petrochemical production.

Indian and Global Petroleum Industries: An overview, Raw materials for organic chemicals-coal, biomass, petroleum and natural gas, Evaluation of crude oil, Petrochemical feed stocks- Natural gas, NGL, Naphtha, Kerosene, and Pyrolysis gasoline.

Crude Oil Distillation Processes: Pretreatment of crude, atmospheric and vacuum distillation process.

Secondary Conversion Processes: Catalytic reforming, catalytic cracking, deep catalytic cracking, alkylation, isomerisation and polymerization, reformulated gasoline and oxygenates.

Heavy Residue Up-gradation Technologies: Hydro-treating, hydrocracking, hydro-visbreaking, visbreaking and delayed coking.

Lubricating Oil, Wax and Bitumen: Dewaxing, deasphalting, lube hydro-finishing, bitumen air blowing.

Sweetening: Desulfurization and hydro-desulfurisation of petroleum products.

Hydrogen: Production and management.

Aromatics Production: Catalytic reforming, aromatic separation, aromatic conversion processes, Cyclar process.

Reference

1. Petroleum Refining: Separation Processes   Wauquier J. P.
2. Hand book of Petroleum Refining Processes   Meyers R. A.,
3. Modern Petroleum Technology- Part I   Dawe R. A.,
4. Modern Petroleum Technology- Part II   Lucas A. G.,

CH542 MULTIPHASE FLOW/CFD MULTIPHASE REACTOR

Flow past immersed bodies: Drag and drag coefficients, flow through beds of solids, motion of particles through fluids, fluidization, types of fluidization and applications.

Two-phase flow: Two–phase flow through pipes. Lockhart-Martinelli parameters and their application in analysis of two-phase flows.

Interaction of fluids: Mixing of a single fluid; degree of segregation, early and late mixing of fluids, models for partial segregation, mixing of two miscible fluids. Gas-liquid flow phenomenon, Types of regimes formation – trickle, pulse, bubble, dispersed bubble, spray regime etc.

Types of Multiphase-Reactors: Various types of multiphase reactors. eg. Packed bed, packed bubble column, trickle bed reactor, three phase fluidized bed reactor, slurry bubble column, stirred tank reactor. Characteristics of above mentioned reactors such as; fluid flow phenomena and flow regimes, flow charts/ correlations, pressure drop, liquid hold up etc. Reactors involving Newtonian and non-Newtonian fluids.

RTD in Multiphase Flow systems: Non Ideal Flow: Residence time distribution of fluid in vessel, E, F & C Curve, Mean and variance, the Dirac delta function, residence time, linear and non-linear processes, models for non ideal flow, dispersion model, N tanks in series model, model for small deviations from plug flow and long tails, conversion in a reactor using RTD data, diagnosing ills of operating multiphase reactors, models for multiphase reactors. Two parameter model; PD model; three parameter models; PE Model.

Reference

1. Chemical Reaction Engineering   Levenspiel O,
2. Elements of Chemical Reaction Engineering   Fogler H Scott
3. Gas-Liquid-Solid Reactor Design   Shah Y.T.,
4. Chemical Reactor Design and Operation
                          Westerterp K.R., van Swaaij W.P.M., and Beenackers A.A.C.M.,

17.0 DEPARTMENT OF BIOLOGICAL SCIENCE AND ENGINEERING

xvi) BIOTECHNOLOGY

BIO511 INSTRUMENTATION IN BIOTECHNOLOGY

Methods of biochemical analysis-Biochemical analytical methods of – bioassays for analysis and estimation of carbohydrates, lipids, proteins, nucleotides and nucleic acids. Principle of enzymatic assays for metabolites.

Nucleic acid and Protein analysis-Principle of extraction of nucleic acids and proteins from cells, PCR: principles; versatile types DNA fingerprinting: RFLP, AFLP, and RAPD and sequencing.PFGE;southern blotting and ribotyping; northern blot analysis; protein array and DNA microarray, principle and applications.

Immunoanalytical Technique-Immunoanalytical Techniques, Antiserum raising including chicken IgY, Bispecific and chimeric antibody production, immunoflorescence, immunohistocompatibility testing, ELISA and ELISPOT, immunohistochemistry, and microfluidics in immunoassays.

Analysis of Bioprocesses-Analysis of Biomassa, measurement of dry weight and biomass composition, analysis of substrate uptake and product formation rates, measure of BOD and COD in waste waters, Gaseous analysis for O_2 and CO_2.

Radiochemical Methods in Analysis - Nuclear reactions, types and principles of radioactive isotope decay and half life, physical basis of instrumentation and measurement of radioactivity: Radiation detectors and applications- radioisotope dilution methods, autoradiography and radioimmunoassay.

References
1. Techniques in Analytical Chemistry   Stewart KK, Ebel
2. Principles of Instrumental Analysis.   Douglas A. Skoog, F. James Holler, Timothy A Nieman
3. Microscopy, Immunohistochemistry, and Antigen Retrieval Methods: For Light and Electron
4. Microscopy .   Hayat M.
5. Practical Skills in Biomolecular Sciences.   Weyers and Allan Jones

BIO512 GENETIC ENGINEERING / POPULATION GENETICS

Recombinant DNA- Concepts, vectors (Plasmids, phage based vectors, Artificial chromosomes-(BACs, YACs), Shuttle vectors, enzymes (DNA ligase, Polymerases, Restriction enzymes, Phosphatases, Kinases), methods of gene transfer, DNA & RNA probes.

Screening of recombinant cells-Immunological screening, colony & plaque hybridization, Expression vectors, In-situ hybridization, Reporter genes.

Applications of Genetic Engineering-Genomic & c DNA libraries, gene cloning in medicine, agriculture, transgenic plants & animals, gene therapy.

Population genetics-structure, Hardy-Weinberg law, Selective, neutral and molecular evolution, natural and artificial selection: Lamarckism: mechanism of genetic variation, Speciation- allopatric & sympatric, Chromosomal rearrangement,

Mendelian inheritance, Homologous and analogous features as evidence of converge, Human Genome Project

References
1. Molecular Biotechnology   Pasternack and Glick.
2. From Genes to Genomes: Concepts & Applications of DNA Technology
                                                        J.W. Dale & M.V. Schartz.
3. Gene Cloning & DNA Analysis: An Introduction   T.A. Brown.
4. Principles of Gene manipulation: An Introduction to Genetic Engineering,   Old RW,Primrose
5. An introduction to Genetic engineering   D.S.T. Nicholl

BIO 513 CELL AND TISSUE ENGINEERING

Tissue culture practices for animal and plant, media composition, culture conditions, micropropagation, haploid culture, apical meristem culture, callus culture, single cell culture, protoplast culture, Blood cell culture, epithelial cell culture.

Comprehensive introduction to living and man-made materials, scaffold materials and applications of tissue engineering, artificial cell, immunochemical techniques in tissue engineering and biomaterial science, Clinical applications of tissue engineering

Basics of Xenotransplantation, Potential organ donor, biological, physical & immunological barriers, Ehtical issues, potential uses of Xenotransplantation, genetic modifications of xenografts, Zoonosis in xenotransplantation.

Application of biotechnological practices for paper, textile, tannery and leather industry. Bioprocessing of functional food and neutraceuticals, production of insect, pest and disease resistant crops.

Pharmacokinetics; use of liposome as drug delivery system, production of hormones and interferon by genetically engineered cells, techniques for the development of new generation antibiotics.

References
- Artificial cells, cell engineering and therapy By S Prakash
- Biomaterials, artificial organs and tissue engineering By L Hench and J Jones
- Xenotransplantation By Jeffrey L. Platt
- Animal Biotechnology By R.I. Freshney
- Plant Tissue Culture By S.S. Bhojwani, M.K. Razdan

BIO514 BIOTECHOLOGY LABORATORY

Experiments connected with theory subject cell and tissue engineering

CH515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

BIO 521 CHEMINFOMATICS& DRUG DESIGNING

Introduction to cheminformatics, history of cheminformatics, applications of cheminformatics, evolution of cheminformatics, future scope of cheminformatics, Data and data source in chemistry, searching chemical structures.

Representation of chemical compounds, manipulations in 2D and 3D structures of chemical compounds, representation of chemical reactions, molecular descriptors, calculations of physical and chemical data, calculations of structural desiphers.

Development of drug, drug life cycle, drug development time lines, stages of drug discovery, strategic issues in drug discovery, emerging approaches to drug design and discovery, drug metabolism physic chemical properties, pharmacokinetic action of drug on human body.

Computer aided drug design, methods of computer aided drug design, ligand design methods, docking algorithms and programs, drug design approaches, Strategy for target identification and validation, Lead compound identification and optimization,

Combinatorial chemistry and library design, virtual screening , drug likelyness and compound filters. absorption, distribution, metabolism, excretion and toxicity (ADMET) property prediction, computer based tools for drug design.

References
1. Introduction to Chemoinformatics by Andrew R. Leach, Valerie J. Gillet
2. Introduction to Computational Chemistry by Frank Jensen
3. Targeted and Controlled Drug Discovery - S.P.VYAS and R.K.Khar
4. Cheminformatics By Johann Gasteiger and Thomas Engel
5. Bioinformatics from Genome to Drug By Thomas Langauer

BIO 522 MOLECULAR BIOTYPING

Polymerase chain reaction - Principle, Design of primers, methodology, RT-PCR, Multiplex PCR, Anchored PCR, Inverse PCR and PCR walking. Identification of PCR products.

Molecular markers – 16S rDNA, RFLP, RAPD, AFLP, repetitive extragenic palindromic (rep), interspersed transcribed sequences (ITS), Blotting techniques: Southern, Northern, Western.

Applications of PCR, DNA chips, and micro array.

Metagenomics- concepts, methodology, softwares, applications.
Stem Cell & applications - Male Germ-line Stem Cells, Hematopoietic Stem Cells, Mesenchymal Stem Cells of Human Adult Bone Marrow, role of stem cells in organ regeneration.

References

Developmental Biology   Scott F. Gilbert.
   1. Stem Cell Biology   Marshak
   2. Genetic engineering   S. Mitra
   3. Principles of Gene Manipulation: An Introduction to Genetic Engineering Old RW, Primrose
   4. Genes   B. Lewin

BIO 523 BIONANOTECHNOLOGY

Introduction to nanotechnology ; Application and benefits of nanotechnology ; Basics tools for nanotechnology – Principals of scanning force microscopy, Scanning electron microscopy ,Transmission electron microscopy; Nanoinprint, Lithography ,Bimolecular recognition **.**

Types of Motor proteins: Linear and Rotary motors, Structure of Motor proteins, Motility properties of motors, ATP hydrolysis mechanism of various motor proteins, comparison of kinetics, steps and force production by motors, chemo-mechanical coupling of motors - single molecule approaches. Protein based nanocrstals, microbial nanoparticle production.

Nano LC and capillary electrophoresis, interphases with mass spectroscopy, chip based separation in micro and nanosized channels, fluorescence imaging, fluorescence correlation spectroscopy, single molecule spectroscopy.

DNA as a polymer and DNA based motors basics of DNA structure, Hairpin loops and helices: reciprocal exchange and stability of DNA structure, Base pairing, motifs used in DNA nanotechnology. RNA polymerase and DNA helicase as motors, Single molecule mechanics and DNA dynamics.

Tissue engineering, Bacterial motors, Nanomechanistic devices from DNA,.Biosensors; Application of biochips, DNA –chip, Protein chip, Application of colloidal particles,bacterials motors   , drug delivery system

Reference

   1. Nanobiotechnology: Concepts, Applications and Perspectives,   Christof M. Niemeye
   2. Nanotechnology: A gentle introduction to the next big idea   Ratner, M.Ratener, D.
   3. Bionanotechnology: Lessons from Nature   David S. Goodsell,
   4. Introduction to Nanotechnology   Charles P. Poole, Frank J. Owens .
   5. Nanotechnology: An introduction to nanostructuring techniques,   M Kohler, W Fritzsche
   6. Handbook of nanotechnology,   Bhushan,

BIO514 BIOTECHOLOGY LABORATORY

Experiments connected with theory subject molecular biotyping

CH515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Deaprtemtn Elective

BIO- 531 BIO-ETHICS; BIO-SAFETY REGULATION

Legal issues, Socioeconomics issues and environmental impact of biotechnology, Special procedure to release GMO.

Intellectual property rights, TRIPS and international contention, Patents and methods of application of patents, Trade secret, Farmers rights, Biopiracy   and Biocolonialism

Patent copy right, Trademarks, patent act (1970), Patent amendment act (2002), Patent specification, Requirements of a patentable invention; interventional and Indian patent laws; Case studies

Biosafety regulation; national and international guidelines, r-DNA guidelines, experimental protocol use of genetically modified organism.

Reference

1. Patents   N.R. Subbaram
2. Biotechnology and Development   Sasson A,
3. Biotechnology in Developing Countries, Present and Future   Sasson A,
4. Biotechnology Emerging trends   J. Selvin, A.S. Ninawe, V.S. Sugunan, N.Sukumaran
5. Basic Biotechnology   S. Ignacimuthu

BIO532   COMPUTATIONAL BIOLOGY

Introduction to Bioinformatics, information networks, biomolecule information resources, an overview on biological databases. Retrieval of biological data, searching sequence database by sequence similarity criteria.

Sequence analysis, sequence alignment, alignment with gap penalties, space efficient sequence alignment, scoring matrices for similarity search PAM, BLOSUM.

Pairwise Alignment ; Introduction, The Scoring Model, Alignment algorithm, Dynamic Programming with more Complex Models, Heuristic Alignment Algorithms, Linear Space Alignment. Multiple Sequence Alignment Methods ; What a Multiple Alignment Means, Scoring a Multiple Alignment, Multidimensional Dynamic Programming, Progressive alignment Methods,

Marcov Chains and Hidden Marcov Models; Marcov Chains, Hidden Marcov Models, Parameter Estimation for HMMs, HMM Model Structure, More Complex Marcov Chains, numerical Stability of HMM Algorithms, multiple Alignment by Profile HMM Training.

Structural Bioinformatics, Basic principles on protein structure prediction, Chou Fasman and GOR methods, Ab initio structure prediction. conceptual modeling of proteins, obtaining, viewing and analyzing structural data. Basic bioinformaticsTools – Genscan, Rasmol, Cn3D, Phylip, Oligo, Clustal W, ALSCRIPT, MOLSCRIPT, CATH and SCOP.

References

1. Bioinformatics- A beginner's guide   Jean-Michel Claverie
2. Structural Bioinformatics   Philip E. Bourne and Helge Weissing
3. Essential Bioinformatics   Jin Xiong
4. Bioinformatics Sequence and Genome analysis   Mount DW

BIO533 MICROBIOLOGY AND IMMUNOLOGY

History & Overview of   Microbial world- Contributions of Scientists,Bacterial classification, Numerical taxonomy, characters for classification, Characteristics of Archaea; eubacteria, Cyanobacteria.

Techniques- Isolation, Pure & Enrichment culture techniques, Staining procedure, Biochemical tests, sterilization- physical & chemical, Phenol coefficient of disinfectant.

Microbial nutrition & Growth

Principles of microbial nutrition, mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, maintenance of cultures.

Virology & Mycology-General characteristics of viruses, life cycle of viruses. General account of Fungi, Economic importance.

Immunology-Types of Immunity, Antigens & antigenicity, Antibody Structure & diversity, Antigen Antibody reaction & Invitro tests – Precipitation, Immunoelectro-phoresis, Haemagglutination, Hypersensitivity and Allergic reactions, Vaccines and Immunization.

References

1. Microbiology: An Introduction   Tortora,
2. Microbiology   M.J.Pelczar, E.C.S. Chan
3. Principles of Microbiology   R.M.Atlas.
4. General Microbiology   R.Y.Stainier, J. L. Ingraham, M.L.

BIO534 COMPUTATIONAL PHYLOGENETICS

Introduction to trees, concept of evolutionary trees, phylogenetic trees, relationship of Phylogenetic analysis to sequence alignment, genome complexity and Phylogenetic analysis, sequence alignment based on evolutionary model.

Methods of phylogenetic analysis like distance matrix, Fitch and Margoliash method,maximum parsimony method, maximum likely hood method, unweighted pair group method with arithmetic mean (UPGMA), neighbour-joining method

Character based methods, evaluation of phylogenetic methods,Converting sequence similarity to distance scores, choosing an outgroup, correcting of distances between nucleic acid sequences for multiple changes and reversions.

Comparison of protein sequences and protein encoding genes, comparison of open reading frames by distance methods.

Reliability of Phylogenetic predictions, problems and complications from Phylogenetic analysis, automated tools for Phylogenetic analysis, bootstrapping and jack knife replicates, jumbling sequences.

References
1. Bioinformatics – Sequence and Genome analysis   David W. Mount
2. Molecular Evolution and Phylogenetics   Nei and Kumar.

BIO 535 PROTEIN ENGINEERING & ENZYME TECHNOLOGY

Basics of protein science: Classification and properties of proteins, denaturation and coagulation of proteins, protein hydration, isolation, extraction and purification of proteins.

Structure of proteins: Organizational levels in protein structure, techniques in protein structure determination, factors determining stability of proteins, determination of protein folding and unfolding pathways, types and importance of post translational modification in proteins

Applications of Enzymes: Classification of Enzymes, Commercial applications of enzymes in food, pharmaceutical and other industries, Enzymes for analytical and diagnostic applications, Purification and characterization of enzymes from natural sources.

Mechanisms and Kinetics of Enzyme Action: Mechanisms of enzyme action, kinetics of single substrate reactions, turn over number, estimation of Michaelis-Menten parameters, Types of inhibition, Allosteric regulation of enzymes.

Enzyme Immobilistion and Enzyme Biosensors : Physical and chemical techniques for enzyme immobilization, Overview of applications of immobilized enzyme systems. Design of enzyme electrodes and their application as biosensors in industry health care and environment.

References
1. Enzymes: Biochemistry Biotechnology,Clinical chemistry. Trevor Palmer and Philip Bonner;
2. Biochemical Engineering   James M. Lee,
3. Principles of Biochemistry   A. Lehninger
4. Enzymes in Food Processing   Gerald Reed
5. Enzyme Technology.   Ashok Pandey.

BIO536 BIOENERGY ENGINEERING

Introduction Biodiversity, historical and geographical causes for diversity, Genetic diversity, molecular taxonomy, species and population biodiversity, quantifying biodiversity, Maintenance of ecological biodiversity, Morphological and molecular characterization of biodiversity, hotspots, and endangered species.

Microbial Diversity- distribution, abundance, ecological niche, and principles of microbial diversity. Structural, biochemical and molecular phylogenetic relationships of microorganisms.

Introduction of Bio energy, Classification and sources of energy, energy from waste..Current energy consumption, overview of biofuel/bioenergy and biorefinery concepts, Biomass preprocessing, Bio-Energy, Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion,hydrogen production

Biochemical and Photosynthetic aspects of Energy Production, Biodiesel production from oil seeds, waste oils and algae, Environmental impacts of biofuel production, Future of Bioengineering.

Uses and values of biodiversity , ,bio piracy .indigenous system knowledge .national policies ,legislation and instruments relating the theprotection of the wild and domesticated flora and fauna as well as habitats ,conservation and management.

Reference
1. Biodiversity:vol.1   Edward O. Wilson,Frances M. Peter
2. Biodiversity: New leads for the pharmaceutical and agrochemical industries
           S.K. Wrigley, M.A. Hayer, R.Thomas, E.J.T. Chrystal and N.Nicholson
3. Microbial diversity and bioprospecting-   Alan T. bull
4. Textbook of biodiversity   K.V. Krishnamurthy

BIO537 GENOMICS & TRANSCRIPTOMICS

Overview - Genes, Genomes, evolution of genomes, Structure & organization of Prokaryotic and eukaryotic genome, mitochondrial & chloroplast genome, gene structure, SNP's, protein coding genes, repeated sequences.

Comparative genomics- Genomes of Escherichia coli, Mycoplasma genitalium, Saccharomyces cervisiae, Caenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana, Homo sapiens, Computational Approaches in comparative genomics.

Genome information resources, Brief outlook of various genome projects and their outcome, Genome rearrangements, the breakpoint graph, expected reversal distance, signed permutations, interleaving graphs and hurdles, algorithm for sorting by reversals, duality theorem and genomic distance.

Genome analysis- sequencing and mapping-physical & high resolution maps, restriction mapping, Introduction to phylogenetic trees, relationship of Phylogenetic analysis to sequence alignment, unweighted pair group method with arithmetic mean (UPGMA), evaluation of phylogenetic methods.

Transcriptomics- importance of transcription, tools and techniques in transcriptomics, microarray technology,sequencing based approaches to study transcriptomes, applications of new generation transcriptome sequencing, gene expression profiling, non coding RNA discovery and detection.

References
1. Genes and genomes   Singer.M, and Berg.P,
2. Gene Structure and Transcription   Beebe.T, and Burke.T
3. Bioinformatics – A practical guide to the analysis of Genes and Proteins
                                          Baxevanis and Fancis Ouellette .
4. Metagenomics: Theory, methods and applications,   Diana Marco
5. Computational Molecular Biology : An algorithmic approach   Pavel A. Pevzner

18.0 DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

xvii) INFORMATION SECURITY (M.Tech)

IS511 COMPUTER & NETWORK SECURITY

Introduction to computer and network security. Basic concepts, threat models, common security goals, Cryptography and cryptographic protocols, including encryption, authentication, message authentication codes, hash functions, one-way functions, public-key cryptography, secure channels, zero knowledge in practice, models and methods for security protocol analysis. Malicious code analysis and defense. Viruses, Worms, spyware, rootkits, botnets, etc. and defenses against them, Detecting Attackers. Software security. Secure software engineering, defensive programming, buffer overruns and other implementation flaws. Language-based security: analysis of code for security errors, safe languages, and sandboxing techniques. Operating system security. Memory protection, access control, authorization, authenticating users, enforcement of security, security evaluation, trusted devices, digital rights management. Network security. Network based attacks, Kerberos,X.509, firewalls, intrusion detection systems, DoS attacks and defense. Case studies: DNS, IPSec. Web security. Securing Internet Communication, XSS attacks and defenses, etc. Advanced topics. Security monitoring, surreptitious

communication, data remanence, trusted devices, privacy and security of low-powered devices (RFID) electronic voting, quantum cryptography, penetration analysis, digital rights management and copy protection, security and the law.

References:
1. William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall, New Jersey.

IS512 CRYPTOGRAPHY

Introduction to cryptography.Security Attacks, mechanism and Services. Cryptosystems, Conventional encryption model and techniques, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stream and block ciphers. Block ciphers principals, fiestal structure, SPN, DES, triple DES, AES,IDEA encryption and decryption, key distribution. finite field: Introduction to graph, ring and field, modular arithmetic, Fermat's and Euler's theorem, Euclid's Algorithm, Chinese Remainder theorem, Entropy and huffman's coding,Comparison of symmetric and public-key cryptographic systems, Principals of public key crypto systems, RSA algorithm, Diffle-Hellman key exchange algorithm, Message Authentication and Hash Function: security of hash functions and MACS, MD5 message digest algorithm, secure hash algorithm (SHA). Digital Signatures.

Reference
1. Cryptography and Network Security: Principles and Practice   William Stallings,
2. Cryptography Theory and Practice   Douglas R. Stinson.

IS513 CYBER CRIME AND INFORMATION WARFARE

Introduction of cyber crime, challenges of cyber crime, categorizing cyber crime, cyber terrorism, virtual crimes, perception of cyber criminals: hackers, insurgents and extremist groups,Interception of data, surveillance and protection, criminal copy right infringement, cyber stalking. Hiding crimes in cyberspace and methods of concealment. Anonymity and markets, privacy and security at risk in the global information society. Privacy in cyber space, web defacements and semantic attacks, DNS attacks, code injection attacks. Information Warfare concept, information as an intelligence weapon, attacks and retaliation, attack and defence. An I-War risk analysis model, implication of I-WAR for information managers, Perceptual Intelligence and I-WAR, Handling Cyber Terrorism and information warfare, Jurisdiction.

References
1. Principles of Cyber crime, Jonathan Clough Cambridge University Press
2. Information Warfare : Corporate attack and defense in digital world, William Hutchinson, Mathew Warren, Elsevier

IS514 COMPUTER LABORATORY 1

Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB

IS515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

IS521 DATABASE SECURITY AND ACCESS CONTROL

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control(DAC), Non-Discretionary Access Control , Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations, Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy, Biba'sintrigity model, Clark-Wilson model, Domain type enforcement model , mapping the enterprise view to the system view, Role hierarchies- inheritance

schemes, hierarchy structures and inheritance forms, using SoD in real system, Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multiline Insurance Company. Smart Card based Information Security, Smart card operating system-fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR,PPS Security techniques- user identification , smart card security, quality assurance and testing , smart card life cycle-5 phases, smart card terminals.

References

1. Role Based Access Control   David F. Ferraiolo , D. Richard Kuhn , Ramaswamy Chandramouli

IS522 SECURITY ASSESSMENT AND RISK MANAGEMENT

IS523BIOMETRICS

Introduction: Definitions, biometric modalities, benefits of biometric versus traditional authenticated methods. Key biometric terms and processes. Authenticationtechnologies: storage tokens, dynamic tokens, token usability. Design of a Biometric System: Building blocks, Modes of operation.

Biometric technologies: Passive & active biometric. user acceptance Ease of use ,technology cost, depoyability,Invasivness of the   technology , maturity of the technology. Fingerprint verification: Minutiae Based Fingerprint Matching, Non-minutiae Based Representations,finger print component, algorithms for interpretion.Fingerprint Enhancement, and Fingerprint Classification. Face Recognition:- Introduction, Authentication vs. Identification, Challenges in Face recognition, Algorithms for face recognitions.

Iris Recognition: Introduction, devices for capturing Iris, Iris representation schemes, Iris

recognition algorithms. Hand Geometry Recognition , Gait Recognition, The Ear as a Biometric, Voice Biometrics, A Palmprint Authentication System. On-Line Signature Verification.3D Face Recognition. Automatic Forensic Dental Identification,DNA.

Introduction to Multibiometrics.- Multispectral Face Recognition.- Multibiometrics Using Face and Ear.- Incorporating Ancillary Information in Multibiometric Systems. Multimodal Biometrics: Limitations of unimodal systems, multibiometric scenarios, levels of fusion, system design, score fusion techniques, score normalization, user-specific parameters, and soft biometrics.

 The Law and the Use of Biometrics.- Biometric System Security.- Spoof Detection Schemes.- Linkages between Biometrics and Forensic Science.- Biometrics in Government Sector.- Biometrics in the Commercial Sector.- Biometric Standards.- Biometrics Databases

Case Study Presentations: Biometrics in Banking Industry, Biometrics in Computerized,

Patient Records, Biometrics in Credit Cards, Biometrics in Mass Disaster Victim,

Identification Forensic Odontology

References

1. Biometrics for network security   PaulReid,
2. Handbook of Fingerprint Recognition   D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar,
3. BIOMETRICS: Personal Identification in Networked Society A. K. Jain, R. Bolle, S. Pankanti,
4. Biometric Systems: Technology, Design and Performance Evaluation,

                                                 J. Wayman, A.K. Jain, D. Maltoni, and D. Maio

IS524 COMPUTER   LABORATORY 2

Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB

IS525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

xviii)ADVANCES COMPUTING(M.Tech)
AC511MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE
Logic: Basics of propositional and first order logic, Completeness and compactness results;
TOC: Universal Turing Machines, undecidability, Rice's theorems for RE sets, Post machines, Basics of Recursive function theory. Equivalence, Church's thesis, Computational complexity, Space and Time complexity of Turing Machines, Relationships, Savage's theorem, Complexity classes, Complete problems, NP-completeness, Cook- Levin theorem.
References
1. Introduction to Automata Theory, Languages and Computation,
J. E. Hopcroft, J. D. Ullman.
2. First-Order Logic   Raymond M. Smullyan,
3. Structural Complexity   J.L. Balcazar, J. Diaz, J. Gabarro,

AC512 ADVANCED DATA STRUCTURES
Review of algorithm analysis, Optimal Binary search trees, Balanced binary search trees, Binary heaps, Advanced heap structures, Binomial heaps, Fibonacci heaps. Amortized analysis, Splay trees. Dictionaries, Disjoint set structures. Data Structures for External Memory, External sorting, String matching. Introduction to Randomized Data structures and algorithms.
References
1. Introduction to algorithms   Cormen and Rivest
2. Randomized algorithms   R.Motwani and P. Raghavan.

AC513 ADVANCED COMPUTER NETWORKS
Review of networking concepts: Network models, Addressing, Data rate limits, Bandwidth, throughput, Latency, Data link control, Multiple Access,Wired LAN, Wireless LAN, VLAN, SONET, ATM, QoS in ATM, ATM applications, IP addressing, forwarding, and routing, IPv4, IPv6, IP Security, Virtual Private Networks, Transport layer protocol, congestion control, Multimedia Networks: Voice/Video over IP, IP Telephony, Voice over ATM, AAL2, Network management, Optical Networks.

AC514 MODELILING AND SIMULATION LABORATORY
Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB

AC515 SEMINAR
Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

AC521ARCHITECTURE OF LARGE SYSTEMS
Pipeline processor principles and design, Instruction set architecture; Memory addressing; Instruction composition; Instruction-level parallelism. Hazards: dynamic scheduling, branch prediction; Memory hierarchy; Processor case studies; Multiprocessor introduction: Shared-memory architectures and their synchronisation and consistency issues, Advanced multi-core topics; Transactional Memory; Interconnection networks.
References:
1. Computer Architecture: A Quantitative Approach,   J. L. Hennessy and D. A
2. .Parallel Computer Architecture: A Hardware/Software Approach,
David Culler, J.P. Singh and Anoop Gupta
3 Advanced Computer Architecture: Parallelism, Scalability, Programmability,
Kai Hwang,.

AC522 OPERATING SYSTEM DESIGN

Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems, Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and microkernels.

Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies, Memory management, virtual memory concept, virtual machines, I/O management, File and disk management, Operating system security.

Distributed Operating system: architecture, Design issues, Distributed mutual exclusion, distributed deadlock detection, shared memory, Distributed scheduling.

Multiprocessor operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.

References:
1. Advanced concept in operating system: M. Singhal, N.G Shivratri
2. Operating system internal and design princilples: William stallings

AC523 SOFT COMPUTING

Introduction to neural networks, Working of an artificial neuron, Perceptron, Back propagation algorithm, Adalines and Madalines. Supervised and unsupervised learning, Counter-propagation networks, Adaptive Resonance Theory, Kohonen's Self Organizing Maps, Neocognitron, Associative memory, Bidirectional Associative Memory.

Introduction to fuzzy logic and fuzzy sets, fuzzy relations, fuzzy graphs, fuzzy arithmetic and fuzzy if-then rules, Process control using fuzzy logic, Decision-making fuzzy systems, Applications of fuzzy logic, Hybrid systems like neuro-fuzzy systems.

Evolutionary Computation: Population-based Search: genetic algorithms and evolutionary computation, Genetic Programming. Swarm optimization, Ant colony optimization. Search techniques like Simulated Annealing, Tabu search etc.

References:
1. Soft Computing and Intelligent Systems Design b   F.O.Karray and C.De Silva,
2. Neural Networks, Fuzzy Logic and Genetic Algorithms   Rajsekaran and Pai,

AC524 MODELILING AND SIMULATION LABORATORY

Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB

AC525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure.

xix) COMPUTER NETWORK

CN 511 ADVANCED COMPUTER NETWORKS

Review of networking concepts: Network models, Addressing, Data rate limits, Bandwidth, throughput, Latency, Data link control, Multiple Access,Wired LAN, Wireless LAN, VLAN, SONET, ATM, QoS in ATM, ATM applications, IP addressing, forwarding, and routing, IPv4, IPv6, IP Security, Virtual Private Networks, Transport layer protocol, congestion control, Multimedia Networks: Voice/Video over IP, IP Telephony, Voice over ATM, AAL2, Network management, Optical Networks.

CN512 GRAPH THEORY AND NETWORK ALGORITHMS

Introduction to Graph Theory, Planar Graphs, Trees, Optimization and Matching, Connectivity of graphs, Graph colouring, Graph Algorithms, Network Flows.

References

   1. Graph, Network and Algorithm   Dieter Jungnickel
   2. Graph Theory with applications   J A Bondy and U S R Murty.

CN513 NETWORKING DEVICES

Introduction to networking devices, Types of Networks LAN, MAN, WAN. Networking Devices,NIC,Repeater,Hub,Bridge,Switch,Router,Gateways. Methods of switching Cut through method ,Store & forward mode method, Fragment free method Modems: CSU, DSU and modulation commands. Signals and Type of Signals (i.e. Analog and Digital) Modulation techniques: ASK, PSK, BPSK, QAM, QPSK. Introduction to VLAN, Spanning Tree Protocol to design VLAN. Network Layer: Need, Services Provided , Design issues, Routing algorithms: Least Cost Routing algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing, Broadcast Routing, Multicast Routing.

Reference

   1. Computer Networks   Tanenbaum A. S
   2. Computer Networks   Stalling W
   3. Data Communication and Networking   Behraj A Forouzan

CN514 COMPUTER SIMULATION LABORATORY

Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB

CN515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

CN 521WIRELESS NETWORKING

Introduction to wireless communication, and future trends, Wireless Generations and Standards, Wireless Physical Layer Concepts, fundamentals of antennas, Cellular Concept and Cellular System Fundamentals.Spread Spectrum Modulation Techniques, Coding and Error Control, Multiple Access Technique for Wireless Communications, OFDM.Wireless LAN Technologies, Wireless IEEE Standards, Mobile Network Layer (Mobile IP). Mobile Transport Layer (Mobile TCP), Mobile Data network (GPRS), WAP Model and architecture, Introduction to Ad hoc networks, Sensor networks, Bluetooth networks and Wireless Mesh networks.

References

1.   Wireless Communications and Networking   William Stallings
2.   Wireless communication: Principles and Practice,   T. S. Rappaport,
3.   Mobile Communications   Schiller
4.   Principles of Wireless Networks: A Unified Approach   Pahalvan, K. and Krishnamurthy

CN 522TCP/IP NETWORKING

 IP: Internet Protocol-IP Address Space, IP header, IP Routing, Routing Principal, Routing tables , IP Fragmentation, Checksum, IP options. Subnetting, Subnet masks, Supernetting, CIDR Directly/indirectly connected machines, special IP addresses. Ethernet, framing, ARP, ARP Cache, ARP Packet Format, RARP, Serial Links, CRC , Bridges, Spanning Tree algorithm, ICMP- ICMP message type , ICMP address mask request and reply,ICMP time stamp request and reply, ICMP port unreachable error , ICMP source quench error message ,Ping program and Traceroute. UDP, UDP Header, UDP Checksum , determining the path MTU. Interaction between UDP and ARP , maximum UDP datagram size. TCP – TCP Services , Header, Flags, Connection Establishment and Termination, Timeout of Connection Establishment, Maximum Segment Size, TCP State Transition diagram , Segmentation . TCP -- acknowledgements, server/client transactions, ISN and sequence numbers. TCP data transfer -- sliding

windows, slow start, congestion avoidance, fast retransmit, fast recovery. TCP – Timeout and Retransmission, RTT measurements, RTO. DNS, DNS Basics, DNS Message Format .multicast and IGMP, FTP- Introduction, FTP Protocols, FTP Examples. SMTP- Introduction, SMTP Protocol, SMTP Examples. PPP, PPP options, HTTP

References
1. TCP/IP Ilustrated vol - I: The Protocols   W Richard Stevens
2. TCP/IP Ilustrated vol – III : TCP for Transaction, HTTP, NNTP, and the UNIX Domain
Protocols.   W Richard Stevens

CN523 NETWORK SECURITY

Introduction to computer and network security. Basic concepts, threat models, common security goals, Cryptography and cryptographic protocols, including encryption, authentication, message authentication codes, hash functions, one-way functions, public-key cryptography, secure channels, zero knowledge in practice, models and methods for security protocol analysis. Malicious code analysis and defense. Viruses, Worms, spyware, rootkits, botnets, etc. and defenses against them, Detecting Attackers. Software security. Secure software engineering, defensive programming, buffer overruns and other implementation flaws. Language-based security: analysis of code for security errors, safe languages, and sandboxing techniques. Operating system security. Memory protection, access control, authorization, authenticating users, enforcement of security, security evaluation, trusted devices, digital rights management. Network security. Network based attacks, Kerberos,X.509, firewalls, intrusion detection systems, DoS attacks and defense. Case studies: DNS, IPSec. Web security. Securing Internet Communication, XSS attacks and defenses, etc. Advanced topics. Security monitoring, surreptitious communication, data remanence, trusted devices, privacy and security of low-powered devices (RFID) electronic voting, quantum cryptography, penetration analysis, digital rights management and copy protection, security and the law.

CN524 COMMUNICATION ENGINEERING   LABORATORY

Simulation of steady state and Dynamic processes using ASPEN PLUS. Simulation of mass transfer processes using ANSYS. Solving linear and non-linear algebraic equations, matrix operations, differential equations, land parameter estimation by linear and non-linear regression methods and MATLAB

CN525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department electives

AC531/IS531/CN531 ADVANCED SOFTWARE ENGINEERING

Software Project Management, Metrics and measurement, Software Configuration management, Software risk management, Requirements Engineering, Software quality assurance, software reliability models.

Object oriented design, object oriented programming (with C++), Formal specifications, Formal verification of programs, Jackson method for design, CASE tools and technology, Clean room method for software development, Information system design, Real-time software specification and design.

Enterprise architectures, Zachman's Framework, Architectural styles, Design Patterns, Architecture Description Languages, Product-Line architectures, Component Based Development.

References:
1. An integrated approach to Software Engineering,   Pankaj Jalote.
2. Software Engineering: A Practitioner approach   Roger Pressman.
3. Software Architecture in Practice.   Len Bass, Paul Clements, Rick Katzman, Ken Bass
4. Software Engineering,   L. Pfleeger.

5.   Pattern Oriented Software Architecture, Volumes 1 & 2   Stal, Doughlas Schmidt

AC532/IS532/CN532 CAD OF DIGITAL SYSTEMS

Basic Mathematical Concepts, Introduction to design methodologies, Design automation tools, Algorithmic graph theory and computational complexities, Computational Approaches and methods for combinatorial optimization, Design of digital hardware and HDLs, Introduction to logic circuits, Implementation technologies, Verilog Programming concepts, Gate level modelling , Data flow modelling , Behavioural modelling, Combinational circuit design, Flip-flops, registers, counters and processor, Sequential circuits design, Tasks and functions, Timing and Delays ,Data Structure in VLSI design , Layout, placement and partition, floor planning, routing, Logic Synthesis, Model Optimization, Verification and Testing , Simple Microprocessor Design .

References
1. Algorithm for VLSI Design automation   Sabih H. Gerez
2. Fundamental of Digital Logic with Verilog Design,   Brown & Vranesic
3. Verilog HDL   Samir Palnitkar
4. Digital VLSI Design with Verilog,   John Williams

AC533/IS533/CN533 DISTRIBUTED COMPUTING

Introduction to Distributed System: Goals, Hardware concepts, Software concepts, and Client-Server model. Example of distributed systems. Communication: Layered protocols, Remote procedures call, Remote object invocation, Message-oriented communication, Stream-oriented communication. Inter process communication in UNIX/LINUX. Processes: Threads, Clients, Servers, Code Migration, Software agent.Naming: Naming entities, locating mobile entities, removing un-referenced entities. Synchronization: Clock synchronization, Logical clocks, Global state, Election algorithms, Mutual exclusion, Distributed transactions.

Consistency and Replication: Introduction, Data centric consistency models, Client centric consistency models, Distribution protocols, Consistency protocols. Fault Tolerance: Introduction, Process resilience, Reliable client server communication, Reliable group communication. Distributed commit, Recovery. Security: Introduction, Secure channels, Access control, Security management. Distributed File System: Sun network file system, CODA files system, Google File System.

References
1. . Distributed Systems: Principles and Paradigms.   Taunenbaum
2. Distributed Systems: Concepts and Design,

G. Coulouris, J. Dollimore, and T. Kindberg,

AC534/IS534/CN534 DIGITAL IMAGE PROCESSING

Introduction to Image Processing Systems, Digital Image Fundamentals:- Image model, Relationship between Pixels, Imaging geometry, Camera model. Image Sensing and Acquisition. Sampling and quantization. Image Enhancement and in spatial Domain: Point processing, Neighbourhood Processing, High pass filtering , High boost filtering, zooming. Image Enhancement based on Histogram medelling. Image Enhacement in frequency domain: 1D& 2D Fourier transform, Low pass frequency domain filter, High pass frequency domain filters, Homomorphics filtering. Image Segmentation:- Detection of discontinuation by point detection, line detection, edge detection. Edge linking and boundary detection:- Local analysis, global by graph, theoretic techniques. Thresh-holding. Morphology, Representation and description. Discrete image transform. Image Compression. Wavelet transformation.

References

1. Digital Image Processing   Gonzalez & Wood
2. Digital Image Processing   A.K.Jain
3. Image Processing   Dhananjay K. Techkedath.

AC535 /IS535/CN535 DATA MINING AND WAREHOUSING

Basic concept of Data ware house, OLAP and Data mining. OLTP vs. OLAP. Data Warehouse Design - Identifying facts & dimensions, designing fact tables, dimension tables, star flake schema query redirection. OLAP operations Data ware house architecture, Multidimensional schemes:- partitioning strategy, aggregation, data marting, metadata. Capacity planning, tuning the data warehouse testing the data warehouse: developing test plan, testing operational environment Distributed and virtual data warehouses. Data Mining: Basic concept, A statistical perspective on Data Mining-point estimation, models based on summarization, Bayes theorem, Hypothesis Testing, Classification issues, statistical-based algorithms, distance-based algorithms, decision tree-based algorithms and rule based algorithms. Clustering - similarity and distance measures, outliers' hierarchical algorithms, partition algorithms, clustering large databases. Association Rules, large item sets, Apriori algorithm, sampling algorithm, partitioning, parallel and distributed algorithms, data parallelism task parallelism. Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. Spatial Mining, Special data overview, Special data mining primitives, generation and specialization, spatial rules, spatial classification algorithms. Temporal Mining modelling temporal events, time series, pattern detection Sequences, temporal association rules. Privacy issues with respect to invasive use.

References
1. Building the data warehouse   W.H Inmon
2. Data mining concepts and techniques   Jimali Han and Micheline Kamber
3..Data Mining Introduction and Advance Topic,   Margaret H. Dunham and S. Sridhar

AC536/IS536/CN536 COMPUTER & NETWORK SECURITY

Introduction to computer and network security. Basic concepts, threat models, common security goals, security policies, security mechanisms, Attacks, security tools, Cryptography and cryptographic protocols, Secret Key Cryptography , public-key cryptography, authentication, message authentication codes, hash functions, one-way functions, Message Digests , Hash And Mac Algorithms, secure channels. Malicious code analysis and defense. access control, digital signature standards (DSS), Kerberos, IPsec,Electronic Mail Security, X.509, Firewalls and Web Security, trusted system, intrusion detection systems, DoS attacks and defense, Cyber crime .

References
1. Cryptography and Network Security: Principles and Practice   William Stallings

AC537 /IS537/CN537 EMBEDDED SYSTEMS

Introduction, Hardware & electronics fundamentals, Peripherals, Program Design and Analysis, Processes and Operating system, Real time Operating system   Memory, Interfacing, Examples of Embedded systems: Digital Camera Examples, Smart card application, Embedded database applications, etc State Machine and Concurrent Process Models, Control Systems Verilog programming, Programming of mobile and Hand-held devices. IC Technology Full-Custom (VLSI) IC Technology, Semi-Custom (ASIC) IC Technology, Programmable Logic Device (PLD) IC Technology, FPGA. Hardware Software Partitioning, Hardware/Software Co-Simulation, Intellectual Property Cores, Low Power design

References
1. Embedded system Design   Frank Vahid, Tony Givargis
2. Computer as Components   Wayne Wolf,
3. 8051 Microcontroller an Application Based introduction, Braithwaite Cowan,Parchizadeh

4. 8051 Microcontroller & Embedded Systems   Rajiv Kapadia
5. The 8051 Microcontroller & Embedded Systems   Mazidi & Mazida

AC538 /IS538/CN538 GRAPH THEORY AND NETWORK ALGORITHMS

Introduction to Graph Theory, Planar Graphs, Trees, Optimization and Matching, Connectivity of graphs, Graph colouring, Graph Algorithms, Network Flows.

References
1. Graph, Network and Algorithm   Dieter Jungnickel
2. Graph Theory with applications   J A Bondy and U S R Murty.

AC539/IS539/CN539 TECHNICAL FOUNDATION FOR E-COMMERCE

Introduction: Electronic commerce, technology and prospects, forces behind e-commerce, advantages and disadvantages, architectural framework, e-commerce strategy, e-commerce emerging issues and implementation issues, e-commerce law, government policies and agenda.

E-Commerce Infrastructure: Internet and Intranet based e-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN,FRAME RELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile information device, mobile computing applications , security issues in m-commerce. Electronic Payment System: Overview, electronic payment mechanisms and protocols, SET protocol, payment gateway, certificate, digital tokens, smart card, credit card, magnetic strip card, electronic money, electronic contracts, micro-payments, e-checks, e-cash Credit/Debit card based EPS, e-commerce payments security, online banking. electronic data interchange and its applications. Internet Advertising. Models of Internet advertising, sponsoring contents, corporate website, weaknesses in Internet advertising, web auctions and trading mechanism. Securing Business on Network. Security policies, procedures and practices, site security, firewalls, securing web service, transaction security, cryptology, cryptological algorithms, public key algorithms, authentication protocols, digital Signatures, virtual private network, security protocols for web commerce. Advanced Topics. Electronic commerce optimization algorithms, decision support systems for e-commerce, data mining for e-commerce, intelligent techniques for e-commerce.

AC541/IS541/CN541 INFORMATION THEORY AND CODING

Information and entropy information measures, Shannon's concept of information. Channel coding, channel mutual information capacity (BW) , theorem for discrete memory less channel, information capacity theorem , error detecting and error correcting codes,

Types of codes: block codes, hamming and Lee metrics, description of linear block codes , parity check codes ,cyclic code. Masking techniques.

Compression : loss less and lossy, Huffman codes, LZW algorithm, Binary image compression schemes, run length encoding, CCITT group 3 1-D compression, CCITT group 3 2D compression, CCITT group 4 2D Compression. Convolutional codes, sequential decoding. Video image compression: CITT H 261 Video coding algorithm, audio (speech) compression. Cryptography and cipher.

References
1. Information Theory, Coding and Crptography   R Bose
2. Multimedia system Design   Prabhat K Andleigh and Kiran Thakrar
3. Multimedia Communications   Fred Halsall

AC542/IS542/CN542 SIMULATION AND MODELLING

Introduction: Systems, modelling, general systems theory, Concept of simulation, Simulation as a decision making tool, types of simulation.

Random Numbers and Queuing Theory: Pseudo random numbers, methods of generating random variables, discrete and continuous distributions, testing of random numbers, Concepts of Queuing theory.

Design of Simulation Experiments :Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

Simulation Languages: Comparison and selection of simulation languages, study of these simulation language.

Case studies: Development of simulation models using simulation language studied for systems like queuing systems, Production systems, Inventory systems, maintenance and replacement systems and Investment analysis.

References

    1. System Simulation   Geoffrey Gordon

    2..System Simulation with Digital Computer   Narsingh Deo

AC543/IS543/CN543 RANDOMIZED ALGORITHMS

Introduction to randomized algorithms. Game Theoretic Techniques. Probabilistic Method, Markov Chains and Random Walks. Randomized Data Structures: Treaps, skip lists, Hash tables. Geometric algorithms and linear programming, Graph algorithms, Approximate Counting, Online Algorithms.

References

  1. Randomized Algorithm   Motwani and Raghavan

AC544/IS544/CN544 PARALLEL ALGORITHMS

Parallel algorithms: Introduction, Terminology, Pipelining & data parallelism, Control parallelism, scalability.

PRAM algorithms: Serial and Parallel computation; Processor arrays, Multiprocessors & Multi-computers, Flynn's taxonomy, Speedup Scaled Speedup and Parallelizability.

Parallel Programming Languages, Mapping & Scheduling;

Matrix Multiplication Algorithm: Sequential, Processor arrays, Multi-computers.

Fourier transform: Introduction, Discrete, Inverse discrete, Fast Fourier transform.

Sorting algorithms, Dictionary operation, Graph algorithm, Combinatorial Search

References

  1. Parallel computing   Michael J. Quinn.

  2. The Design of Parallel and Analysis Algorithms   Selim G. AkM.

AC545/IS545/CN545 WEB SEARCH AND INFORMATION RETRIEVAL

Information retrieval model, Information retrieval evaluation, Searching the web, Document Representation, Query languages and query operation, Metadata search, Indexing and searching, Scoring and ranking feature vectors, Ontology, domain specific search, Parallel and distributed information retrieval, Text and multimedia languages, Social networks

References:

  1. An introduction to Information Retrieval Manning,   C., Raghavan, P., and Schutze, H.

  2. Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman   Chakrabarti, S.

AC 546/IS546/CN546WIRELESS COMMUNICATION AND MOBILE COMPUTING

Introduction to wireless communication, and future trends, Wireless Generations and Standards, Wireless Physical Layer Concepts, fundamentals of antennas, Cellular Concept and Cellular System Fundamentals.Spread Spectrum Modulation Techniques, Coding and Error Control,

Multiple Access Technique for Wireless Communications, OFDM.Wireless LAN Technologies, Wireless IEEE Standards, Mobile Network Layer (Mobile IP). Mobile Transport Layer (Mobile TCP), Mobile Data network (GPRS), WAP Model and architecture, Introduction to Ad hoc networks, Sensor networks, Bluetooth networks and Wireless Mesh networks.

References

1. Wireless Communications and Networking　　　　　William Stallings
2. Wireless communication: Principles and Practice,　　T. S. Rappaport
3. Mobile Communications　　　　　　　　　　　　Schiller
4. Principles of Wireless Networks: A Unified Approach
　　　　　　　　　　　　　　　　　Pahalvan, K. and Krishnamurthy

AC547/IS547/CN547 DISTRIBUTED DATABASES

Introduction: Distributed Data processing, Distributed database system (DDBMSS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture

Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation.

Semantic Data Control: View Management, Data security, Semantic Integrity Control

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing

Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction

Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms.

Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management.

Database Interoperability: Database Integration, Query processing

References

1. Principles of Distributed Database Systems,　　　　M.Tamer Ozsu Patrick Valduriez
2. Distributed Databases principles and systems　　　StefanoCeri,Giuseppe Pelagatti,

AC548/IS548/CN548 NATURAL LANGUAGE PROCESSING

Regular Expressions and Automata, N-grams, Part-of-Speech Tagging, Hidden Markov and Maximum Entropy Models, Formal Grammars of English, Syntactic Parsing, Statistical Parsing, Features and Unification, Language and Complexity, The Representation of Meaning, Computational Semantics, Computational Lexical Semantics, Information Extraction, Question Answering and Summarization, Machine Translation

References

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition　　　D. Jurafsky and J. Martin
2. Foundations of Statistical Natural Language Processing　Manning and H. Schutze

19.0 EPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

xx) DIGITAL COMMUNICATION(M.Tech)
First Semester
DC511 SATELLITE COMMUNICATION

Introduction, History of Satellites, Kepler's law, Elements of orbital mechanics.Equations of motion. Tracking and orbit determination. Orbital correction/control. Satellite launch systems. Geostationary Satellites, Satellite System, Parameters, Elements of communication satellite design. Spacecraft subsystems. Reliability considerations. Spacecraft integration.

Multiple access techniques. FDMA,TDMA,CDMA. Random access techniques. Satellite onboard processing. Satellite link design: Performance requirements and standards. Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite - based personal communication.

Earth station design. Configiration. Antenna and tracking systems. Satellite broadcasting.

References:
1. Satellite Communication   D.Roddy
2. Satellite Communication   T.Pratt & C.W.Bostain,
3. Design of Geosynchrons Spacecraft,   B.N.Agrawal,

DC-512 ADVANCED DIGITAL COMMUNICATION

Digital Modulation Schemes. Information measures. Source coding. Channel Coding Theorems, ISI & channel equalization, partial response signalling. M-ary modulation systems, error probability calculations. Digital Transmission over Bandlimited Channels. Spread spectrum systems.

References:
1. Communication. Systems   A B Carlson,
2. Modern Digital & Analog Communication .   B P Lathi

DC513 OPTICAL COMMUNICATION

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model. Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Design of Advance fibers, measurement techniques like OTDR.

Optical sources - LEDs and Lasers, Photo-detectors - pin-detectors, detector responsivity, noise, optical receivers. Optical link design – Rise Time and Power budget analysis BER calculation, quantum limit. Optical switches - coupled mode analysis of directional couplers, electro-optic switches.

Nonlinear effects in fiber optic links,group velocity dispersion . Optical amplifiers - EDFA, Raman amplifier, and WDM systems, Optical Networks

References :
1. JFibre Optic communication   Keiser
2. Nonlinear fibre optics   G.Agrawal,

DC514 CAD LABORATORY

Moedlling and Simulation of VLSI and embeded systems

DC515 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication

Second Semester
DC521 D.S. P. & its Applications

Discrete Time Signals,Discrete systems: attributes, Z-Transform, Analysis   of   LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Implementation of Discrete Time Systems. Design of FIR & IIR Digital filters.

Parametric and non-parametric spectral estimation. Introduction to multirate signal processing. Application of DSP to Speech and Radar signal processing.

References:
1. Discrete – Time signal processing   A.V Opprenheim and R.W Schaffer
2. Digital Signal Processing using MATLAB   S. Mitra "
3. Int. to Digital Signal Processing   Proakis,

DC522 INFORMATION THEORY & CODING

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.Adaptive Huffman Coding, Arithmetic Coding, 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, Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding.

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

DC523 DIGITAL IMAGE PROCESSING

Digital Image Fundamentals, Image Enhancement, Image denoising, Image segmentation, Image Compression, Digital water marking, object recognition, medical image processing, face recognition, fingerprint recognition, signature recognition, iris recognition, image fusion.

References:
1. Digital Image Processing by Gonzalez and Woods, 2nd edition Prentice Hall.
2. Introduction to Biometrics by **Jain**, Anil K., **Ross**, Arun A., **Nandakumar**, Karthik springer publication

DC524 MODELLING AND SIMULATION LABORATORY

Moedlling and Simulation of digital communication systems

DC525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication

Departmental Electives

DC531 MOBILE COMMUNICATION

History and evolution of mobile radio systems, Types of mobile wireless services/systems Cellular, WLL, Paging, Satellite systems, Standards, Future trends in personal wireless systems, Cellular concept and frequency reuse, Multiple Access Schemes, channel assignment and handoff, Interference and system capacity, Trunking and Erlang capacity calculations, Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading and Base band impulse respond models, parameters of mobile multipath channels, Antenna systems in mobile radio, Analog and digital modulation techniques, Performance of various modulation techniques-Spectral efficiency, Error-rate, Power Amplification, Equalizing Rake receiver concepts, Diversity and space-time processing, Speech coding and channel coding, Multiple Access Techniques-FDMA,TDMA and CDMA systems, operational systems, Wireless networking, design issues in personal wireless systems.

References
1. Wireless digital communications   K. Feher,
2. Wireless digital communications: Principles and practice,   T. S. Rappaport,.
3. Mobile communications Engineering: Theory and Applications, W. C. Y. Lee,

DC532 MICROWAVE COMMUNICATION

Microwave radio system: Transmitter & receivers block allergen , FM microwave repeater, protection scything microwave terminal station, repeater station. Microwave links: Block deign path characteristics, system gain, free space path logs E/N ratio. Microwave digital communication block diagram, regeneration repeater, digital modulation & demodulation at microwave frequencies analog & digital multiplying, line codes. Local microwave distribution system. Propagation of microwave : line of sight, duet propagation as Troposcatter links.

References
1. Advance Electronic Comm System.   W Tomasi
2. Electronic Comm. Systems   Roy Blake Thomsar
3. Electronic Comm.   Kemealy & Dakis

DC-533 VLSI DESIGN

Introduction to MOS Technology,Basic Electrical properties of MOS,Scaling of MOS circuits,Circuit Characterization and Performance Estimation ,Advanced Techniques in CMOS Logic Circuits,CMOS Design Methods,CMOS Testing

References
1. Principles of CMOS VLSI design   Nei l H.E. Weste &Kamraneharghian
2. CMOS Circuit design   Jacob baker, Harry wili & David Boyce.

DC-534 STATISTICAL SIGNAL ANALYSIS

Statistical characterization and analysis of signals, ideas of estimation, optimal linear filtering, geometric ideas, autocorrelation matrices and their properties, eigenanalysis,linear prediction, KL-expansion, factorization of autocorrelation matrices, Kalman filtering, least-squares filtering, adaptive filtering theory, LMS, RLS, and other algorithms, Singular Value Decomposition, SVD, fundamentals of array signal processing.

References
1. Fundamentals of Statistical Signal Processing   Kay, Steven M.
2. Digital Processing of Random Signals: Theory and Methods   Boaz Porat

DC-535 QUEUING THEORY

Queuing Models: Data Traffic Characteristic: Poisson process; Birth-Death Processes: Markov Chain Models; M/M/1Queues: Delay and Little's Formula; M/M/S/K Queues: Average Queue Length, Delay and Waiting Time, Blocking Probability; M/G/1 Queues- Imbedded Markov Chains, Pollaczek-Kinchin Transform Formula, Delay Formula Using Residual Service Time,Network of Queues and Jackson's Theorem.

Queuing Theory: Introduction, Queuing system, Elements of a Queuing System, Operating Characteristics of Queuing system, Probability distributions in Queuing system, Probability distributions in Queuing systems, Distribution of arrivals, Distribution of Inter – arrival times, Distribution of Departures, Distribution of Service Times, classification of Queuing Models, Definition of transient and steady states, Poisson Queuing systems.

References
1. Probability & Statistics with Reliability, Queuing, and   Computer Science Applications,
                                                 Kishor S. Trivedi,
2. Fundamentals of Queueing Theory,   Donald Gross , Carl M. Harris

DC-536 DETECTION & ESTIMATION THEORY

Review of random variables and random processes, response of linear systems to random inputs, special class of random processes; signal detection, minimum mean square error filtering, estimation of parameters of random process.

References
1. Detection Theory   Ralph D. Hippenstiel
2. Detection Estimation and Modulation Theory-Part-II,   H.L. Van Tree,
3. Random Signals: Detection,   Estimation and Data Analysis,
                                K. Sam Shanmugham and Arthur M. Breipohl,

DC537 MODERN TELECOM SWITCHING SYSTEMS

Electronic space Division switching- Stored program control (SPC), switching matrices, multistage switching, enhance services photonic switching. Time Division switching: - Time division space, and time switching, multiplexed switching, combination switching, T-S, T-S-T, switching n-stage combination switching, PBX switching, PBX networking, digital PBX. Traffic load, Grade of service, Erlang formulas, blocking modeling switching systems, blocking model. Subscriber Loop, Dialing Systems - Switching hierarchy & routing, Transmission plan, numbering plan, charging plan, signaling technique. Digital subscriber lines, DSL, ADSL etc, WLL, FIL, wireless for local telephone services. Integrated services digital network.

References
1. Telecomm. Switching systems & networks   Thaigrajan PHI
2. Comm. System   Taub & Schilling,
3. Telecomm. & the Computers   James Martin PHI

DC-538 DATA COMPRESSION & CRYPTOGRAPHY

Compression Techniques: Loss less compression, Lossy Compression, Measures of prefonnance, Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes. Introduction to security attacks, services and mechanism, Classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, steganography, Stream and block ciphers.

References
1. Introduction to Data Compression   Khalid Sayood,
2. Cryptography and Network Security: Principals and Practice   William Stallings

DC539 OPTICAL NETWORK

Interconnection networks; Networks: Introduction to computer data networks, ISO-OSI models, SDH, SONET; Fiber-optic LAN architectures and protocols- ring, star and bus architectures, DQDB, FDDI; High speed bus protocols-, WDM Network design - Lightpath Topology, All Optical Networks.

References:
1. High Sped Networks & Internet   William Stalling,
2. Optical Networks   Rajiv Ramaswamy and Kumar N. Sivarajan,

DC541 NEURAL NETWORKS

Introduction of artificial neural networks, fundamental models of artificial neurons, artificial neural network architectures, feed forward and feedback neural networks, neural networks learning methods, radial basis function networks, Hopfield network, self organizing map (SOM), application of neural networks.

References
1. Neural Networks: A Comprehensive Foundation   Simon Haykin,
2. Fundamentals of Artificial Neural Networks,   Mohamad H. Hassoun,
3. Neural Networks: A class room approach,   Satish Kumar.

DC541 FUZZY LOGIC

Fuzzy sets - basic definitions and extensions, Measure of fuzzyness, The extension principle and applications, Fuzzy relations and Fuzzy graphs, Fuzzy analysis, Possibility theory, Fuzzy numbers, Fuzzy positioning, Fuzzy grammars and Automata. Applications - Fuzzy approximate reasoning & Expert systems, Fuzzy control, pattern recognition, Decision making in Fuzzy environment, Fuzzy scene analysis, Fuzzy linear and goal programming.

References
1. Fuzzy Logic with Engineering Applications,   T. Ross,
2. Fuzzy Sets and Fuzzy Logic: Theory and Applications,   George J. Klir and B. Yuan,
3. . Introduction to Fuzzy Sets and Fuzzy Logic,   M. Ganesh

DC542 ACTIVE RF DEVICES AND CIRCUITS
IC Technology Review for RF Applications, Complex Modulation; Receiver Architectures, Amp Design for Power Gain, High Frequency BJT and MOS Distortion, Fundamental of Mixers; Active Current Commutating Mixers, Discrete Time Transceiver Architectures, Quadrature VCOs.
References
1. Analysis and Design of Integrated Circuits,
                    Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer
2. The design of CMOS radio-frequency integrated circuits,   Thomas H. Lee
3. RF microelectronics,   Behzad Razavi.

xxi)   VLSI & EMBEDDED SYSTEM DESIGN(M.tech)

First Semester
VED-511 VLSI TECHNOLOGY
Environment for VLSI Technology: Impurity incorporation: Solid State diffusion modelling and technology; Ion Implantation modelling, technology and damage annealing; Oxidation: Oxidation technologies in VLSI and ULSI
Lithography: Photolithography, E-beam lithography and latest lithography techniques for VLSI/ULSI. Chemical Vapour Deposition techniques, Epitaxial growth of silicon; modelling and technology. Evaporation and sputtering techniques Metal film deposition,Multi- level metallization schemes. Etching, annealing, growth and deposition in ULSI. Process integration for NMOS, CMOS and Bipolar circuits; Advanced MOS technologies.
References:
1. ULSI Technology,   C.Y. Chang and S.M.Sze,
2 VLSI Fabrication Principles.   S.K. Ghandhi,.
3 VLSI Technology   S.M. Sze,
VED-512 VLSI DESIGN
Introduction to MOS Technology,Basic Electrical properties of MOS,Scaling of MOS circuits,Circuit Characterization and Performance Estimation ,
Advanced Techniques in CMOS Logic Circuits,CMOS Design Methods
CMOS Testing
References
1. Principles of CMOS VLSI design   Nei l H.E. .
2. CMOS Circuit design   Jacob baker, Harry wili & David Boyce
VED513 EMBEDDED SYSTEMS
Introduction to embedded systems, their characteristics, Hardware and Software Architectures, Standard peripherals, Common Interfacing techniques and protocols, Specification models and languages, Design Automation
References
1. Frank Vahid , Tony Givargis "Embedded System Design: A unified Hardware / Software Introduction", Publisher: Wiley-India ,July 2006,
2. David D Gajski, Frank Vahid, Sanjiv Narayan , Jie Gong, "Specification and design of Embedded Systems" , Publisher: Prentice Hall Inc . 1994.
3. Heath Steve. "Embedded System Design". Publisher: Newnes 1997.
Second Semester
VED521 LOW POWER VLSI DESIGN
Sources of power consumption, Physics of power dissipation in CMOS FET Devices. Principles of low power design and its limits. Power estimation in combinational and sequential circuits, power sensitivity analysis. Techniques for low power design. Power estimation at circuit level. Logic level and circuit level optimization for low power, Low voltage design techniques, low power static RAM architecture, software design for low power, Case studies.

References
1. Practical Low Power Digital VLSI Design   Gary Yeap
2. Sharat Prasad, "Low Power CMOS VLSI Circuit Design   Kaushik Roy,

VED522 VLSI SIGNAL PROCESSING

Introduction to DSP systems, Iteration Bound, Pipelined and parallel processing, Retiming, unfolding, algorithmic strength reduction in filters and transforms, Systolic architecture design, fast convolution, pipelined and parallel recursive and adaptive filters, Scaling and round off noise, digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic, Numerical strength reduction, synchronous, wave and asynchronous pipe lines, low power design. Programmable digit signal processors.

References
1. VLSI Digital signal processing systems, design and implementaion,   Keshab K. Parthi,
2. Analog VLSI signal and information processing,   Mohammad Isamail and Terri Fiez,
3. VLSI and Modern Signal Processing,   S.Y. Kung, H.J. White House, T. Kailath

VED523 TESTING OF VLSI CIRCUITS

VLSI testing process, fault modeling, logic and fault simulation, testability Measures, combinational circuit test generation, sequential circuit test generation. Testing memory, analog and mixed signal testing, delay and IDDQ test.

References:
1. "Essentials of Electronic Testing for digital memory and mixed signal VLSI circuit

                                             Viswani D. Agraval, Michael L. Bushnell
2. Design-For-Test For Digital IC's and Embedded Core Systems   Alfred L. Crouch,

Departmental Electives

VED531 DIGITAL SYSTEM DESIGN

Review of sequential circuits, Mealy & Moore Models, Analysis & Synthesis of Synchronous sequential circuits,Digital system design Hierarchy, ASM charts, Reduction of state tables, State Assignments,Analysis and synthesis of Asynchronous sequential circuits, critical and non-critical races, Essential Hazard,Digital system design implementation options: ASICs – Full custom, gate array based, standard cell based and Programmable ASICs, Antifuse, SRAM, EEPROM/EPROM Technologies for Programmable ASICs.

Combinational and sequential circuit design with PLD's , Introduction to CPLD's & FPGA's, Digital system modeling: Behavioral, structural and physical domains,Fault Modeling.

References:
   1.Digital principles and design   Donald D.Givone
   2. Digital Design   Morris Mano

VED532 MIXED SIGNAL DESIGN

Signals, filters and tools, sampling, aliasing, analog and digital filters, Data converters – SNR, Noise shaping, Bandpass data converters, high speed data converters, RF IC design issues

References:
1. CMOS: Mixed-Signal Circuit Design,   R. Jacob Baker
2. The Design of CMOS Radio-Frequency Integrated Circuits,   Thomas H.   Lee

VED533 MEMS

MEMS system-level design methodology, Equivalent Circuit representation of MEMS, signal-conditioning circuits, sensors based devices; Micro-machining technology, signal processing applications; Modeling and simulation of Micro-sensors and actuators; sensors and smart structures; micro-opto-electromechanical sensors.

References:
   1. Micromachined Transducers Sourecbook   Gregory T.A. Kovacs,
   2. an Introduction to Microelectromechanical Systems   Nadim Maluf,

VED534 DESIGN OF SEMICONDUCTOR MEMORIES

Random Access Memory Technologies, silicon on insulator (SOI) technology advanced SRAM architectures and technologies, application specific SRAMs, Dynamic Random Access Memories (DRAMs), Advanced DRAM designs and architecture – application specific DRAMs. Nonvolatile Memories, Memory fault modeling, testing and memory design for Testability and fault tolerance, Semiconductor memory reliability and radiation effects, Advanced memory technologies and high-density memory packaging technologies.

References
1. Semiconductor Memories Technology, testing and reliability   Ashok K.Sharma
2. Semicoductor memory design and application,   Gerald Luecke
3. Advanced Semiconductor Memories: Architectures, Designs, and Applications, Ashok K. Sharma

VED535 ACTIVE FILTER DESIGN

Butterworth, Chebyshev & Inverse-Chebyshev filter response and pole locations; LC ladder filter – prototype & synthesis; Frequency transformation of lowpass filter. Impedance converters; Gm-C filters – Gm-C biquad, Q-enhancement, Automatic Tuning; Active-RC filters – Comparison with Gm-C filter, Issues in realizing high frequency active-RC filters; Characterization of on-chip integrated continuous time filters.

References
1. Design of Analog Filters   R. Schaumann and M.E. Van Valkenburg,
2. Current-Mode VLSI Analog Filters - Design and Applications,   P. V. Ananda Mohan,
3. , Analog Filter Design   M.E. Van Valkenburg

VED536 PHYSICAL DESIGN AUTOMATION

Introduction to VLSI Physical Design Automation. Standard cell, Performance issues in circuit layout, delay models Layout styles. Discrete methods in global placement. Timing-driven placement. Global Routing Via Minimization. Over the Cell Routing - Single layer and two-layer routing, Clock and Power Routing. Compaction, algorithms, Physical Design Automation of FPGAs.

References
1. Algorithms for VLSI Physical Design Automation   Naveed Sherwani,
2. Algorithms for VLSI Design Automation   Sabih H. Gerez,

VED537 ASIC DESIGN

Introduction to ASICs, CMOS logic cells, ASIC Library Design, Gate Design Programmable ASICs, Programmable ASIC I/O cells, Programmable ASIC Interconnect, Delay, ASIC Construction.

References:
1. Michael John Sebastin Smith, - "Application - Specific Integrated Circuits"   Pearson Education.
2. Malcolm R.Haskard; Lan. C. May, "Analog VLSI Design - NMOS and CMOS" Prentice Hall.
3. Andrew Brown, - "VLSI Circuits and Systems in Silicon", McGraw Hill.

VED538 CO-DESIGN OF LARGE SYSTEMS

Introduction to System Level Design, elements of a generic synthesis system, design representations and abstraction levels, models and architectures, specification languages, specification translation, System partitioning – partitioning algorithms, functional partitioning, hardware/software partitioning algorithms, Design quality estimation – Various quality metrics, hardware estimation, software estimation., Specification refinement – refining variable grouping, channel refinement, resolving access conflict, refining incompatible interfaces, refining hardware/software interfaces.

References
1. Computers as Components   Wayne Wolf
2. Embedded Systems – Architecture, Programming and Design   Raj Kamal.
3. Embedded System Design   Heath Steve

VED 539 DESIGN OF ANALOG IC

MOSFET Device Models, BJT Device Models, Single-Stage Amplifier, Differential Amplifiers, OP-AMP Design, Frequency Response, Stability and Compensation, Analog subcircuits, Data Converter Fundamentals & Archi tecture, voltage controlled oscillators, Ring oscillators, Phase locked loops.

References
1. Design of Analog CMOS Integrated Circuits   Behzad Razavi,
2. Analysis and Design of Analog Integrated Circuit
   Paul R. Gray, Paul J.   Hurst, Stephen H. Lewis, and Robert G. Meyer, .
3. Analog Design Essentials   Willy Sansen,

VED541 DESIGN FOR TESTABILITY
DFT fundamentals, DFT and Scan design, Built-in self-test, Memory BIST, Boundary scan standards, Analog Test Bus, System test methods, core based design.

References
1. Essentials of Electronic Testing for digital memory and mixed signal VLSI circuit
   Viswani D. Agraval, Michael L. Bushnell
2. Design-For-Test For Digital IC's and Embedded Core Systems Alfred L. Crouch

VED542 ADVANCED SIGNAL &IMAGE PROCESSING
Review of linear algebra; functional analysis, time-frequency representation; frequency scale and resolution; uncertainity principle, short-time Fourier transform, Multi-resolution concept and analysis, Wavelet transforms. Wigner-ville distributions. Multirate signal processing; discrete-time bases and filter banks; 2D signals and systems, 2D sampling in arbitrary lattices, 2D-linear transforms, 1D/2D signal compression; introduction to DSP architecture, monochrome & colour vision models, colour representation ; image sampling & quantization; 2-D systems; image transforms; image coding; stochastic models for image representation; image enhancement, restoration & reconstruction. Image analysis using multiresolution techniques

References
1. Advanced Signal Processing Handbook: Theory and Implementation   for   Radar, Sonar andMedical Imaging Real Time Systems,   StergiosStergiopoulos
2. DigitalImage Processing Using MATLAB   Rafael C. Gonzalez, Richard E

VED543 DEVICE MODELING AND SIMULATION
Band theory of solids, carrier transport mechanism, P-N junction diode, MOS Capacitor Theory, C-V characteristics, MOSFET operation, Types of compact models, Input Voltage Equation, Charge Linearization, Charge Modeling, Concept of Core Model, Quasi-static and Non-quasi-static Model, Introduction to Verilog-A, Brief overview of EKV and PSP

References:
1. Compact Mosfet Models for VLSI Design,   A. B. Bhattacharyya
2. CMOS / BiCMOS CLSI Low Voltage Power   Kiat Seng Yeo, Samir S.Rofail, Wang-Ling Gob

20.0 DEPARTMENT OF MATHEMATICS
xxii)BIOINFORMATICS
BI511 – BIOINFORMATICS COMPUTING
Introduction, chronological history of Bioinformatics, evolution of Bioinformatics, Objectives of Bioinformatics, Importance of bioinformatics, Bioinformatics in business, future scope of Bioinformatics. Bioinformatician and bioinformaticist, role, need and importance of Biology, Computer Science, mathematics and information technology in bioinformatics, biological classification and nomenclature, life in space and time.

Introduction, information networks, protein and genome information resources, DNA sequence analysis, pairwise alignment techniques, multiple alignment techniques, secondary databases, analysis packages.

The dawn of sequencing, the biological sequence or structure deficit, human genome project and its status, homology and analogy, web browsers, European molecular biology network, national centre for biotechnological information, specialized genomic resources.

Building a sequence search protocol, practical approach for structural and functional interpretation, introduction to analysis package, commercial databases, softwares and comprehensive packages, internet packages specializing in DNA and protein analysis.

References
1. Introduction to Bioinformatics   T.K. Attwood and Parry Smith
2. Introduction to Bioinformatics   Arthur M. Lesk
3. Fundamental Concepts in Bioinformatics   Krane and Raymer

BI512 BIOLOGICAL DATABASES AND THEIR MANAGEMENT

Introduction to database: Data Abstraction, Data `Models, Basic concepts of database: Data Independence DML, DCL, DDL and structure of Data Base Management System, Entity relationship diagram: Basic and Advance concepts Application of ER diagram in designing database system. Relational Algebra, Tuple Relational Calculus

Database design issues, Normalization 1NF, 2NF, 3NF, 4NF, BCNF and 5NF, database design problem. Security   and   Integrity: Use of SQL for specifying Security and integrity. Authorization, view, Encryption. Storage structure indexing and hashing. Different type of file organization.

Transaction & concurrency control, Schedules, testing, serializability, Lock based Protocol, Time stamp protocol, validation technique, Multiple granularity, Multi-version scheme Insert and delete operation, Crash recovery, Log based recovery, buffer management checkpoints, shadow paging. Object oriented databases.

Distributed database structure, Design transparency and Autonomy, Distributed Query processing Recovery, commit protocol Deadlock handling, Multidatabase system, Parallel database concept and related issues, Web interface to database, Database System Architecture

Introduction to biological databases, Nucleic acid sequence data banks: Genbank, EMBL, DDBJ, TrEMBL, GenPept, nucleotide sequence databank, cDNA databanks, AIDS Virus sequence data bank, rRNA data bank, Protein sequence data banks: NBRF-PIR, SWISSPROT, Signal peptide data bank etc.

References

1.   Database System Concept   C.J. Date.
2.   Database System   Aho. Ullman.
3.   Database Systems   Rob, Coronel.

BI513 - BIOMATHEMATICS

Growth and Decay Models in Biological; Population in Natural and Laboratory Environments. Intoxicants and Nutrients. Stability Analysis Interacting Population with Predation; Basic Models and Their solutions.

Epidemic Models; Deterministic models with and without Removal, General Deterministic Models with removal and Immigration. Control of an Epidemic, Stochastic Epidemic Model without removal.

Models in Genetics; Basic models for Inheritance, Further Discussion of Basic Model for Inheritance of Genetic Characteristics, Models for Genetic Improvement: Selection and Mutation, Models for Genetic Inbreeding

Pharmaco-Kinetics, Compartmental Models in terms of System of   Differential   Equations.   Bio-diffusion. Diffusion of Drugs. Trans-Capillary Exchange. Oxygenation and Deoxygenating of Blood. Cardio Vascular Flow Patterns. Temperature regulation in Human Subjects.

      Curve Fitting and Biological Modeling; Fitting curves to Data, The Method of Least Squares, Polynomial curve Fitting.

References
1.   Mathematical Biology   J. D. Murray
2.   Mathematical Models in Biology and Medicine.   J. N. Kapur
3.   Mathematical Models in Biology; An Introduction.
                                                Elizabeth S. Allman and John A. Rhodes
4.   Linear Models in Biology (Pharmacy):   Cullen
5.   Bio-Fluid Mechanics: F. C. Fung
6.

BI514 COMPUTATIONAL   LABORATORY 1
Moedlling and Simulation and sythesis
BI515 SEMINAR
Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication

Second semester
BI521 DATA MINING AND DATA WAREHOUSING IN BIOINFORMATICS
Need for data warehouse, definition, goals of data warehouse, Data Mart, Data warehouse architecture, extract and load process, clean and transform data, star, snowflake and galaxy schemas for multidimensional databases, fact and dimension data, Designing fact tables. partitioning, partitioning strategy – horizontal partitioning, vertical partitioning,
Data warehouse and OLAP technology, multidimensional data models and different OLAP operations, OLAP Server: ROLAP, MOLAP and HOLAP. Data warehouse implementation, efficient computation of data cubes, processing of OLAP queries, indexing OLAP data.
Data preprocessing, data integration and transformation, data reduction, Discretization and concept Hierarchy Generation, Data mining primitives, Types of Data Mining, Data Mining query language, Architectures of data mining. data generation & Summarization based characterization, Analytical characterization, Mining class comparisons, Mining descriptive statistical measures in large data bases.
Mining Association Rules in large databases: Association rule mining, single dimensional Bookan association rules from Transactional DBS, Multi level association rules from transaction DBS, multidimensional association rules from relational DBS and DWS, Correlation analysis, Constraint based association mining.
Classification and Prediction : Classification by decision tree induction, Back propagation, Bayesian classification, classification based in association rules, Prediction, classifier accuracy, Cluster analysis, partitioning and hierarchical methods, Denrity based methods Grid based methods, web mining, Temporal and spatial data mining.
References
1.   Building Data Ware House   W.H.Inmon,
2.   Data warehousing   S . Anahory and D.Murray
3.   Data Mining Concepts & Techniques   Jiawei Han & Micheline Kamber
4.   TMH Oracle 8i Building Data Ware Housing
                                           Michall Corey, M.Abbey, I Azramson & Ben Taub.
BI-522 - BIOMODELLING AND SIMULATION
System Models : Concept, environment, stochastic activities, continuous and discrete simulation, Model Type- static, dynamic and probabilistic models. Growth and Decay model examples. Principles of Mathematical modeling, static physical model, system modelling.
Continuous systems models, differential equations, analog computers, analog methods, hybrid computer, analog simulations, continuous system simulation, languases, CSMP III hybrid simulation, feedback system, simulation of an interactive system, real time simulation.
Discrete system simulation, probability concepts in simulation, random number generations and their testing, stochastic variable generation, fixed time stop versus event to event model.
Simulation of queuing systems, arrival pattern, Poisson arrival pattern, exponential distributions, hyper-exponential distribution, service times, simulation of a single-server queue, normal distribution, measures of queues.

Simulation languages, continuous and discrete simulation languages, block-structured continuous simulation languages, GPSS, SIMSCRIPT, SIMULA, factor in selection of a discrete simulation language.

References

1. Simulation and Modeling   Gordan
2. System simulation and modelling   Narsingh Dev - PHI

BI-523 OPTIMIZATION TECHNIQUES AND GRAPH THEORY

Linear Programming, Mathematical Model, Assumptions of Linear Programming, simplex Method, Degeneracy, Applications, Duality, Dual Simplex Method, & Algorithm   Assignment Problem. Hungarian Method & its Algorithm.

Transportation Problem, Integer Programming: - Gomorra's method, Branch and Bound techniques. Integer Programming Algorithm, Dynamic Programming:- Bellman's Principle of optimality, Dynamic Programming Approach, optimal subdivision problem, Decomposition, Applications in linear programming.DPP Algorithms.

Queuing Theory : Queuing problem and system, Transient and steady state distributions in queuing system, Poisson process, Exponential process, classification of queuing models, Model I (M/M/1) : (∞/FCFS), Model -II General Erlang Queuing model, Model - III (M/M/1) : (N/FCFS), Model - IV (M/M/S) : (∞/FCFS), Algorithms.

Inventory Theory :- Basic concepts, classification of Inventory systems & models, Economic order quantity, Deterministic Inventory models :- EoQ Models without shortages, EoQ Models with shortages, Probabilistic Inventory Models with instantaneous demand, no set up cost model, Discrete and continuous cases.

Games Theory : solution of games with saddle points, Minimax-Maxmin principle for Mixed strategy games, Dominance, to reduce size of game, Graphical method, solution of (mxn) game by simplex method & Algorithms, Job sequencing : Processing n jobs through 2 machines, Processing n jobs through 3 machines & Algorithms, PERT – CPM: introduction, applications, network diagram representation, Determination of the critical

path, updating.

References

1. Operations Research   S.D. Sharma,
2. Operations Research   P.K.Gupta & D.S.Hira
3. Operations Research,   Kantiswaroop

BI524 COMPUTATIONAL LABORATORY 2

Moedlling and Simulation and systhesis

BI525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication

xxiii) COMPUTATIONAL AND SYSTEM BIO-INFORMATICS
CSB511FOUNDATION OF COMPUTATIONAL & SYSTEMS BIOLOGY

Introduction to Computational Biology & Systems Biology, Biology in time and space. Models and Modeling: purpose, adequateness, advantage of computational modeling, basic notion for computational models, model scope, statements, system state, variables parameters constants, behavior, classificatiom, steady states. Fundamentals of Nucleic acid and protein sequence analysis. Analysis of complex biological systems Sequencing (DNA & amino acid) and Micro array. Protein structure analysis. Genome assembly

Tools and Databases Computational gene hunting (gene predication -HMM) Alignment of bio-molecular sequences (Local, Global, DP, Blast, multiple) their principles and methods. Motif finding. structural

modeling and structure prediction Network modeling. Genomic regulation Protein folding Genetic variation RNA world Systems Biology (gene, protein and membrane machine)--Human and Pathogens--Cancer genomics (Tumor complexity)--Gene regulatory network Codon optimization Algorithmic Drug designs. Current and emerging areas in the field of computational and systems biology

References

1. Systems Biology: A Textbook by Edda Klipp, Wolfram Liebermeister, Wiley BlackWell
2. Pavel A. Pevzner, Computational Molecular Biology, An Algorithmic Approach, The MIT press, 2001
3. Neil C. Jones and Pavel A. Pevzner, An Introduction to Bioinformatics Algorithms, Indian reprint by Ane Books, 2005

Nello Cristianini and Matthew W. Hahn, Introduction to Computational Genomics: A Case Studies Approach, 2007, Cambridge

CSB512 APPLIED BIOINFORMATICS

Overview of Bioinformatics. Data Acquisition, Database Content, Database Structure and Annotation: Biological Data Mining: Introduction to Nucleic Acid and Protein Sequence DataBanks: Database Searching by Similarity: Pair wise sequence alignment: Advance Similarity and Multiple sequence alignments**:**Patterns, Motifs and Profiles in sequences:

Introduction to Phylogenetics: Introduction to Structural Bioinformatics: Introduction to following:Hidden Markov Model (HMM) & its Application. Microbial Genomics, Metabolic Flux Analysis.

References

1. Introduction to Bioinformatics   T. K. Attawood & D.J. Parry-smith
2. Bioinformatics   Arthur Lesk.
3. Instant notes in Bioinformatics   S. Sundara rajan & R. Balaji

CSB513 MATHEMATICAL & COMPUTATIONAL BIOLOGY

Introduction to Mathematical Modelling and concepts, Modeling process, probabilities and rates, model classes. Discrete Time Models: Scalar Discrete-Time models, Systems of Discrete-Time Equation. Ordinary Differential Equation: Introduction, Scalar equation, systems of equation (reaction kinetics, interaction model for two population, epidemic model, nondimensionalization), Qualitative analysis of 2X2 systems, general system of three or more equation, discrete time model from continuous time model, elementary bifurcations. Partial Differential Equations: Partial Derivative, age structured model, reaction diffusion equation. Stochastic Models: introduction, markov chains, random variables, diffusion process, branching process, linear birth and death process. Cellular Automata and Related Models: Wolframs Classification, theoretical results, Greenberg-Hastings Automata, Generalized cellular automata. Estimating Parameters: Likelihood function, stochastic models without measurement error, deterministic models, Model comparison (Akaike information criterion, likelihood ratio test for nested models, cross validation), Optimization algorithm (algorithms, positivity). Maple Course: constant, functions, data sets, linear regression, discrete dynamical systems (ricker model, procedures in maple, feigenbaun diagram and bifurcation analysis), stochastic models with maple, ODEs (application to epidemic model), PDEs (age structured model), stochastic model (common cold in household) Development of Dynamic System, analytical tools. Initial value problems, boundary value problems and calculus of variations. Mathematics of chemical reaction network. Finite difference methods for parabolic equations in 1D – explicit methods and implicit methods. Von Neumann stability Analysis. Solution of tridiagonal systems Finite difference methods for parabolic equations in 2D.

References

1. A course in Mathematical Biology: Quantitative Modeling with mathematical and Computational
            Gerda, Thomas, Mark, Birgitt
2. Introduction to Computational Biology: An evolutionary approach
            Bernhard Haubold, Thomas Wiehe,
3. Finite Difference Schemes and Partial Differential Equations,   Strikwerda.
4. Principles of Computational Cell Biology   Volkhard Helms, Wiley-WCH.

CSB514 COMPUTATIONAL   LABORATORY 1
Moedlling and Simulation and systhesis
CSB515 SEMINAR
Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication

CSB521MATHEMATICAL MODELING AND SIMULATION OF BIOLOGICAL SYSTEMS
Mathematics: Linear Modeling & equation, Gaussian elimination algoritm, systematic solution, matices, ODE, Difference equation, Graph and network theory Introduction Systems elements and units. Idealization and simplification. First & Second Order Systems, System analogies and equations. Control system. ordinary differential equations, partial differential equations, partial functional differential equations and optimal control theory. steady state and fixed points, stability, numerical solution, creating a mathematical model, modelling and simulating dynamical systems, running simulation. Algorithms for modeling and simulation of biological systems: application to gene regulatory network. continuous, stochastic or Boolean models Mathematical frame work of generalized kinetic theory. Models of system: systems, models modeling, classification, constraint on model structure, misuses of model. Modelling process Qualitative & Quantitative Model Formulation. Numerical Techniques. Parameter Estimation. Model Validation, Analysis. Applications: Photosynthesis & Plant Growth, Hormonal Control, Population and Individual, Chemostat, Diseases, Spatial pattern & processes, scaling models, chaos in biology, cellular automata and recursive growth, evolutionary computation. Modeling of Biochemical Systems, Specific Biochemical Systems. Model Fitting. Analysis of High Throughput Data. Gene Expression model. Stochastic Systems and variability. Optimality and Evolution
Simulation.
Components of Modeling and Simulation System. Modeling and Simulation Processes. Computer Simulation Analysis. Simulation Perspective – Continuous, Discrete, Hybrid discrete/continuous.
Numeric Consideration – Errors, Differential Equations and Integration, Random Numbers. Algorithms – Monte Carlo Method, Metropolis Algorithm. Simulation for conformational analysis, *Ab initio*, DFT and semi-empirical methods, Design of ligands. Foundation of Biomolecular Simulation – classical versus quantum description, statistical mechanics of biomolecules (eg. canonical ensemble, ergodicity), Assumption in biomolecular simulation. Modeling Interactions in Proteins – Bond length & bond angle potential, dihedral angle potential, non bonded interactions. Computation of non bonded energy terms – distance cut-offs, ewald method for electro static interaction, implicit solvent model. Molecular Dynamics Simulation – Idea of MD, structure of MD code (Initialization, force computation, numerical integration of Newton equation of motion(verlet algorithm), constraints in MD (RATTLE, SHAKE)), MD program packages (CHARMM, NAMD, AMBER).
References
1. A course in mathematical Biology   Gerda de vries
2. Understanding Molecular Simulations: From Algorithms to Applications D. Frankel and B. Smit
3. Systems Biology: A Textbook   Edda klipp,
4. Mathematical Models in population Biology and Epidemology   F. Brauer, C. Castillo-Cháves
5. . Dynamic Modeling   Fishwick:

CSB522PETRI NET MODELS IN BIOLOGY
Static structure of Petri Nets, Dynamic Behavior of Petri Nets, Analysis Techniques, Petri Nets as a modeling techniques for system biology. Modelling Technique: Discrete modeling, modeling regulatory network, hybrid functional Petri Net with extension for Dynamic Pathway Modeling, stochastic modeling, qualitative analysis, Fuzzy modeling Topological analysis of metabolic and regulatory network, Analysis

of dynamical models of signaling networks with Petri Nets and Dynamic Graphs, A modular, qualitative modeling of regulatory networks using Petri nets, prediction of network structure.

References
1. Modeling in System Biology: The Petri Net Application Ina Koch, Wolfgang Reisig, Falk,
2. Elements of Computational Systems Biology   Huma m Lodhi, Stephen H Muggleton,

CSB523DATA WAREHOUSING AND DATA MINING

I. Data Mining.

Background, Introduction to Data mining in Bioinformatics.Data Cleaning, Data Preprocessing, Data Integration and transformation, data reduction, Discretization and concept Hierarchy Generation, Data mining primitives, Data Description for data mining (clustering and link analysis). Types of Data Mining, Data Mining query language, Architectures of data mining. Exploration of data mining tools for biodata analysis. Data mining process model. Data generation & Summarization based characterization, Analytical characterization, mining class comparisons, and mining descriptive statistical measures in large data bases.   Mining Association Rules in large databases: Association rule mining, single dimensional Bookan association rules from Transactional DBS, Multi level association rules from transaction DBS, multidimensional association rules from relational DBS and DWS, Correlation analysis, Constraint based association mining. Data Mining Applications. Mining BioLiterature: Towards Automatics Annotation of Genes and Proteins.

II. Data Warehousing.

What's in a Data Warehouse, expectation from data warehouse., Need for data warehouse, definition, goals of data warehouse. Data Warehouse Architecture, Data extraction, movement and loading process, Data Mart, clean and transform data, star, snowflake and galaxy schemas for multidimensional databases, fact and dimension data, Designing fact tables. Partitioning, partitioning strategy – horizontal partitioning, vertical partitioning. Relational Database, Data Warehouse and OLAP technology, Multidimensional data models and different OLAP operations, OLAP Server: ROLAP, MOLAP and HOLAP. Data warehouse implementation, efficient computation of data cubes, processing of OLAP queries, indexing OLAP data. Data Privacy in Data Warehouse.

III. Classification and Prediction. Introduction to classification: Naïve Bayes and Nearest Neighbour.Using Decision Trees for Classification, Decision Tree Induction, Back Propagation, Bayesian classification, classification based on Association Rules. Prediction, classifier accuracy, Estimating the predictive Accuracy of a classifier.Cluster analysis, partitioning and hierarchical methods, Denrity based methods Grid based methods, web mining, Temporal and spatial data mining.

References
1. Modeling in System Biology: The Petri Net Application   Ina Koch, Wolfgang Reisig, Falk,
2. Elements of Computational Systems Biology   Huma m Lodhi, Stephen H Muggleton,

BI524 COMPUTATIONAL   LABORATORY 2

Moedlling and Simulation and systhesis

BI525 SEMINAR

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication

Department electives

BI531/CSB531 GENOME INFORMATICS & PROTEOME INFORMATICS

Genome Informatics: Gene Recognition, DNA Sequence Analysis. Accessing Sequence Data. Genome Databases. Mapping Sequence, Gene prediction. Gene Structure Prediction. Gene Expression Database. Gene Regulation and Expression. Probabilistic models of genome sequences. Statistical sequence analysis. Sequence alignment. Data Mining in Genome. Neural Network in Genome Informatics. Introduction to Human Genome Computing. Software for Human Genome Sequencing. Human EST Sequences. Genome Analysis: bacteria, viruses. Functional genomics, Comparative genomics.

Genome Informatics Application: Design Issue Feature Presentation, Data Encoding Neural Network.

Nucleic Acid Sequence Analysis.

Proteome Informatics: The promises of Proteomics: Biology, Application and Challenges. Accessing Sequence Data, Protein Structure, Protein Structure Prediction. Proteomics technologies and Bioinformatics. Public Protein Databases and Interafaces. Proteomic Knowlwdge Database. Proteome Knowledge Bases in the context of Cancer. Data standards in Proteomics. Data Standardization and Integration in Collaborative Proteomics. Informatics Tools for Functional Pathway Analysis Using Genomics and Proteomics. Data Mining in Proteomics, Protein Expression Analysis. Protein Identification by Searching Collections of Sequences with Mass Spectrometric Data. Statistical Design and Analytical strategies for Discovery of Disease-Specific Protein Patterns. Application of Proteomics: Biomedical, Pharmaceutical.

References
1. Bioinformatics – A practical guide to the analysis of Genes and Proteins
                                                        Baxevanis and Fancis Ouellette
2. Computational Molecular Biology – An algorithmic approach   Pavel A. Pevzner
3. Modern Genetic Analysis :Integrating Genes and Genomes
                                AnthonyJ.F. Griffiths,William M. Gelbart,Jeffery H. Miller.

BI532/CSB532 METABONOMICS & METABOLOMICS

Introduction to Metabonomics and Metabolomics, their role and application. Analytical methods for metabolome science. Mass spectrometry for Metabolite Identification. Metabolomics: Data Integration and Data Mining. Integrating Profiling of Metabolites and proteins. Integrating profiling data using linear correlation to reveal co regulation of transcript and metabolites. Visualization and analysis of molecular data. Analysis to metabolomic data. Application of Metabolome Analysis to Biosciences, Lipidomics. Metabolome Informatics: Introduction to ARM Database, Genome based E-Cell Modeling. Metabolic Network. Metabolomics and Medical Science. Databases and Standardisation of reporting methods for metabolite studies. Metabonomics and Global Systems Biology: Example of use of metabonomics in normal and disease models, the Microbiome an integral part of global systems, Pharmaco-metabonomics, combining Omics.

References
 Metabolomics: Methods and Protocols   Wolfram Weckwerth.
1. Metabolomics: The Frontier of Systems Biology   M.Tomita, T.Nishioka.
2. Metabolomics, Metabonomics and Metabolite Profiling   Wiliam J Griffiths

BI533.CSN533 BIO-INSPIRED ARTIFICIAL INTELLIGENCE AND SOFT COMPUTING TECHNIQUES

Introduction to AI various types of production system. Analysis of problem for developing an AI system. Problem characteristics, Production system and its characteristics. BFS, DFS, and Different heuristic search techniques- Hill climbing, Ascent Hill climbing, Constraint satisfaction. A* algorithm AO* Algorithm,

Knowledge Representation: Representation and mappings, Approaches to knowledge representation, Issue in knowledge representation, Knowledge representation using predicate logic resolution, and unification algorithm. Knowledge representation using rules procedural versus declarative knowledge logic programming, Forward and back ward reasoning. Symbolic reasoning under uncertainty monotonic and non monotonic reasoning. Semantic nets, Frames Conceptual dependency.

Natural language processing and study of its different phases, Game planning Minimax Search procedure, Adding Alpha Beta cut-offs, Iterative deepening Planning components of planning system Goal stack planning Nonlinear and Hierarchical planning.

Statistical reasoning Probability and Bayes Theorem Certaininty factor and rule base system Bayesian Networks Dempster Shafer Theory Fuzzy Logic. Understanding Parallel and distributed AI Psychological Modeling, Parallelism in reasoning system.

Introduction to learning, various learning techniques Introduction to Expert System. Connectionist Model Hopfield networks learning in Neural Networks Application Common Sense Common Sense ontologies and Memory organizations.

References

1. Artificial intelligence   Rich & Knight.
2. Artificial intelligence   Norwing.

BI-534.CSB534 LANGUAGES, ALGORITHMS & TOOLS IN BIOINFORMATICS

Sequence comparison, Sequence similarity search, computational models for sequence analysis, sequence alignment, longest common subsequence problem, alignment with gap penalties, space efficient sequence alignment, Scoring matrices for similarity search PAM, BLOSUM etc.

Comparing a sequence against a database, method of sequence database similarity search, BLAST, FASTA, and other methods for comparing databases of sequence and patterns- PSI-BLAST, PHI-BLAST & PROBE etc.

Methods of optimal alignment, distance and similarity, motifs & patterns, evolutionary basis for sequence alignment, Smith Waterman, Needleman and Wunsch dynamic programming algorithms, progressive alignment methods, alignments presentation methods, multiple sequence alignment (MSA), practical aspects of MSA, tools and applications of MSA.

Programming languages – Perl, Bioperl, Java, Biojava, HTML, BioXML etc.,

Bioinformatic Tools – Genscan, Rasmol, Cn3D, Phylip, Oligo, Clustal W, ALSCRIPT, MOLSCRIPT etc.

References

1. Perl for Bioinformatics   Tisdall and James.
2. Introduction to Bioperl   Tata Mc Graw Hill.
3. The complete reference –Java2,   Patrick Naughton et al.

21.0 ENERGY CENTER

xxiv) RENEWABLE ENERGY (M.Tech)

EN 501: RENEWABLE ENERGY SOURCES

Introduction, Solar Energy, Principle of Wind Energy Conversion. Tidal and geothermal Energy.Bio-Energy: Classification, Characteristics of biomass, Biomass conversion processes, Gasifiers. Biomethanation, Basics of anaerobic processes,   Environmental significance, Biogas production mechanism; Hydel Energy : Types, Hydrological analysis, Water Ways – Fourbay, trashtacks, intake gates, air inlets, power canal, surges in power canal and penstocks. Types & working of surge tanks; Hydraulic Turbines – Types, working, Governing and controls

EN -502 ENERGY CONSERVATION AND AUDIT

Energy audit: Energy Accounting & Analysis, Heating, Ventilation & Air Conditioning audit, Building system energy audit, Energy management, Energy efficient motors. Tariffs and power factor improvement in power system, Load curve analysis and load management.

Thermodynamics of Energy Conservation. energy efficient house keeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation. Maintenance – friction, lubrication, Predictive and preventive maintenance.

Reference Books:

1 Hand book of Energy Audits   Albert Thuman,

2 Energy management   Paul'Callaghan

EN-503 ENERGY ECOLOGY AND ENVIRONMENT

Origin of the earth. Earth's temperature and atmosphere. Sun as a source of energy, nature of its radiation. Biological processes, photosynthesis. Food chains Marine ecosystem. Ecosystem theories. Auctecology, sources of energy, classification, quality and concentration of an energy source, characteristics temperature. Fossil fuels : coal, oil, gas, geothermal, tidal and nuclear energy. Solar, wind, hydropower, biomass. Resources of energy and energy use pattern in different regions of the world. Environmental degradation, primary and secondary pollutants. Thermal and radioactive pollution, air and water pollution. Micro climatic effects of pollution. Pollution abatement methods.

EN-551 WIND ENERGY &ITS UTILIZATION

Introduction: Historical developments, latest developments, state of art of wind energy technology, Characteristics of wind: Nature of atmospheric winds; wind resource characteristics and assessment; anemometry; wind statistics; speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography Aerodynamics of blade and rotor; Wind turbine design; Control Mechanisms: Wind turbine dynamics ; Wind farm: design, Planning

References

1. Wind Energy Comes of Age,   Paul Gipe,
2Wind Energy Conversion System,   L.L.Freris,

EN552 SOLAR ENERGY & ITS UTILIZATION

Solar radiation spectrum; The Photo Voltaic effect; Spectral response; p-n junction; different types; characteristics; Effect temperature; insolation level & tilt angle; Fabrication and costs of PV cell. Photovoltaic modules; Battery storage; Charge regulators, System Performance.

Principles of applied heat transfer, Solar thermal collectors applications : solar ponds; dryers; distillation; solar cooker. Passive Solar design.

EN553 ENERGY ECONOMICS, POLICY & PLANNING

Energy and Environment Basic Issues:Criteria for Economic Growth; Energy-Economy-Environment Linkages; Emissions Inventories: Assessment and Policy Relevance.

Issues for Developing Countries: Energy and Environment Policies from Urban and Rural perspectives. Analysis Methodologies: Scenarios and Models, Global and Local Environmental Issues: Climate Change Negotiations Technological Options: Energy-Efficiency and New Energy Technologies; Renewable Energy: Issues, Prospects and Policies

EN511 INSTRUMENTATION & CONTROL

Introduction to instrumentation and controls of energy systems, display instruments, Recorders.

Transducers, sensors, actuators and Transmitters such as pressure, temperature, velocity, speed, volume, torque and solar flux measuring devices, current, voltage and power factor.Gas analysers, power plants and industrial instrumentation and pollution monitoring devices.

Signal conditioning of Inputs, Single channel and multichannel Data Acquisition System, Computer based DAS, D/A and A/D converters, Data loggers, Supervisory control.

Data Transmission systems, Time division multiplexing, Pulse Modulation, Digital Modulation.

EN512 ENERGY STORAGE TECHNOLOGY

Technology Types– Batteries, flywheels, electrochemical capacitors, SMES, compressed air, and pumped hydro; Theory of Operation– Brief description of the technologies and the differences between them; State-of-the-art – Past demonstrations, existing hurdles and performance targets for commercialization; Cost and cost projections: – Prototype cost vs. fully commercialized target

EN561 POWER PLANT ENGINEERING

Types of thermal power stations. Steam power stations based on fossil fuels. Economy and thermal scheme of the steam power stations. Thermal power plant equipment : boilers, superheaters, economizers, condensers, combustion chamber and gas loop, turbines etc. Gas turbine power stations, steam gas power stations, peak load generating sets. Hydro Electric Stations : Selection of site, Essential features and elements, Elements of nuclear power plant. Load curves, load factor, diversity factors and their significance, Economic scheduling of power stations.

EN562 SOLAR PASSIVE ARCHITECTURE

Passive heating of buildings- Methods and Techniques of heating buildings naturally, Study of building examples of passive heating. Passive cooling of buildings - Methods and techniques of cooling building naturally. Earth bermed design of buildings. Study of building examples of passive cooling. Study of daylight integrated buildings. Methods and techniques of innovative daylight design. Study of Solar energized buildings. Scope and extent of use of photovoltaic cell for building operations and services.

EN563 ENERGY EFFICIENT ELECTRIC DRIVES

Introduction of Electrical Drives, D.C. Motor Drives & their classification, Design considerations of thyristorised drives. Induction Motor Drives parameters of speed control stator & rotor side control, Analysis & performance, Harmonic effect & analysis. Design aspects of AC Drives. Vector Control of I.M. Transients in electrical drives, Transient analysis during starting braking & speed control of DC & AC Drives, calculation of energy loss. Energy conservations in Elect. Drives, Selection of Drives for Industrial application.

E514 GREEN BUILDINGS

Need of energy in buildings. Role of building design and building services to evaluate the energy performance in buildings. Study of Climate and its influence in building design for energy requirement. Environmental science of buildings. Study of Thermal environment and visual environment. Heat gain and heal loss phenomenon of buildings. Role of building enclosures, openings and materials in thermal environment.Energy efficient light design of buildings.. Design for visual environment. Energy rating of buildings.

EN-515 POWER CONVERSION TECHNIQUES

Introduction to power electronics devices.Power diodes, SCRs, Triacs, GTOs, Power Transistors, P-Mosfets, CMOS and other devices. Converters : A.C. to D.C. Rectifiers and Inverter operations. Choppers & Inverters; A.C. to A.C. Regulators: Voltage control, frequency control. Use of triacs, static switches. Trigger and Controller Circuits: Trigger devices UJT, Optocompilers. Typical firing angle control circuits.

EN566 INTEGRATED ENERGY SYSTEMS

System Aspects of Integration : voltage effects, thermal effects, fault level. Islanding. Stand Alone Systems : Network voltage and system efficiency, Energy storage methods, Lead-Acid Batteries, Battery charger, case studies of stand alone system. Hybrid Energy Systems and its economic evaluation. Mathematical modeling of Integrated Energy Systems. Technological aspects of power electronic systems connection to the grid

EN567 ENERGY FROM WASTE

Waste as a Renewable Energy Source, Waste-to-Energy Conversion: Thermochemical Conversion, Biochemical Conversion, Physico-chemical Conversion, Factors affecting Energy Recovery from waste, Agricultural Residues, Animal Waste, Industrial Wastes, Forestry Residues, Municipal Solid Waste (MSW), Converting Waste Heat to Electricity, Bio energy as by product of waste processing, Environmental significance, Introduction to anaerobic digestion, Process fundamentals and design considerations, Process analysis and reactor configurations, Methane production, Energy assessment, Biomethanation from sludge digestion, Types of reactors

xxv)   **Green technology (M.Tech)**

GT 11 RENEWABLE ENERGY SOURCES

Introduction, Solar Energy, Principle of Wind Energy Conversion. Tidal and geothermal Energy.Bio-Energy: Classification, Characteristics of biomass, Biomass conversion processes, Gasifiers. Biomethanation, Basics of anaerobic processes, Environmental significance, Biogas production mechanism; Hydel Energy : Types, Hydrological analysis, Water Ways – Fourbay, trashtacks, intake gates, air inlets, power canal, surges in power canal and penstocks. Types & working of surge tanks; Hydraulic Turbines – Types, working, Governing and controls

References

1. Non Conventional Energy   Khan, B H,
2. Renewable Energy Resources: basic principle & application,   Tiwari and Ghosal,
3. Energy Resources, Conventional & Non-Conventional   Koteswara Rao,

GT 512 ENERGY CONSERVATION AND AUDIT

Energy Scenario : Commercial and Non-commercial energy, Primary energy resources, commercial energy production, Energy Management & Audit : Definition, need and types of Energy Audit. Energy

Management approach-understanding energy costs, Energy Action Planning : Key elements, force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Financial Management : Investment-need, appraisal and criteria.

References

      1 Hand book of Energy Audits   Albert Thuman
      2 Energy management   Paul'Callaghan

GT 513 ENERGY MODELING & SIMULATION

Energy Models. Surveys, Steady-State Computer Models, Dynamic Models: advantages and disadvantages, Interdependence of energy-economy-environment; Modeling concept, and application .
Quantitative methods Basic concept of econometrics and statistical analysis; The 2-variable regression model; The multiple regression model; Tests of regression coefficients and regression equation; Econometric techniques used for energy analysis with case studies form India Input – Output Analysis Basic concept of Input-output analysis; concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy;

References

1. Probability and Statistical for Engineers.   Johnson, R.A.   Miller & Freund's
2. Applied Statistics for Civil and Environmental Engineers.   Kottegoda, N.T. and Rosso, R.
3. Advanced Engineering Mathematics.   Kreyszig, E.
4   Similarity and dimensional methods in mechanics.   L.I. Sedov
5. Renewable Energy in India- A Policy Analysis   Ravindranath Rao, Usha, Natarajan
6. Energy Planning and Economics   A.V. Desi

GT521 SOLAR THERMAL AND PV SYSTEM

Solar radiation spectrum; The Photo Voltaic effect; Spectral response; p-n junction; different types; characteristics, Effect of temperature; insolation level & tilt angle; Fabrication and costs of PV cell. Photovoltaic modules; Battery storage; Charge regulators, Solar PV systems.
Principles of applied heat transfer, Solar thermal collectors applications : solar ponds; dryers; distillation; solar cooker. Passive Solar design.

GT-522   WIND ENERGY & SMALL HYDRO POWER

Wind energy technology, Historical developments, latest developments, Indian scenario and worldwide developments, present status and future trends, wind power plant economics- installation cost, operation cost and cost of energy. Types of wind turbines and their characteristics, Wind turbine dynamics, multiple stream tube theory, vortex wake structure; tip losses; rotational sampling, aerodynamic loads, transient and extreme loads. Types and characteristics of generators used in WECS Hydrology: Water power development : Rainfall and its measurement, average rainfall consisting of rainfall data, Runoff and infiltration indices, river gauging, flood hydrograph analysis, investigation of sites, potential of a river or a basin, pondage Estimation of available power. Types of hydro power plants and their schemes, Elements of hydro power plant

References

1. Wind Energy Comes of Age   Paul Gipe .
2. Wind Energy Conversion System'   L.L.Freris
3. Wind energy Hand Book'   Tony Burton et al,

GT523 CARBON SEQUESTRATION AND EMISSION TRADING

Climate Change Diagnostics and baseline determination Climate change strategy & adaptation Greenhouse emissions information management systems Risk assessments & mitigation Verification & auditing Carbon accounting Carbon sequestration (forest sinks) Energy efficiency opportunities Carbon abatement, emission reduction strategies and processes Emission trading Kyoto compliance analyses Biofuels feasibility studies and business design Behavioural change strategies

Department electives

GT531 INSTRUMENTATION & CONTROL

Introduction to instrumentation and controls of energy systems, display instruments, Recorders.

Transducers, sensors, actuators and Transmitters such as pressure, temperature, velocity, speed, volume, torque and solar flux measuring devices, current, voltage and power factor.Gas analysers, power plants and industrial instrumentation and pollution monitoring devices.

Signal conditioning of Inputs, Single channel and multichannel Data Acquisition System, Computer based DAS, D/A and A/D converters, Data loggers, Supervisory control.

Data Transmission systems, Time division multiplexing, Pulse Modulation, Digital Modulation.

GT-532 ENERGY STORAGE TECHNOLOGY

Technology Types– Batteries, flywheels, electrochemical capacitors, SMES, compressed air, and pumped hydro; Theory of Operation– Brief description of the technologies and the differences between them; State-of-the-art – Past demonstrations, existing hurdles and performance targets for commercialization; Cost and cost projections: – Prototype cost vs. fully commercialized target

GT534 HYDROGEN ENERGY AND FUEL CELLS

Hydrogen Energy & Applications Hydrogen: Its merit as a fuel; Applications. Hydrogen Economy: Hydrogen and fuel cell; Suitability of Hydrogen as a fuel and fuel cell as energy conversion device

Hydrogen Production Methods Production: from fossil fuels, electrolysis, thermal decomposition, photochemical,photo catalytic, hybrid; Hydrogen Storage and Transport Storage: Metal hydrides, Metallic alloy hydrides, Carbon nano-tubes; Sea as the source of Deuterium. Transport: Road, railway, pipeline, and ship. Fuel Cell: Basics Fuel cell definition, difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cell, performance characteristics of fuel cells Types of Fuel CellsFuel cell types: alkaline fuel cell, , polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, Geometries of solid oxide fuel cells: planar, tubular,

References
1. Nanoparticles and nanotechnology: An introduction to modern concepts of nanoscience, Wolf, Edmond L.
2. Fuel Cell Fundamentals   O'Hayre R., Cha S., Colella W., Prinz F B
3. Hydrogen and Fuel Cells,   Sorensen, B.
4. Chemical and Electrochemical Energy Systems   Narayan R, and B Viswanathan

GT-535 POWER PLANT ENGINEERING

Types of thermal power stations. Steam power stations based on fossil fuels. Economy and thermal scheme of the steam power stations. Thermal power plant equipment : boilers, superheaters, economizers, condensers, combustion chamber and gas loop, turbines etc. Gas turbine power stations, steam gas power stations, peak load generating sets. Hydro Electric Stations : Selection of site, Essential features and elements, Elements of nuclear power plant. Load curves, load factor, diversity factors and their significance, Economic scheduling of power stations.

GT536 GEOTHERMAL, TIDAL & OCEAN ENERGY

Introduction of Geothermal Energy, Geothermal resources; definition and classification, Hydrothermal system, Hot dry rock systems, Geopressured reservoirs, Magma energy, Dry rock and hot aquifer analysis Utilization of geothermal resources, Direct utilization; Swimming bathing & balneology, space conditioning, district heating, Geothermal heat pump; basic concept of heat pump, air conditioner, heating and cooling mode in heat pump, Heat pump with geothermal resources; typical GHP loop configuration Ocean Thermal: Introduction, OTEC history and technology progress, working principle, resources & site requirement ,Tidal Energy: Introduction, causes and working principle, Tidal power calculation, Basic modes of operations, current status of Tidal power. ,Wave Energy: Introduction, basics of wave motion, wave energy generation, wave energy conversion devices, Advantages and disadvantages of wave energy.

References
1., Non Conventional Energy   Khan, B H
2., Renewable Energy Sources and Emerging Technologies,   Kothari, Singhal & Rajan
3. Renewable Energy Resources: basic principle & application,   T iwari and Ghosal,

4. Energy Resources, Conventional & Non-Conventional   Koteswara Rao,
5. Sustainable Energy-Choosing Among Options   Tester,

GT567 ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

Electrical System **:** Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit**,.**Electric Motors **:** Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motor.. Fans and blowers : Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities .Lighting System **:** Light source, choice of lighting, luminance requirements, and energy conservation avenues. Diesel Generating system: Factors affecting selection, energy performance assessment of diesel conservation avenues. Energy Efficient Technologies in Electrical Systems **:** Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters

GT538 ENVIRONMENTAL IMPACT ASSESSMENT

 Conceptual facts of eia: Introduction, Definition and Scope of EIA, Objectives in EIA, Basic EIA Principles, Classification of EIA Baseline data acquisition: Environmental Inventory, Data Products and Sources: thematic data, topographical data, collateral data and field data.. Planning and management of impact studies: Conceptual Approach for Environmental Impact Studies, Proposal Development, Interdisciplinary Team Formations, Team Leader Selection and Duties, General Study Management, Fiscal Control. Operational aspects of EIA:Screening: Application for Prior Screening for Environmental Clearance, Screening Criteria; Methods for impact identification: Background Information, Interaction-Matrix Methodologies: simple matrices, stepped matrices, development of a simple matrix, other types of matrices, summary observations on matrices, Network Methodologies:

References
1. Textbook of Environmental Science & Technology   M.Anji Reddy,
2. Technological guidance manuals of EIA.   MoEF.
3. Man and Environment   D.H.Carson
5. Environmental Impact Assessment,   Y.Anjaneyulu,

GT-566 ENVIRONMENTAL POLLUTION CONTROL TECHNOLOGIES

Classification of Pollution and Pollutants, Causes, Effects and Sources of Pollution.air pollution: primary and secondary pollutants, automobile pollution, industrial pollution, ambient air quality standards, meteorological aspects of air pollution---temperature lapse rates and water pollution: point and non-point source of pollution, major pollutants of water, water quality requirement for different uses, global water crisis issues. marine and nuclear pollution: misuse of international water for dumping of hazardous waste, coastal pollution due to land/soil pollution: Effects of urbanization on land degradation, Impact of Modern Agriculture on Soil, Effect on Environment and Life sustenance, Abatement measures.

References
1. Text book of Environmental Science and Technology   Dr. M. Anji Reddy
 2. Environmental Science- Towards a sustainable future   Richard T. Wright,

 xxvi) NANOTECHNOLOGY(MTech)
First semester

NT-511 STRUCTURE AND PROPERTIES OF SOLIDS

Crystal Bonding and Structure, Crystalline, polycrystalline & Non-crystalline solids, X-ray diffraction procedures Defects in solids, Band theory of solids, Free electron theory, Transport properties of materials, dielectric properties of solids, Magnetic materials & its properties, Ferrits & Nano-magnets. Structure of Ceramics, Polymers & Composites.

REFERENCES:
1.   Introduction to Solid State Physics   :   Kittel
2.   Introduction to Theory of Solids   :   H.M. Rosenberg

NT-512 PROPERTIES OF NANO MATERIALS

Introduction to Nanotechnology: Characteristic scale for quantum phenomena, Drexler-Smalley debate - realistic projections.

Electronic structure;.Quantum well, quantum dots, quantum wires . Nano-clusters , clusters of rare gases, Clusters of Alkali metals. The Jellium Model. Discovery of C_{60}.   Fullerene Structure and bonding. Carbon nano tubes. Transport, Optical, Thermal and Mechanical Properties of Nano tubes. Synthesis of nanomaterials using chemical techniques. Application of Nano Materials. Micro & Nano Electromechanical Systems.

REFRENCES :
1.   D.Bimberg, M.Grundman, N.N. Ledenstov   :   Quantum Dot Heterostructures
2.   Sharma Ashutosh, Jayesh   :   Adv. In Nano Science & Tech.
3.   Dresselhaus M.S. & Avouris   :   CNT Synthesis, Structure
,

NT-513 PROCESSING AND FABRICATION OF NANOSTRUCTURES

Si processing methods: Cleaning /etching, oxidation-oxides, Gettering, doping, epitaxy. Top-down techniques: Photolithography, other optical lithography's (EUV, X-ray, LIL), Particle beam lithography's (e-beam, FIB, shadow mask evaporation), probe lithography's. Processing of III-V semiconductors including nitrides. Molecular-beam epitaxy, chemical beam epitaxy, metal-organic CVD (MOCVD). Bottom-up techniques: self-assembly, self-assembled monolayer, directed assembly, layer-by-layer assembly. Combinations of top-down and bottom-up techniques: current state of the art

REFRENCES :
1.   Nanostructures   :   Tsakalakos, Ovidko & Vasudevan
2.   Physics of Amorphous Solids   :   Richard Xylen

NT-514 LAB PRACTICE-I
List of Experiments:
1.   Study of Hall effect
2.   Band gap of semiconductor by Four Probe Method
3.   LASER Characteristics :
        a)   Measurement of spot size, b) Power , c) Beam diversion
4.   G.M. Tube Characteristics
5.   Absorption Coefficient using GM counter
6.   Design & Study of CE amplifier
7.   Study of operational amplifier IC – 741
8.   Study of Emitter follower
9.   I/V characteristics of FET
10.   I/V characteristics of MOSFET

NT-515 SEMINAR

1. Seminar on Current Trends in Nanotechnology covering Synthesis Process, Characterization.

Second Semester

: **NT-521 NANOSTRUCTURE CHARACHTERIZATION TECHNIQUES**

Compositional surface analysis: Ultraviolet (UV) and X-ray photoelectron spectroscopy (XPS), Secondary ion mass spectrometry (SIMS), Contact angles

Microscopies: Optical microscopy, Fluorescence & Confocal microscopy, Cathodoluminescence (CL) and photoluminescence (PL) ,TEM, SEM.

Probe techniques: Atomic force microscopy (AFM), scanning tunneling microscopy (STM), scanning nearfield optical microscopy (SNOM), Deep level transient spectroscopy (DLTS), Kelvin-probe measurements. Nanoscale current-voltage (I-V), capacitance-voltage (C-V) relationships

REFRENCES

1. Nanostructures & Nano Materials : Ghuzang Cao
2. Hand Book of Nanophase :Zhong Lin Wang (Springer)
   & Nanomaterials (Vol. I&II)

NT-522 PROPERTIES OF LOW DIMENSIONAL SYSTEM

Transport properties: quantization of conductance, density of states, Coulomb blockade, Kondo effect. Hall, quantum Hall, fractional quantum hall effects

Vibrational and thermal properties: phonons, quantization of phonon modes, heat capacity and thermal transport

Optical properties: Collective oscillation (Gustav-Mie explanation), surface plasmon resonance, interactions between Nanoparticles, coupled-dipole approximation, Linear and Nonlinear optical properties.

REFRENCES :

1. Handbook of nanotechnology : Bhushan
2. Nano optoelectronics : M.Grundman
3. Nanophotonics : Paras N.Prasad

NT-523 INSTRUMENTATION (Elective-3)

Resistivity Probing, conductivity, Hall Mobility, Ferroelectric & dielectric measurements. Optical mapping, auto radiography, Electron Micrography. Phase Identification. Chemical assessment, Spectrophotometery, Differential Thermo Analysis. Determination of Physical Structure, use of electrometer. Spectroscopic techniques, NMR, ESR, Photoacousitc spectroscopy. Electron Microprobe Analysis. Measurement of low pressure penning-pirani gauge. Film thickness monitoring & measurement.

REFRENCES :

1. Crystal Growth and Characterisation : R. Ueda and J.B. Mullin
2. Solid State Physics : Ibach and Luth
3. Experimental Techniques of Surface Science: Woodruff and Delchar
4. Handbook of Thin Film Technology : Leon I Maissel & R Glang

NT-524 Lab Practice - II

List of Experiments:

1. Study of Nanomaterials using AFM
2. Photoluminescence studies of Nanomaterials
3. To take Debye Scherrer pattern of a given poly-crystalline material and determination of third "d" values from powder lines.
4. To determine the response of silicon solar cells and the effect of prolonged irradiations, and to calculate the efficiency and fill factors of a variety of solar cells.
5. Demonstration of SEM
6. Hysteresis Properties of Ferroelectric materials using P-E Loop Tracer
7. Preparation of materials using CVD & PVD Technique.

NT-525 SEMINAR

Seminar on Current Trends in Nanotechnology covering Synthesis Process, Fabrication and Characterization of nanomaterials and their applications in devices.

I & II SEMESTER Deaprtmental ELECTIVES

NT-531 OPTO ELECTRONICS

Principle of light guidance in optical wave guides. Fabrication and types of Optical fibres, rays and modes, losses in optical fibres and applications. Optical fibre interconnectors, concept of optical waveguides. Nonlinear optics. Second harmonic generation. Birefringence. Electro-optics (Kerr effect, Pockels effect, Faraday effect), Magneto-optics.

Optical Integrated Circuits, Light Emitting Diode, Solar Cells.

REFRENCES :

1.	Optical Electronics	:	A. Ghatak & K. Thyagarajan
2.	Quantum Electronics	:	A. Yariv
3.	An Introduction to Optical Fibers	:	A.H. Cherin

NT-532 NANO ELECTRONICS

Spintronic: Spin injection, spin valve effect, spin valves and MRAM devices
Solid state devices: quantum dots, quantum wires, microwave induced transport Josephson junctions
Photonic bandgap materials, nanoscale photonic devices, Special phenomena in 2D and 3D structures.
The basic properties of liquid crystals and their display and non-display applications at the nanoscale

REFERENCES

1. Nano Electronics and Information Technology : Rainer Waser

NT-535 PHOTONIC MATERIALS

Atomic scale structure of materials. Magnetism: moments, environments and interactions, order and magnetic structure. Scattering theory: Excitations of crystalline materials, magnetic excitations, sources of X-rays and neutrons.

Interaction of light with photon: L.A.S.E.R. Chaotic light and coherence. Laser spectroscopy. Multiphoton processes. Light scattering by atoms. Electron scattering by atoms. Coherence and cavity effects in atoms. Trapping and cooling.

REFRENCES :

1.	Light & Matter	:	Yehuda Band
2.	NanoPhotonics	:	Paras N. Prasad
3.	Nanostructured Films & Coatings	:	Gang Moog Chow

NT-536 MOLECULAR STRUCTURES

Molecular structure: Born-Oppenheimer approximation; Electronic structure ionic and covalent bonding, H_2, H_2^+; Vibrational and rotational structure.

Molecular spectra: Microwave, infrared and optical spectra of molecules; selection rules, experimental set-ups and examples; Raman spectroscopy. ortho-para states.

Molecular processes: Collisions with electrons and heavy particles; Experimental techniques.

REFERENCES

1.	Physics of Molecules	:	Wolf Gang Demtroder
2.	Hand Book of Molecular Physics & Quantum Chemistry	:	Stephen Wilson

NT-541 SEMICONDUCTOR DEVICES

Semi conducting materials, p-n junction, space charge and electric field distribution at junctions, forward & reversed biased condition, minority & majority carrier currents, Zener and avalanche break downs, Schottky barrier, Shockley diode & silicon control rectifier, Zener diodes, tunnel diodes, photo diodes. Two port network analysis, H,Y & Z parameters, BJT in CE configuration, Constants of CB & CE amplifier, FET, MOSFET, Equivalent circuit of FET. Source amplifier. Idea of transistor biasing and amplifiers.

REFRENCES :

1.	Electronic Devices & Circuits	:	Millman & Halkins
2.	Solid State Electronic Devices	:	Ben G Streetman
3.	Microwave Principle	:	W.J. Reich
4.	Electronics	:	S. Bhadran

NT-542 ADVANCED TOPICS IN PHYSICS

Electrets physics: various types of electrets, methods of preparation, various studies on electrets, uses of electrets

Luminescence: various kinds of luminescence, theory of luminescence, paramagnetic behavior, activators and co-activators, Clustering, color centers. Preparation techniques and application.

Amorphous semiconductor materials. Preparation techniques in bulk form & in thin form. Rocking and quenching of materials. Characterization of amorphous materials.

REFRENCES :

1.	Amorphous Materials	:	S.R. Elliot
2.	Physics of Amorphous Solids	:	Richard Xylen

NT-545   COMPUTAIONAL METHODS

Differential equation, special functions Bessel's, Hermite's. Laguerre polynomials. Eigen value , Eigen functions. Perturbation theory. Numerical analysis. Idea of visual basic, c++ and c-sharp.

REFERENCES

1.   Matehmatical Physics   : S.S. Rajput
2.   Visual Basic & C ++   : Shyaum Series

NT-546   AMORPHOUS MATERIALS

Physics of Amorphous Material: preparation of amorphous materials, metallic glass, thermal evaporation techniques such as sputtering, CVD Techniques, quenching. Glasses, theory for glass transition, glass transition temperature. Chalcogenide glasses. Structure of disordered materials. Experimental techniques, electronic density of states. Localization phenomenon, transport , optical and dielectric properties.

REFRENCES :

1.	Amorphous Materials		:	S.R. Elliot
2.	Physics of Amorphous Solids		:	Richard Xylen
3.	Electronic process in Non-Crystalline Materials :		:	Davis & Mott.
4.	Disordered Material an Introduction		:	Paolo M. Ossi

Open Elective-I

NT-551 MOLECULAR ELECTRONICS AND BIOMOLECULES

Organic semiconductors, Organic molecules as switches, motor-molecules and biomimetic components .conducting polymers, light emitting polymers,

The self-assembly of complex organic molecules, Molecular connections and the integration of molecular components into functional devices, Contact issues,

Structure of biomolecules; Biotechnology, recombinant DNA technology, molecular biology

Structural and functional principles of bionanomachines, Interfacing bio with non-bio materials, Porous silicon

References

1.   Molecular Electronics   : T. Helgakar
2.   Semiconductor Quantum Dots   : Masumota Takaga

NT-552 LOW TEMPERATURE BEHAVIOR OF MATERIALS

Thermodynamics & liquefaction of gases, Cryostat design , Transport Phenomenon, Fermi surface, Magnetism. Conductivity of solids, Technique of measurement, Paramagnetic & Nuclear adiabatic demagnetization. Superconductivity. fundamental phenomena of super conductivity, Meissner effect, London equation, Type I and Type II superconductors, qualitative idea of Cooper pairing and BCS theory. Ginsburg-Landau theory, coherence length, Green's functions of electrons and phonons, isotope effect, The BCS Hamiltonian, the gap parameter, Superconductor in a field, flux quantization effect, SQUIDS, High-T_c materials.

REFRENCES

1.	Superconductivity	:	Werner Buckel & Reinhold
2.	Thermodynamics	:	M.S.Yadav
3.	Treatise on Heat	:	V.K. Shrivastava

Open elective-II

NT-555 LASER TECHNOLOGY

Interaction of radiation with matter, absorption and stimulated emission, absorption and gain coefficient, spontaneous emission, homogeneous and inhomogeneous broadening, Doppler width. basic principles of lasers , properties of laser beams, population inversion in three and four level lasers, resonance frequencies, modifications of the laser output, single mode operation, Q- switching. laser materials and types of lasers, solid state lasers, characteristics of dye lasers, semiconductor lasers. Laser applications. Material processing metrology and Remote sensing. Laser induced controlled thermonuclear fusion. Laser applications in spectroscopy.

REFRENCES :

1.	Introduction to Laser Physics	:	K. Shimoda
2.	Laser Spectroscopy A Basic Concepts and Instrumentation	:	W. Demtr der
3.	Atomic and Laser Spectroscopy	:	A. Corney

NT-556 NANO FLUIDS AND SURFACES

Nanofluidics and surfaces: liquid structure near solid-liquid interfaces (simple liquids; layering electrolytes: Poisson-Boltzmann equation; Debye Hückel approx.) Hydrodynamic boundary condition: slip vs. non-slip, electro kinetic effects (electrophoresis, electro osmotic effect, electro viscous effect), surface reconstruction, dangling bonds and surface states

REFRENCES :

1.	NANO- THE NEXT REVOLUTION	: Mohan Sunder Rajan (NBTI)
2.	INTRODUCTION TO NANO TECHNOLOGY	: Charles P. Pode (Springer)
3.	QUANTUM DOT HETEROSTRUCTURES	: D.Bimberg, M.Grundman

xxvii) GEOINFORMATICS AND APPLICATIONS (M.Tech.)
First semester
GI 511 BASICS OF MAPPING AND CARTOGRAPHY
Principles and classifications of surveying, chain surveying basic concepts and terminology and instruments used. Linear measurements along sloping ground and base line correction including slope corrections. Conventional symbols, different types of scales and field and office work for the preparation of maps.
Measurement of angles and Directions: different types of bearings and their measurement systems, reference meridians, azimuth, magnetic declination and local attraction. Different types of compasses for the measurement of bearings compass traversing and closing error adjustments.
Leveling: Principle, terminology and instrumentation, booking of leveling readings, reduction of levels, difficulties, sources of errors and precautions in leveling and setting of grade stakes. Classifications of leveling, profile leveling, cross-sectioning and reciprocal leveling.
Contouring: Definition and terminology, methods, interpolation and characteristics of contours, contour gradients and uses of contour maps.

Angles and Directions with Theodolites: Different types of theodolites and their construction, use and adjustment, measurement of horizontal angles. Theodolite traversing, latitude and departure, traverse computations and plotting, balancing of traverse, calculation of traverse area and omitted measurements.

Computation of area: Area computations from field notes and plotted plans using graphical methods and planimeter.

Computation of volumes: Formulae for the calculation of cross-sectional area and volume and Mass Haul diagram. Computation of the volume of earth work and storage from contour maps using end area method and prismoidal formulae.

Electronic total station: Principle, Components and working.

REFERENCES:

1. Plane Surveying   A. M. Chandra
2. Surveying and Leveling-Part-I & II   T. P. Kanetkar and S. V. Kulkarni,

GI 512 BASIC CONCEPTS OF PHOTOGRAMMETRY

History and development – types of aerial photo- classification of aerial cameras – optics for photogrammetry, camera calibration – photographic process Scale – overlaps – stereoscopy – concepts – viewing and measuring systems – image and object co-ordinates – floating mark – parallax equation – height information – Tilt – Rectification – Displacement. Flight planning – computation for flight plan – photo control – cost estimation – aerial mosaics – types.

Concepts of interior, relative, absolute orientation – object, image relation – linearization – effect of orientation elements – scaling and leveling – analytical procedures – map compilation using stereo plotters – Introduction to digital photogrammetry. Elements of Aero triangulation and analytical method – strip deformation, strip and block adjustment – Terrestrial photogrammetry – Geometry & products – orthophoto – mapping.

References:

1. Geoinformation: Remote Sensing, Photogrammetry and   Geographic Information Systems.
                                                                    Gottfried Konecny,
2   Elements of Photogrammetry,   Paul R.Wolf,
3. Photogrammetry, Vol 1&II   Karl Kraus,
4 . Introduction to Modern   Edward M. Mikhail , James S. Bethel , J. Chris McGlone,

GI 513 PRINCIPLES OF REMOTE SENSING TECHNOLOGY

Definitions and introduction to remote sensing, components of remote sensing system, active and passive remote sensing, electromagnetic radiations and their interactions with the earth features and atmosphere. Spectral windows and spectral signatures and their significance in remote sensing. Radiometric quantities used in the collection of spectral signatures.

Remote sensing satellite orbits, image acquisition process, repeativity, row/path and ground swath and coverage. Introduction to various global remote sensing satellite sensors and their data products like Landsat Return Beam Videocon (RBV), Multi–Spectral Scanners (MSS), Thematic Mapper (TM), SPOT push broom scanners, ISRO Linear Imaging Self Scanner (LISS) and Cartosat sensor etc. Thermal infrared scanning systems, radiometers, Radar, Lidar and SAR.

Geometry, radiometry and other characteristics of remotely sensed data products. Pre-processing of remotely sensed imagery and ground truth collection methods for various applications

Characteristics of photographic images and colour, tone, texture etc. photo-image interpretation keys. Digital image analysis techniques: False color Composite (FCC), vegetation Index map density slicing, digital image classification techniques and extraction of thematic information

Role of remote sensing in terrain investigation and advantages over conventional mapping techniques. Extraction of topographic information from remotely sensed data and generation of digital terrain model from stereo pairs of images. Resource mapping for engineering projects and various application in Civil Engg.

References

1. Remote Sensing and image interpretation   Lillesand T.M. and Kiefer R. W
2. Introduction to remote sensing   J. B. Campbell
3. Introductory digital image processing   J. R.Jensen
4. Remote Sensing in Civil Engineering,   Kennie, T. J. M. and Matthews M. C

GI 514 REMOTE SENSING & CARTOGRAPHY LAB

List of experiments

1. Study of conventional and modern surveying equipments
2. Drawing of conventional symbols of maps
3. Study and use of Prismatic Compass for plotting of ground objects
4. Study and use of Theodolite for plotting of ground objects
5. Study of the given stereo pairs of aerial photographs for the geometric elements and determination of area , scale and distances
6. Visual Interpretation of given stereo pairs of aerial photographs for the Drainage Pattern, Phsiography of the area, Landuse/Landcover pattern etc.
7. Use of stereoscope for the analysis of stereo pairs of aerial photographs.
8. Position and Navigation data collection using hand-held GPS receiver
9. Introduction to basic operations of Erdas Imagine softaware like data export/ impot, satellite image reading and manipulations
10. Georeferencing of remote sensing satellite images
11. Digital remote sensing image Classification using ERDAS Imagine software

GIE515 SEMINAR 1

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Second Semester

GI 521 SPACE GEODESY AND GNSS BASED MAPPING

Definition & fundamentals of Geodesy, Development - Applications in space geodesy – Geoid and Ellipsoid**.** Map projection-necessity and classification, properties of commonly used map projection. Global and Local Datums and datum transformation . GPS – different segments – space, control and user segment – satellite configuration – GPS signal structure – orbit determination and orbit representation, Anti spoofing and selective availability – task of control segment – GPS receiver- main receiver component- example of GPS receiver.

GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – data processing – software modules – solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid static methods with GPS - semi kinematic and pure kinematic methods – basic constellation of satellite geometry and accuracy measures.

Geodetic control surveys, cadastral surveying, photogrammetry and remote sensing, engineering applications and monitoring – GIS. GLONASS satellite configuration comparison – satellite laser ranging & applications – concept of satellite altimetry. Mobile mapping system for GIS database

References:
1. GPS satellite surveying,   Alfred Leick,
2. GPS Theory, Algorithms and Applications,   Guocheng Xu,
3. Introduction to GPS, the global positioning system,   Ahmed ei-rabbany,
4. GPS: Theory & Applications progress in astronautics and aeronautics,

                                              Bradford W. Parkinson, James J.Spilker

GI 522 BASIC CONCEPTS OF GIS

Basics of Geographic Information System (GIS) – Definition– Evolution & Components. Data : Spatial and Non-spatial – Spatial Data: Point, Line, Polygon/Area and Surface – Non-Spatial Data. Geographical concepts and terminology. Introduction to GIS data input devices like scanner, digitizer, GPS, Remote sensing etc. Guidelines for the selection of map digitization accuracy and scanning DPI for various types of maps. Manual and semi-automatic line following digitization.

Data Model: Raster Data Model – Grid – Tessellations – Geometry of Tessellations — Data Compression – Vector Data Model – Topology – Topological consistency – Vector data input– Raster Vs. Vector comparison – File Formats for Raster and Vector – Vector to Raster conversion- raster formats

Spatial and attribute data model structure. Digital Elevation Models: Generation, Representation, Applications. Spatial and attribute data visualization and query, Vector Data analysis tools: Buffering, overlays, distance measurements and pattern analysis. Raster data analysis using local, neighborhood, zonal and other operations. Viewshed and water shed analysis. Spatial interpolation models for GIS. Path analysis and network applications for planning and management of highways and utility lines. Open GIS consortium – Customization in GIS – Object Oriented GIS – WebGIS. Introduction to popular GIS software like ArcGIS and Q-GIS.

References
1. Principles of Geographic Information Systems for land Resources Assessment   P.A. Burrough
2. Geographic Information Systems: A Management Perspective,   Stan Arnoff
3. Fundamentals of Spatial Information Systems   Robert Laurini and Derek Thompson
4. Geographical Information Systems, Vo. I and II   Paul Longely, M.F. Goodchild, et.al,

GI 523 DIGITAL PROCESSING OF REMOTELY SENSED DATA

Pixel bands, digital numbers(DN), Grey level, image formats like BIL, BSQ, RLE etc., header, DPI, Look up Table (LUT). Special relevance to remote sensing satellite, images for read, write and display tasks. Coomercial image processing system software.. Geometric and radiometric correction, establishing, spatial transformation, model using GCP's, intensity interpolation techniques (nearest neighbour, bilinear and cubic convolution).

Contrast manipulation: Grey Level thresholding, level slicing and contrast stretching. Spatial feature manipulation: spatial filter, edge enhancement and Fourier analysis. Point, local and regional operation – Fourier transform, scale- space transform, wavelet transform –principle component analysis- Multi image manipulation: Multi-band rationing and differencing principal components, vegetation indexes, color composition (True and False Color Composite) and Intensity Hue Saturation (IHS).

Image histogram, mean, standard deviation, variance, covariance matrices. Image display alternatives: mono and color, composites of MSS, Band Combination and optimum index factor (OIF), Variance-Covariance and correlation matrices. Pattern recognition, boundary detection and representation, textural and contextual analysis,

Image Classification and thematic information extraction, General steps for land cover information extraction, classification levels and supervised and unsupervised classification techniques, selection of

appropriate algorithms for classification: Parallelopiped, Minimum distance, Maximum likelihood, Isodata, fuzzy classification, classification accuracy assessment. Hybrid training, Non- parametric, and sub-pixel classification, Hyper – spectral image analysis.

References

1. Physical Principles of Remote Sensing,   W.G.Rees -
2. Remote sensing models & methods for image processing,   Robert Shcowebgerdt ,
3. Digital Image Processing   Rafael C. Gonzalez , Richard E. Woods
4. Remate Sensing Digital Image Analysis   John A.Richards,

GI 524 GPS AND GIS LABORATORY

Practical exercises on the use of GPS for field data collection and GIS data storage & analysis techniques

GI525 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department Elective

GI 531 REMOTE SENSING & GIS FOR ENVIRONMENTAL ENGINEERING

Revenue management-environment and ecological concerns- Resource development in remote areas- Impacts of anthropogenic activity- Solid Waste management- Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status. Taxonomical classification of soils, soil survey interpretation and mapping, impact of agricultural and industrial activity on soil properties. soil salinity/alkalinity, erosion studies, Applications of GIS in assessing soil salinity, erosion productivity etc. Classification of water quality for various purposes. Data base creation and quality modeling using GIS. Database Creation and maintaining water supply network, sewerage network using GIS. Case studies. Aquifer Vulnerability Intrinsic and specific vulnerability.

Atmosphere: Chemicals, Particulate matters present in the atmosphere, allowable limits, Remote Sensing technique to monitor atmosphere constituents, air pollution due to industrial activity, modeling using GIS case Studies.. Introduction to environmental satellites GEOS, NOAA, AVHRR, etc. for Monitoring land, water, atmosphere and ocean using Remote Sensing Data, case studies.

References:

1. Integrated Solid Waste Management Techobanoglous   George, Hilary Theisen,   Samuel Vigi,
2. , GIS for sustainable development   Michele Campagna

GI 532 MICROWAVE REMOTE SENSING

Introduction and early history, Basic concepts, plane waves, antenna systems, radiometry, microwave interactions with atmospheric constituents, Earth's surface and vegetation, Radiometric systems, Sensors, Data products and its applications.Radar Basics, Radar interaction with Earth surface and vegetation, Surface scattering theory. Radar equation, fading concept, Measurement and discrimination, Physical mechanisms and empirical models for scattering and emission, Geometry of Radar images, Radar return and image signature, Resolution concepts, SAR, Speckle in radar imagery, concept of roughness, geometry of targets, resonance, dielectric constant, surface and volume scattering, signal penetration and enhancement.

Airborne, Spaceborne, different platforms and sensors, Data products and selection procedure, SEASAT,SIRA,SIRB,ERS,JERS,RADARSAT missions, Doppler radar, JASON,TOPEX/POSEIDON, Aircraft: AirSAR, C/X SAR, E-SAR, STAR-1. SAR   interferometry-Basics-   differential   SAR

interferometry, Radar polarimetry-Radargrammetry and applications-Altimeter and its applications, scatterometer and its applications.

Applications in Agriculture, Forestry, Geology, Hydrology, ice studies, landuse mapping and ocean related studies, military and surveillance applications, search and rescue operations, ground and air target detection and tracking.

References:

1. Microwave remote sensing vol-1,vol-2   Ulaby,F.T.,Moore,K.R. and Fung,
2. Principles and applications of Imaging   Floyd.M.Handerson and Anthony,J.Lewis
3. Air and spaceborne radar systems-An introduction,
      Philippe Lacomme,Jean clande Marchais,Jean-Philippe Hardarge and Eric Normant,
4. Introduction to microwave remote sensing,   Iain H.woodhouse,

GI 533 AIR BORNE LASER TERRAIN MAPPING

LASER , LiDAR – Principles and properties – Different LiDAR system – Applications – Advantages, Disadvantages – Space borne and airborne LiDAR missions – Typical parameters of a LiDAR system.Principle of Laser Altimetry – Components of the system – GPS, IMU LASER, LiDAR data formats – Terrain Mapping Laser Configuration – Ocean bathymetry Laser Configuration   - Limitations of the system. GPS and IMU data processing – Strip Adjustment – Geometric Correction – Data quality enhancement – Digital Surface Model – Filtering – Ground Point Filtering – Digital Elevation Model.

Hydrology, Disaster Mitigation and Management – 3D city models – Telecommunication Modeling – Urban planning – Coastal Zone Bathymetry Mapping – Feature extraction, vectorisation – Surface and landuse classification.

Orthophoto rectification using LiDAR – Integrated LiDAR and Digital Photogrammetry Techniques – Integration of LiDAR DEM with other hyper spectral data.

References:

1.Laser Altimetry: Principles and Applications   Mathias Lemmens,
2.Digital Photogrammetry   Yves Egels and Michel Kasser,
3.Manual of Aerial Survey: Primary Data   Acquisation,   Roger Read and Ron Graham,
4.Digital Terrain Modeling: Principles and Methodology,
                              Zhilin Li Qing Zhu, Chris Gold, Christopher Gold,

GI 534 HYPERSPECTRAL REMOTE SENSING

History and Description of Hyperspectral Imaging, Spectral Radiometry, Imaging Spectrometers, Hyperspectral Remote Sensing and the Atmosphere, Information Extraction from Optical Image Data, Hyperspectral and Ultraspectral Information Extraction Approaches, AVIRIS data, JPL data and USGS hyperspectral data classification, Application of Hyperion data in Agricultural, Environmental, Forestry , Geology, Mining and coastal mapping.

References:

1. Hyperspectral Remote Sensing, Principles and ApplicationsMarcus Borengasser,William S. Hungate
2. Introductory Digital Image Processing,   Jensen, J.R..
3. Remote Sensing and Image Interpretation,   Lillesand, T.M. and Kiefer, R.W.

GI 535 REMOTE SENSING AND GIS FOR HYDROLOGY AND WATER RESOURCES

Hydrological cycle, estimation of various components of hydrology cycle, clouds, rainfall, runoff evaporation, transpiration , evapo–transpiration, interception, depression storage, spectral properties of water, GIS application in surface water modeling , case studies. Watershed divide, stream networks, Delineation and codification of watersheds morphometric analysis, linear, areal, relief aspects, Rainfall-

runoff modeling , urban hydrology, case studies.   Mapping of snow covered area,   snow melt runoff,   flood forecasting, risk mapping and flood damage assessment soil moisture area   drought forecasting and damage assessment, GIS application in aerial assessment , case studies

Project investigation, implementation, maintenance stage- location of storage/ diversion works   canal alignment, depth-area capacity   curve generation,   conjunctive use of surface and ground water, Mapping and monitoring the catchment command area,   artificial recharge of groundwater,   water harvesting structures,   sediment yield,   modeling of reservoir siltation,   prioritization of watershed, modeling of sustainable development,   Development of information system for Natural resource management, case studies. Applications of Remote Sensing, GPS & GIS in water resources projects.

References

1.   Satellite Remote Sensing for Hydrology and Water   Management,   Eric C. Barrett, Clare H.Power,
2.   Hydrologic and Hydraulic Modeling Support with Geographic Information Systems
                                                                Dr. David Maidment, Dr. Dean Djokic,
3.   Hydrology: An Introduction   Wilfried Brutsaert,
4.   Trimble, Environmental Hydrology   Andy D. Ward and Stanley W.

GI 536 CHANGE DETECTION USING REMOTE SENSING

Definition and importance of Change detection, Land use Land cover, Classification of Multitemporal data sets, LULC classification system, Stages of land use land cover classification, General Methods of change detection for land use land cover, Change Detection Based on Remote Sensing Information Model.

Algebraic methods of Change Detection, principle components, post classification comparison, Multivariate alteration detection (Canonical correlation analysis, Orthogonality properties, Scale invariance, iteratively reweighted MAD, Correlation with the original observation, postprocessing), Decision thresholds and unsupervised classification of changes, Radiometric Normalization.

Image Fusion techniques of change detection, Change Vector analysis Technique, Change detection using remote sensing technology as a tool for Natural hazards planning and damage assessment.

Urban change detection mapping and analysis, Landslides, causes of landslides, Factors affecting, Detection of landslides using remote sensing and GIS techniques.

References:

1. Remote sensing and image interpretation   Lillesand and Kiefer .
2. Image analysis Classification and Change Detection in remote Sensing with algorithms for ENVI/IDL
                                                                Morton J Canty .
3. Remote Sensing and GIS accuracy Assessment   Ross Luneta and John G Lyon
4. Spatial statistics for Remote Sensing-   Alfred Stein, Freek Vander Meer and Ben Gorte - Kluwer

GI 537 REMOTE SENSING AND GIS FOR EARTH SCIENCES

Introduction – Rocks and Minerals, image characters of igneous, sedimentary and metamorphic rocks - Lithological mapping using aerial and satellite data- Structural Geology, introduction, Mapping structural feature such as folds, Lineaments / faults, fractures image characters of folds, faults, lineaments etc., - Digital techniques for lithological and structural analysis , case studies.

Spectral properties of geologic features in different regions of Electromagnetic Spectrum, Elemental composition and nature of the spectra of rocks and minerals, Optimal spectral windows , Geologic Remote sensing and its significance in Geologic mapping - case studies. Geomorphic   Landforms, Drainage network and patterns classification and implications of drainage patterns, geomorphic mapping using, aerial and satellite data - Landform analysis in natural resources and management case studies.

Different types of Geophysical Surveys, Electrical resistively surveys, aeromagnetic surveys Electromagnetic surveys Seismic surveys, Planning Geophysical surveys using satellite data Applications of different types of geophysical surveys in resource mapping , case studies.

Introduction, Applications of Remote Sensing and GIS for Resource mapping, monitoring and management , Preparation of thematic layers , Integration of all relevant primary and secondary data using GIS in Surface and groundwater studies - Engineering Geology, Mineral exploration and Petroleum exploration, Disaster Management studies like Droughts, Floods-Case studies.

References:

1. Applications and Investigation in Earth science
   Frederic k. lutgens, kennth G.pinzke and Edward j. tarbuck
2. Remote Sensing principles and interpretation   Sebins, F.
3. Engineering and General Geology   Parbin Singh
4. image interpretation in Geology   Drury, S.A.
5. Fundamentals of GIS,   Michael N.Demers

GI 538 DIGITAL PHOTOGRAMMETRY

Evolution of digital photogrmmetry – Phases of Photogrammetry - comparison of analog, analytical & digital systems – advantages – automation – accuracy- representation of digital images B/W – RGB – HIS - image source – analog and digital cameras

Digital cameras- CCD camera- full frame, frame transfer, interline CCD camera - Time delay integration-spectral sensitivity of CCD sensor – geometric problem of CCD image – line jitter, blooming,warm up effect – tralling – types of CCD systems - Linear array line scanner – use of CCD scanner in high resolution satellites, SPOT, MOMS, IRS, IKONOS and Quickbird.

Image Generation - Data Compression - formats - Data procuring concepts – Georeferencing - Stereo viewing - Display modes - image matching techniques - Image measurements - symbol library - feature coding.

Review of space resection & intersection - interior & exterior orientation - Automatic tie point generation - Automatic Block triangulation, feature collection and plotting annotation - editing – various formats of map data.

DEM Generation - accuracy of DEMs, Orthorectification - regular & irregular data collection methods - contour generation - watershed delineation - satellite photogrammetry principles – missions - stereo image products - issues - stereo satellite missions.

References:

1. Digital Photogrammetry: A Practical Course   Wilfried Linder,
2. Fundamentals of Computational Photogrammetry   Ghosh, Sanjiv.k
3. Image Sensors and Signal Processing for Digital Still   Cameras Junichi Nakamura,
4. Digital Terrain Modeling: Principles and Methodology   Zhilin Li, Qing Zhu, Chris Gold,

GI 539 REMOTE SENSING AND GIS FOR AGRICULTURE & FORESTRY

Introduction , Spectral properties of crops in optical & TIR region, Microwave backscattering behavior of crop canopy , crops identification and crop inventory, crop acreage estimation, vegetation indices, Yield modeling , crop production forecasting through digital analysis, crop condition assessment , command area monitoring, land use and land cover analysis, Microwave RS for crop inventory , Case studies

Introduction, soil genesis, Soil morphological characters, Soil pedology, Soil survey, Types and methods of soil surveys, Soil classifications, Hydrological Soil grouping , Characteristics of saline & alkaline Soils , Factors influencing soil reflectance properties, principle component analysis and orthogonal

rotation transformation, Soils mapping using RS data, Problem soil identification and mapping , land evaluation, Soil sedimentation & erosion, Soil loss assessment , Soil conservation , Case studies

Detection of pest & diseases, Flood mapping and Assessments of crop loss , Remote sensing capabilities & contribution for drought management, Land degradation due to water logging & Salinity, crop stresses reflectance properties of stressed plants and stress detection.

Introduction, Forest taxonomy , inventory of forestlands , forest types and density mapping using RS techniques, Forest stock mapping, factors for degradation of forest, Delineation of degraded forest - Forest change detection and monitoring , Forest fire mapping & damage assessment , LiDAR remote sensing for Forest studies.

Introduction, Integrated surveys for agriculture & forest development , RS & GIS for drawing out action plans, water shed approach , Rule of RS & GIS for watershed management , Land use planning for sustainable development, Precision forming, Case studies.

References
1. Wetland & Environmental application of GIS,   John G. Lyon, Jack MCcarthy,
2. Hyper spectral RS of tropical and sub -tropical forest   Margareb Kalacska, G. Arturosanchez,
3. Advances in land RS: System, modeling invention and   applications   Shunlin liang
4. Soil mineralogy with environmental application, Library of congress   Joe Boris dexon

Open Elective

STR551 ADVANCED SOFT COMPUTING TECHNIQUES

Artificial Neural Systems – Perceptron – Representation – Linear separability – Learning – Training algorithm – The back propagation network – The generalized delta rule – Practical considerations – BPN Geomatic applications. Hopfield nets – Cauchy training – Simulated annealing – The Boltzmann machine. Associative memory – Bidirectional Associative Memory Network – Geomatic Applications.

Counter propagation network and self organizing maps: CPN building blocks – CPN data processing. SOM data processing - Adaptive Resonance Theory network - Geomatic Applications

Fuzzy logic: Fuzzy sets and Fuzzy reasoning – Fuzzy matrices – Fuzzy mebership functions – Operators Decomposition – Fuzzy automata and languages – Fuzzy control methods – Fuzzy decision making

Neuro – fuzzy modeling: Adaptive networks based Fuzzy interface systems – Classification and Regression Trees – Data clustering algorithms – Rule based structure identification – Neuro-Fuzzy controls – Simulated annealing – Evolutionary computation - Geomatic Applications.

References
1. Neural Networks – Algorithms, Applications & Programming Techniques
                                                       James Freeman A. and David Skapura M.
2. Fuzzy Logic with Engineering Applications   Timothy J.Ross,
3. Artificial Neural Networks   Yegnanarayana B.
4. Fundamentals of Neural Networks   Lqurene Fausett
5. Neuro-Fuzzy and soft computing   Jang J.S.R., Sun C.T. and Mizutani E

STR 552   FINITE ELEMENT METHODS

Introduction to Finite Elements, Plane Stress and Plane Strain, Axi-Symmetric Stress Analysis, Elements in 2– D and 3-D Problems, Three Dimensional Stress Analysis, Nonlinear analysis.

References
1. Finite Element Analysis Theory and Programming   Krishnamoorthy, C.S.
2. Introduction to Finite Element Method   Desai, C.S. and Abel, J.F.

3.	The Finite Element Method in Engineering.	S.S.Rao
4.	The Finite Element Method	Zinkiewicz, O.C. and Taylor, R.L
5	An Introduction to Finite Element Method.	Reddy, J. N.,

ENV552 ENVIRONMENTAL MODELLING

Systems approach - concept and analysis. problems formulation, model construction and deriving solution from models. modelling of wastewater management systems- model formation and solution. modelling of pesticide management problems; optimization model for planning municipal wastewater treatment.

Lagrange multipliers- unconstrained and constrained optimisation, limitations. sequential search algorithms- box algorithm, limitations linear programming models, solution and sensitivity analysis; general linear programming models for air quality management of agricultural non-point source pollution. separable and integer programming- application to multi-objective planning. application of integer programming to municipal solid waste management. transportation models. dynamic programming models- application to land use planning and air pollutant emission control. present value concepts-optimization over time.

References

1.	Handbook of Environmental and Ecological Modelling	H. Sorensen B., Nielsen S.N et al
2.	Fundamentals of Atmospheric Modelling	Jacobson Mark Z.
3.	An Introduction to Water Quality Modelling	James A. (Ed)
4.	Techniques for Environmental System Analysis	R.H.Pantell

ENV552 GLOBAL ENVIRONMENTAL ISSUES AND ETHICS

Earth capital – natural resources, renewable and non-renewable ecosystem services, biogeochemical cycles, redundancy & biodiversity, environmental degradation and its impacts on various cycles.

Society and use of fossil fuels, carbon dioxide & global warming, the likely impacts, the importance of mitigation on methane, connections with meat eating and livestock, sectoral contributions, international interventions and the role of united world action.

Biodiversity & introduced species, ecosystem components, species interactions, loss of habitats and adaptation, bio-concentration and bioaccumulation, loss of food webs.

Genetically modified foods and their fallouts, green revolution, and the consequences of food grown on chemical fertilisers and pesticides, urbanisation and its consequences, fallouts of expanding transportation, housing, and lifestyle sectors. spread of modern diseases, case studies of significant environmental problems and disasters and the lessons learnt, historical role of technology, and the consequences of modern technology.

Role of environmental ethics, Anthropo-Centric versus eco-centric world views, ecological traditions, Religio- philosophical approaches, semitic versus non-semitic perceptions of environment and their fallouts, role of science and technology in environmental degradation and conservation, the concept of deep ecology and Gaia hypothesis.

References:
1. Global Environmental Issues	Frances Harris
2. An introduction to global environmental issues: instructor's manual	Kevin T. Pickering
3. Global environmental issues: A climatological approach	David D. Kemp

ENV553 ENGINEERING ENVIRONMENTAL LEGISLATION

Environmental acts - their need, historical background, national and international acts and agreements, genesis of environmental acts - general procedure followed in changing a bill into an act; implementation of an act, role of executive, legislature, and judiciary. legislative powers and their limitations.

Major National Acts – The Water (prevention and control of pollution) Act, The Air Act, The Environment (protection) Act, Hazardous waste Rules, Biomedical Waste (Management and Handling)

Rules,, Municipal Solid Waste Rules, Batteries (Management and Handling) Rules, e-waste (management and handling) Rules, Prevention of Cruelty to Animals (Slaughter House) Rules, Slaughter Act.

Role and Functions of the Central and State Pollution Boards and the powers vested in them., Municipal Acts, Acts related to Land Ownership and use, Factory Act, Acts related to Environmental and Occupational health, Industrial hygiene, Significant International and Interstate Conventions and Treaties on issues such as Climate Change, Ozone depletion, Riparian Rights and sharing of Waters etc, ISO: 14000 - its need, procedure and significance, ISO: 14000 Certification, National Certifications, Role of BIS, Role of Public Hearing, Non -Governemntal Organisations and their role, Role of Civil Society, and Judiciary, Water Policy, Rehabilitation Policy, and other related major policies of the government of India. Amendments to various Acts from time to time.

References
1. Environmental Legislation in India   K.R. Gupta
2. Environmental Law   DS Sengar
3. ISO 14001 and beyond: environmental management systems in the real world
                                                         Christopher Sheldon

GEO551 ADVANCED SOFT COMPUTING TECHNIQUES

Artificial Neural Systems – Perceptron – Representation – Linear separability – Learning – Training algorithm – The back propagation network – The generalized delta rule – Practical considerations – BPN Geomatic applications. Hopfield nets – Cauchy training – Simulated annealing – The Boltzmann machine. Associative memory – Bidirectional Associative Memory Network – Geomatic Applications.

Counter propagation network and self organizing maps: CPN building blocks – CPN data processing. SOM data processing - Adaptive Resonance Theory network - Geomatic Applications

Fuzzy logic**:** Fuzzy sets and Fuzzy reasoning – Fuzzy matrices – Fuzzy mebership functions – Operators Decomposition – Fuzzy automata and languages – Fuzzy control methods – Fuzzy decision making

Neuro – fuzzy modeling: Adaptive networks based Fuzzy interface systems – Classification and Regression Trees – Data clustering algorithms – Rule based structure identification – Neuro-Fuzzy controls – Simulated annealing – Evolutionary computation - Geomatic Applications.

References
1. Neural Networks – Algorithms,   Applications & Programming
                                     James Freeman A. and David Skapura M.,
2. Fuzzy Logic with Engineering Applications   Timothy J.Ross, "
3. Artificial Neural Networks   Yegnanarayana B.,
4. Fundamentals of Neural Networks   Lqurene Fausett

HYD552 COMPUTER APPLICATIONS TO HYDRAULIC SYSTEMS

Object oriented programming, data type and operators, control statements arrays, pointers, functions, classes, function and operator overloading, polymorphism, finite difference, roots of linear and nonlinear equations, polynomials, curve fitting, regression, interpolation, numerical integration and differentiation, computer programs related to hydraulics problems.

References
1. Programming in C++   M. Kumar
2. Numerical Methods for Mathematics   Mathew John H
3. Numerical Method for Engineers   SC Chapra and RP Canale,
4. Programming with C++,   D. Ravi Chandran,

HYD553 COMPUTATIONAL FLUID DYNAMICS
Introduction and overview of CFD, Accuracy and errors, consistency, stability and convergency, applications areas, differential flow equations, initial and boundary conditions, finite difference method, finite element method, finite volume method, turbulence models, type of grids, grid generation methods, application to flow governing equations.

References

1. Computational Fluid Flow and Heat Transfer   Murlidhar K. & Sundararajan
2. An Introduction to Computational Fluid Dynamics   Versteeg H.K.& Malalasekera W
3. Turbulent Flow   Garde R.J
4. Numerical Heat Transfer and Fluid Flow   Patankar Suhas V

TRE551 PROBABILITY & STATISTICS
Concept of Probability theory and statistics and numerical methods for solving engineering problems, testing of hypothesis, concept of design of experiments, correlation and regression.

References

1. Engineering mathematics   Grawal
2. Engineering mathematics   H.K.Dass

TRE552 OPTIMIZATION TECHNIQUES
General optimization procedures, programming techniques and its application in transport infrastructure problem, unconstrained and constrained optimization, search techniques, Fibonacci and golden search, reliability concepts in engineering.

References

1. An introduction to Numerical Methods and Optimization Techniques   R.W.Daniels,
2. Engineering Optimization   S.S Rao

TRE553 OPERATION RESEARCH
Introduction: Definition and scope of operations research, problem formulation and model construction.Linear Programming: Concept of optimality, graphical solution, simplex method, duality, sensitivity analysis, degeneracy, Transportation and assignment model: Transportation and assignment problems as special cases of linear programming, balanced and unbalanced transportation problem, assignment problem, trans shipment problem.

Network analysis: Project planning, difference between PERT and CPM, crashing of network , resource leveling, probability calculations in PERT analysis.

Queuing theory: Introduction to probability theory, queuing problem, case of poison arrivals and exponential service time for single channel system,

References

1. Quantitative Techniques in Management   N. D. Vohra
2. Operation Research   P.K. Gupta & D.S. Hira,
3. Operation Research   Sesiani, Arkoff & Arkoff

TRE554 ENGINEERING ECONOMICS AND PROJECT MANAGEMENT
Introduction to economics, its importance, principles, engineering and economics, economic problems, demand and supply, employment and income, gross national product, net national product consumption. accountancy & book keeping cash book profit & loss accounts, auditing of bills and vouchers, various forms used in construction work. measurement book, material at site account, imprest account. stock tools and plants, various types of running bills, secured advance and final bills.

Project management : principles and functions of management, management of construction projects. construction site management : construction site, organization charts and manuals, personnel in construction, welfare facilities, labour laws and human relation, safety engineering,specifications and contracts & types of specification, specification of various trades ofengineering works.contracts: different types of contracts, notice inviting tenders, contract documents,departmental method of construction, security deposit, earnest money, administrative approval, technical sanction, condition of contract and arbitration.

References
1. Construction engineering and Management   S. Seetharaman,
2. Principles of construction management   Roy Pilcher
3. Operation research   P.K. Gupta and D.S. Hira.

WRE551 GEOSPATIONAL TECHNIQUES IN WATER RESOURCES ENGINEERING

Introduction to Geospatial Technologies. Usefulness in Water Resources Engineering.   Fundamentals of remote sensing - Interpretation - Equipments - Techniques of data acquisition – Satellites   and sensors – Digital Image processing.Introduction to GPS - Working principle of GPS - Measurement and mapping techniques.Introduction - Geo referenced data - Data input & output - Data quality and management - GIS analysis functions - Implementation of GIS.Geospatial Analysis-Methods - Measurements - Analysis – GeovisualizationDifferent geospatial technology software - Salient features – Capabilities.Application of Geospatial Technologies to Water resources Engineering - Case studies

References
1. Essentials of GPS   Agrawal N.K.,.
2. Remote Sensing and GIS   Bhatta B.,
3. Remote Sensing and Image Interpretation   Lillesand T.M. and Kieter R. W.,
4. Geographical Information Systems   Stan Aronoff,

WRE552 FINITE ELEMENT METHOD FOR WATER RESOURCES ENGG.

Basic concepts of mathematical models and numerical simulation, Initial and boundary value problems, classification of partial differential equations, flow governing equationsapplid to water resources, features and steps of FEM analysis, weak formulation, Ritz method, weighted residual methods, discretisation of domain, coordinate systems, interpolation functions, element matrix, assembly of element matrices, application of boundary conditions, solution of algebraic equations, numerical integration, parametric formulations, serendipity elements, Jabobians, application of FEM to simple discrete system and continuous domain problems of water resources

References
1. An Introduction to The Finite Element Method   Reddy J.N
2. Finite Element Analysis- Theory and Programming,   C.S. Krishnamoorthy
3. Finite Element Handbook,   H. Kardestuncer

WRE 553 TRANSIENTS IN PIPE FLOW

Causes of transients; Governing Equations; Method of characteristics; Transients in pumping schemes and hydro electric schemes; Transient bubble flow; Transient control.

TH551 NON CONVENTIONAL THERMAL ENERGY SYSTEM

Energy sources   & Availability, Solar Energy, Solar radiation data & solar charts, solar energy storage devises, application of solar energy solar cookers, solar still, solar refrigeration, active & passive heating system, Solar photovoltaic system – principle, main parts & modules. Solar Collectors, Design of flat plate collector-characteristics, loss-coefficient, heat transfer analysis. Solar water   heating   system. Biomass Energy, Utilisation of biogas – Gasifiers, direct thermal   application of Gasifiers. Advantages & problems in development of Gasifiers, Other Energy Sources, Geothermal Energy: Status   & estimates, geothermal sources, geothermal   systems & their characteristics, Fuel Cells. Energy form thermo nuclear fusion, OTEC, hydrogen, thermoionic generation & tidal & waves.

References
1. Principles of Solar Energy   - Duffy & Beckman
2. Solar Energy   - S.P. Sukhatme

TH 552 THERMAL POWER PLANT ENGINEERING

Siting of Power Stations & Plant Layout, Power Plants Economics, Load curve, Load duration curve, Load factor and diversity factor. Effect of load curve and diversity factor on the performance of power plant.Duct Work,Piping and Insulation, Design and layout of ducting for air, fuel, Pipe insulation. Optimum and Economic thickness. Specification of insulation. Power Plant Components,

Radiant superheaters and reheaters, economizer and preheaters. Plant Instrumentation, General & Special Instrumentation, centralized & automatic control equipment, types of controls.Supercritical Power Stations, principle of working, Power Plant Testing, Preliminary performance checks, acceptance tests for various components. Power Plant Management:Operation and Maintenance of Turbines:

Starting, loading and stopping of turbine, normal operation checks, maintenance logging, parallel operation.

References

1. Power Plant Engineering   - Arora & Domkundwar
2. Power Plant Engg   - P.K.Nag

ID 551 APPLIED ERGONOMICS

Human being in man-made world. Gross human anatomy, anthropometrics, static and dynamic, muscles and work physiology, static and dynamic work including maximum capacity. Biomechanics, environmental condition including thermal, illumination noise and vibration, biological transducers and nervous system including their limitations. Controls and displays psycho physiological aspects of design. Research techniques in ergonomic data generation. Interpretation and application as statistical methods. Case analysis. Project work involving ergonomic design research for product systems.

ID 552 CONCURRENT ENGINEERING

Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team. Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools. Quality by design: Quality Function Deployment methodology, Taguchi methods of robust design, Design for manufacturability: Virtual manufacturing, Introduction to Value Engineering, Value Engineering analysis and techniques, Design for assembly: Introduction to various DFA technologies.

Rapid Prototyping: Need and use of RP, various RP technologies, Design for Reliability: Reliability fundamentals and design for reliability principles, Design for Serviceability: Factors affecting serviceability, serviceability evaluation, Design for Maintainability and Economics.

References

1. Concurrent Engineering, shortening lead times, raising quality & lowering costs
                                                                     John. R. Hartley, Susmu Okamato.
2. Total quality development, a step by step guide to world class concurrent engineering
                                                   Don Clausing,
3. Concurrent engineering, what every engineer should know about series   Thomas A. Salomone

ID 553 - DESIGN OF COMPUTER AIDED ENGINEERING SYSTEM (CAE)

Over view of CAD, CAE system design and implementation processor requirements analysis, functional specifications, outline systems design, components of cae system, project management.

MT551 THEORY OF TRIBOLOGY ELEMENTS

Introduction to Tribology: Theoretical Back ground , engineering surface, laws of friction, sliding & rolling, dry and lubricated riction, lubricated friction.Wear, its types, abrasive, adhesive, corrosive,

erosive, fretting, fatigue & cavitation wear, practical examples, wearreduction measures, prevention of wear, Lubrication Principle : Principle of lubrication, lubrication regimes, boundary lubrication, Hydrodynamic and Hydrostatic lubrication, Elasto hydrodynamic lubrication, types of lubricants, solid, liquid, semi solid and gaseous lubricants, lubricant additives.

Tribo Elements - I - Bearings : Bearings types, journal bearings, important parameters for better performance, special additives, rolling   element bearings, their types and important parameters in their selection. Tribo Elements - II – Gears: Gears, gear types, gear drives, gear loces and reduction gears, selection of gear drives, gear lubrication and maintenance, gear failures. Chains for power transmission, types, service factors, maintenance and lubrication of chains.

Tribo Elements - III - Seals : Metallic and elastomeric seals, non contacting seals for   rotating   shafts, radial lip seals, mechanical face seals, selection of seal types for rotating shaft application. Seal failure, its analysis. Practical consideration in use of seals.

References

1. Basic Lubrication Theory   A Cameron
2. Friction and Lubrication in   Mechanical Design   A.A. Seireg
3. CRC Hand book of lubrication – Vol. II   Ed. E.Richard Booser
4. Hand Book of fluid sealing   Ed-R.V. Brink

MT552 MAINTENANCE ECONOMICS AND TURN GROUND MANAGEMENT

Objective: To introduce the concepts of economic theory and behavior for preparing the strategic financial models for maintenance investment decisions. Fundamentals concepts of economics: Scope, definition, characteristics of economic, relationship to the functional areas of business, theory of firm, its constraints and limitations, nature and function of profit, basics of demand and supply equilibrium.

Demand Analysis: Demand theory, demand estimation, simple multiple regression analysis, demand forecasting- qualitative forecasts; survey techniques, opinion polls, quantitative forecasts; time – series analysis, smoothing techniques input-output forecasting. Production and Cost Analysis: Production theory and estimation, production function, returns to scale, comparative advantage, cost theory and estimation, short-run and long run costs, plant size and economies of scale, learning curve, cost-volume profit analysis and operating leverages, cost estimation based on project cost, types of costs, inter-alias, design, installed capital, commissioning and decommission costs, operating costs maintenance and opportunity costs, life cycle costs, cost output analysis and maintenance cost history .

Product/project Life Cycle: Concepts of product/project life cycle capital assets, reliability and risk, life cycle costs and its economic consequences for strategic development. Project financing and capital structure, financial leverages, working capital and capitalization. Turnaround:Characteristics of the maintenance work load, critical path analysis and its use for the planning of large shutdowns, procedure of managing shut downs; Initiation, validation of work scope, organizing preparatory work , contractor packages, shutdown plan,manpower plan.   A typical shutdown operation-administrative and resource structures, site logistics plan and its preparation, cost profile, safety and quality plans, executing and controlling the shutdown, review procedures.

References

1. Managerial Economics   Salvatore
2. Applied Economics for Engineers and Managers   S.K. Jain
3. Engineering Economics   Tarachan
4. Industrial maintenance management   Srivastava

MT 553 COMPUTER AIDED MAINTENANCE MANAGEMENT

Introduction Definition Basic components of CMMS, Uses of Computers in Maintenance CAMSS Justification reasons for lack of CMMS effectiveness

Basic Hardware Components General Software categories, fundamentals of C, CH, Network Software, Networking CAMSS Softwares, Flowchart Algorithms & Programming.

Approach towards Computerization, selction of computer system, Master files, Maintenance files, Maintenance Module, classification records, Preventive and repair planning module, codification for Break down, job sequaning files/records.

Developing softwares:- Planning & Scheduling equipment & facilities control, work central Maintenance of spare parts and inventory centre performance reporting and other tools and techniques of Industrial engineering used in Maintenance Management.

References

1. Maintenance Engineering Hand book   Kindly lIndley and R Higgins
2. Engineering Maintenance Management   Benjamin W.Niebel
3. Industrial Maintenance Management   S.K. Shrivastava.
4. Maintenance Planing & Central   Anthony kelly

EM551 ADVANCED MECHANICS OF MATERIALS

Stress concentration and its determination, Contact & Residual stresses, Rotating rims, discs, cylinders, With and Without Temperature variations, Bending of curved bars, Stresses and deflection calculations, Pressure Vessels, Unsymmetrical bending, Beam Columns, Bending of Beams of Variable cross Sections. Torsion of non-circular bars.

References

1.Advanced Mechanics of materials   Boresi
2 Advanced Mechanics of materials   Cook
3 Mechanics of Materials   E.J. Heavan
4 Strength of Materials   Timoshenko

CH551 POLLUTION CONTROL & ENGINEERING AND SAFETY

Introduction: Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards for ambient air, noise emission and effluents. Pollution Prevention: Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization, Fugitive emission/effluents and leakages and their control-housekeeping and maintenance. Air Pollution Control: Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers. Water Pollution Control: Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation. Biological Treatment: Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying. Solids Disposal: Solids waste disposal – composting, landfill, briquetting / gasification and incineration. Process Safety: Process safety, accident and loss statistics, nature of the accident/hazardous process, hazardous substance classification and hazardous substance rules; Factories Act.

Reference

1. Pollution Control Acts, Rules, Notifications issued there under" CPCB, Ministry of Env. and Forest, G.O.I., 3rd Ed. (2006).
2. Fundamentals of Air Pollution   Vallero D.,
3. Industrial Water Pollution Control   Eckenfelder W. W.,
4. Handbook of Solid Waste Management   Kreith F. and Tchobanoglous G.,

CH 552 MODELING & SIMULATION OF CHEMICAL ENGG. SYSTEMS

Introduction to modeling, a systematic approach to model building, classification of models. Conservation principles, thermodynamic principles of process systems.

Development of steady state and dynamic lumped and distributed parameter models based on first principles. Analysis of ill-conditioned systems.

Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.

Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method. R-K method, shooting method, finite difference methods. Solving the problems using MATLAB/SCILAB.

Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods.

Sequential modular, simultaneous modular and equation oriented approaches; Partitioning and tearing; Simulation examples of fluid flow, heat transfer, mass transfer and reaction processes; Monte Carlo simulation.

Reference

1. Process Modelling and Model Analysis   K. M. Hangos and I. T. Cameron,
2. Process Modelling, Simulation and Control for Chemical Engineers   W.L. Luyben,
3. Computational Methods for Process Simulation   W. F. Ramirez,
4. Numerical Methods and Modelling for Chemical Engineers   Mark E. Davis,

CH 553 INDUSTRIAL CATALYSIS

Review of Heterogeneous Catalysis: Role of catalyst components and other constituents, characterization of catalyst and its support. Transport Processes: Analysis of external transport processes in heterogeneous reactions in fixed bed, fluidized bed and slurry reactors. Intrapellet mass transfer, heat transfer, mass transfer with chemical reaction and simultaneous mass and heat transfer with chemical reaction. Catalyst Selectivity: Effect of intrapellet diffusion on selectivity in complex reactions, effect of external mass transfer on selectivity. Catalyst Deactivation: Modes of deactivation – poisoning, fouling and sintering. Determination of deactivation routes, combined effect of deactivation and diffusion on reaction rates, effect of deactivation on selectivity. Reactor Design: Design calculation for ideal catalytic reactor operating at isothermal, adiabatic and non-adiabatic conditions. Deviations from ideal reactor performance. Design of industrial fixed-bed, fluidized bed and slurry reactors. Thermal stability of packed bed and fluidized bed reactors, Overview of various areas of Green chemistry, Successful approaches to Green Chemistry education.

Reference

1. Chemical Engineering Kinetics   Smith, J. M.,
2. Catalytic Reaction Engineering   Carberry, J. J.,
3. Heterogeneous Catalytic Reactors,   Butterworth.   Lee, H. H.,
4. Catalytic Reactor Design   Tarhan, M. O.

CH 554 PHARMACEUTICAL TECHNOLOGY

Practice of the following unit operation in pharmaceutical industries: Heat transfer, evaporation, distillation, dry, mixing size reduction, crystallization, filtration, size separation, conveying, humidification, air conditioning and refrigeration.

Formulation, development of sterile dosage forms. Production facilities, environmental control and personnel in the production of sterile dosage form, compounding, processing, filtration, sealing, sterilization, packing and labeling of sterile dosage forms. Quality control tests like sterility, pyrogen, clarify, safety and leakage testing.

Types of tablets. Manufacturing of tablets by wet granulation, dry granulation and direct compression. Tablet processing problems and defects, tablet standardization: hardness, friability, weights variation, disintegration, dissolution and content uniformity tests.

Capsules: Hard gelatin capsule, capsule size, formulation and preparation of filled hard gelatin capsules, soft gelatin capsule, soft gel – manufacturing procedures. Quality control of capsule. Cosmetics and Toiletries: Introduction, factors to be considered in the formulation of facial cosmetics, dentifrice's, deodorant, antiperspirants, shampoos, hairdressing and hair removers.

Pharmaceutical packing: Packing components, types of packing containers and closures, materials used for and their pharmaceutical specification, method of evaluation, stability aspects of packaging materials.

Reference

1. The Theory and Practice of Industrial Pharmacy   Leon Lachman, H.A. Lieberman, J.L.K.
2. Unit Process in Pharmacy.   Ganderton
3. Chemical Engineering in Medicine And Bodogy   D. Hershey,
4. Chemical Engineering in Medicine – Chern. Engg. Prpgrer Syrnp Series No. c 66, Vol 62.

CH 555 ADVANCED ENVIRONMENTAL BIOTECHNOLOGY

General effluent treatment – nature of sewers, sewage; Methods adopted in effluent treatment; Legal Consideration – Royal Commissions. Current situation in laying of charging ownership, regulations, legislation; Activated sludge process equipment, plant kinetics, CSTR modeling. PFR modeling, recycle stability, washout; Advanced Process – Trickling fitter, moving medium system; Biology of effluent treatment process: Roles of bacteria, fungi and protozoa.

Extracellular Polymers, films, flocs, Analysis of effluent; Nutrition, Carbon removal, influences of loading ratio, retention times, season on kinetics and performance, Nitrogen and Phosphorous requirement for adequate plant performance. Nitrification and De-nitrification Anoxic process, extended aeration, high rate process; Sludge disposal methods; Anaerobic processes. Sludge digestion (contact digester), Management of digester sludge. Aerobic effluent treatment. Gas production and utilization, related problem.

Reference

1. Industrial Microbiology,   M.J. Waites, N.L. Morgan, J.S. Rockey, and G. Higton
2. Biotechnology a Text book of Industrial Microbiology   W. Grueger and A. Crueger,
3. Biochemical Engineering Fundamentals   J E Bailey and D F Ollis,

CH 556 CORROSION ENGINEERING

Basic concepts: Definition and importance; Electrochemical nature and forms of corrosion; Corrosion rate and its determination.

Electrochemical thermodynamics and kinetics: Electrode potentials; Potential-pH (Pourbiax) diagrams; Reference electrodes and experimental measurements; Faraday's laws; Electrochemical polarization; Mixed potential theory; Experimental polarization curves; Instrumentation and experimental procedure.

Galvanic and concentration cell corrosion: Basic concepts; Experimental measurements, and determination of rates of galvanic corrosion; Concentration cells.

Corrosion measurement through polarization techniques: Tafel extrapolation plots; Polarization resistance method; Instrumental methods and Errors in measurement of polarization resistance; Commercial corrosion probes; Other methods of determining polarization curves.

Passivity: Basic concepts of passivity; Properties of passive films; Experimental measurement; Applications of Potentiostatic Anodic Polarization; Anodic protection.

Pitting and crevice corrosion: Basic concepts; Mechanisms of pitting and crevice corrosion; Secondary forms of crevice corrosion; Localized pitting. Metallurgical features and corrosion: Inter-granular corrosion; Weldment corrosion; De-alloying and dezincification.

Environmental induced cracking: Stress corrosion cracking; Corrosion fatigue cracking; Hydrogen induced cracking; Some case studies; Methods of prevention and testing; Erosion, fretting and Wear.

Environmental factors and corrosion: Corrosion in water and Aaqueous Ssolutions; Corrosion in sulphur bearing solutions; Microbiologically induced corrosion; Corrosion in soil; Corrosion of concrete; Corrosion in acidic and alkaline process streams.

Atmospheric and elevated temperature corrosion: Atmospheric corrosion and its prevention; Oxidation at elevated temperatures; Alloying; Oxidising environments. Prevention and control of corrosion: Cathodic protection; Coatings and inhibitors; Material selection and design.

Reference
1. Corrosion Engineering   Fontana, M.G.
2. Principal and Protection of Corrosion   Jones, D.A.,

BIO551 SYSTEMS BIOLOGY

Integrating biological networks, Methods of study: Micro array, Hierarchical clustering, Self- organizing maps, translation of biochemical pathways into linear algebra. Whole cell simulation, principle and levels of simulation, Virtual erythrocytes, pathological analysis, fermentation analysis, flux balance analysis, minimal gene complement.

Relationship analysis, predicting ligand binding function, guilt by association, Use of gene cluster, comparative genome analysis, Binding surface comparisons, Detecting protein - protein interaction.

Molecular graphics, Surfaces, An introduction to computational quantum mechanics: Polyelectronic atoms and molecules, Molecular orbital calculations, The Hartree-Fock equations, Basis sets, ab initio quantum mechanics, Approximate molecular orbital theories, molecular dynamics and free energy calculations

Molecular dynamics using simple models , Setting up and running a molecular dynamics simulation , , Molecular dynamics at constant temperature and pressure, Incorporating solvent effects into molecular dynamics:conformational changes from molecular dynamics simulations. Evolutionary algorithms and simulated annealing, Solving protein structures using restrained molecular dynamics and simulated annealing.

Structural databases, Molecular fitting, Clustering algorithms and pattern recognition techniques, Reducing the dimensionality of a data set, Covering conformational space: poling, A "classic" optimization problem: predicting crystal structures. Structure dynamics of membrane, electrostatic properties of membrane, flexible and charged membrane,

References
1. Foundations of system biology   Hiraoki Kitano
2. System biology dynamic pathwasy modeling   Olaf Wolkehaner
3. System biology properties and reconstructed networks   Bernhard O Palsson
4. Molecular Modeling for Beginners   Alan Hinchliffe
5. Molecular Modeling and Simulation   Tamar Schlick

BIO552 MOLECULAR AND CELLULAR DIAGNOSTICS

Redoxmediated systems, FET's (Field Effect Transistors), Thermistors, Conductimeters, Piezoelectric crystals, Optoelectric biosensors. Principle of diagnostic enzymology: Liver, cardiac, skeletal enzyme and digestive enzyme Emerging trends in molecular medicine- expert reviews on molecular medicine related to vaccine design and systemic diseases-developments as updated from time to time.

Methodology of detection of mutation in DNA, Diagnosis of genetic diseases. Molecular markers and DNA polymorphism. Case studies related to bacterial, viral and parasitic infections. DNA fingerprinting.

Genetic pathways that protect cells from uncontrolled growth and genes: tumor suppressor genes, oncogene. Pathways that regulate tumor initiation and/or its progression. Cell cycle

control genes; the role of tumor suppressors in the cell cycle; Potential anti-cancer therapies that target the visualization process; the process of differentiation and cancer therapies that work by inducing differentiation of tumor cells; tumor stem cells-clinical implications; current methods of cancer screening, development new diagnostic tests, and other innovations for the future.

Molecular Mechanisms of Human Disease. Infectious Agents- Biological Aspects and Clinical Implications. Molecular Haematology and Oncology. Selection and Evolution: Implications for Molecular Medicine. Molecular Basis of Development of Medicine- Diagnostic and Therapeutic Potential. Human embryonic stem cells: biology and clinical implications.

Antibody markers, CD Markers, HLA typing,Molecular beacons. Applications and uses of biosensors, Clinical chemistry, medicine and health care, Veterinary, Agriculture and Food production, Environmental control and pollution monitoring.

Reference

1. Biosensors   Tran Minh Canh
2. Biosensors Fundamentals and applications   Turner, A.P.F, Karube.I.,and Wilson,G.S
3. Molecular diagnostics: for the clinical laboratorian, William B. Coleman, Gregory J. Tsongalis.
4. Molecular diagnostics   George P. Patrinos, Wilhelm Ansorge
5. Diagnostic microbiology   W. R. Bailey, E. G. Scott. .

BIO 553   COMPUTATIONAL ADVANCEMENTS IN BIOTECHNOLOGY

PERL, Introduction, Features, Scalar Variables, Array Variables, File Handling, Lists (Arrays),Hashes (Associative Arrays), Control Structures, String Processing, Subroutines

PYTHON Introduction, Features, Python Interpreter, Control Flow Tools, Data Structures, Modules, Input and output, Errors and Exceptions, classes.

RUBY, Introduction, Features, General syntax rules, classes, objects, variables, containers, Blocks, Iterators, Loops, Branching, Arrays, Hashes, Strings, Regular Expressions, Subroutines, Exceptions, Terminal IO, File IO

XML ,Introduction, Need , The general structure of XML,XML Tags ,Elements and sub elements, XML documents, XML attributes, Well formed XML documents ,Valid XML documents, XML DTD.

MATLAB, Introduction, The basic features, Vectors and matrices, Built-in functions, Plotting, Programming in MATLAB, M-files: Scripts and functions, Loops ,Polynomials in MATLAB ,Numerical Methods

References

1. 'Programming Ruby The Pragmatic Programmers

                                                Dave Thomas with Chad Fowler and Andy Hunt,
2. Beginning Python   Peter Nortan,

BIO 554 QUALITY MANGEMENT PROCESS DESIGN AND MARKETING

Quality management: Selection and specification of equipments for handling fluids and solids, selection, speciation, design of heat mass transfer equipments used in bioprocess industries, Determination of the best system for a given conversation, advantages and limitations of series combinations.

Design of facility for cleaning of process equipment used in biochemical industries, utilities for biotechnology production plants, process economics, bioprocess validation, safety considerations.

Marketing management: Need to commercialize biotechnology, from laboratory to land: Extension services of biotechnology, creating and marketing the image of the biotechnology company, art of recognition & effective communication.

Marketing of product, availability of technology, raw materials, equipments, human resources. Workable marketing and the strength of distribution. Effective advertising and marketing. Marketing of technology, informal sector and small enterprenurs, sustainable development in biobusiness, industrial biotechnology policy for semiindustrial contries, the role of translational cooperators,.

References
1. Applied Process Design for Petrochemical Plants   E.E. Ludwig
2. Chemical Engineering
        R.K. Sinnott, J. M. Coulson and J.F. Richardsons and Butter worth- Heinemann
3. Manufacturing Facilities Design and material handling   F. E. Meyers and M. P. Stephens
4. Process plant layout and Piping Design   E. Bausbacher and R. Hunt
5. Plant Design and Economics for Chemical Engineers   M. Peters and K. Timmerhaus

BIO- 555 BIOPROCESS ENGINEERING

Design and Analysis of Bioreactors- Stirred tank reactor, Modeling of Non-Ideal Behavior, RTD–Tanks in series and Dispersion models, applications to design of continuous sterilisers; Design and operation of novel bioreactors, Air-lift loop reactors; Fluidized bed bioreactors. Stability analysis of bioreactors.

Bioreactor Process-Regime analysis of bioreactor processes, Correlation's for oxygen transfer; Scale-up criteria for bioreactors based on oxygen transfer and power consumption. On-line data analysis for measurement of important physicochemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry.

Monitoring of Bioprocesses Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes; Computer-based data acquisition, monitoring and control-LABVIEW Software.

Role of Downstream Processing in Biotechnology-Role and importance of downstream processing in biotechnological processes, Economics of downstream processing in Biotechnology, characteristics of biological mixtures.

Primary Separation and Recovery Processes : Cell disruption methods for intracellular products: Mechanical and Chemical methods, Removal of insolubles: flocculation and sedimentation, centrifugation and filtration methods.

Bioprocess engineering of marine products -Bioprocess engineering for Marine products, photo bioreactors – light regime, mass transfer and scale up, downstream processing of marine products, Management of Marine production, Storage and transport.

References
1. Bioprocess Engineering Calculation   Pauline Doran
2. Biochemical Engineering   Harvey W. Blanch, Douglas S. Clark
3. Biochemical Engineering Fundamentals   Bailey And Ollis,
4. Bioprocess Engineering,   Shuler And Kargi,.

IS551/AC551/CN551 TECHNICAL FOUNDATION FOR E-COMMERCE

Introduction: Electronic commerce, technology and prospects, forces behind e-commerce, advantages and disadvantages, architectural framework, e-commerce strategy, e-commerce emerging issues and implementation issues, e-commerce law, government policies and agenda.

E-Commerce Infrastructure: Internet and Intranet based e-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN,FRAME RELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile information device, mobile computing applications , security issues in m-commerce. Electronic Payment System: Overview, electronic payment mechanisms and protocols, SET protocol, payment gateway, certificate, digital tokens, smart card, credit card, magnetic strip card, electronic money, electronic contracts, micro-payments, e-checks, e-cash Credit/Debit card based EPS, e-commerce

payments security, online banking. electronic data interchange and its applications. Internet Advertising. Models of Internet advertising, sponsoring contents, corporate website, weaknesses in Internet advertising, web auctions and trading mechanism. Securing Business on Network. Security policies, procedures and practices, site security, firewalls, securing web service, transaction security, cryptology, cryptological algorithms, public key algorithms, authentication protocols, digital Signatures, virtual private network, security protocols for web commerce. Advanced Topics. Electronic commerce optimization algorithms, decision support systems for e-commerce, data mining for e-commerce, intelligent techniques for e-commerce**.**

IS552/AC552/CN552 DIGITAL FORENSICS

Introduction to legal issues, context, and digital forensics. Digital Evidence - Sources of digital evidence, evidence gathering methods: - Imaging, Forensics copy, selection and extraction, auditing logging, evidence correlation and preservation. Evidence analysis techniques: keyword searches, timelines, hidden data.

Computer Forensics and investigations as a profession, understanding computer investigations, Data Acquisition, processing Crime and Incident Scenes Digital Forensics Models. Working with Windows and DOS Systems, Current Computer Forensics Tools, Macintosh and Linux Boot Processes and Disk Structures, Computer Forensics Analysis and Validation Recovering Graphics Files, Network Forensics, E-Mail Investigations, Cell Phone and Mobile Devices

References

1. Computer Forensics and Investigations   Nelson Phillips, Enfinger,Steuart
2. Computer Evidence Collection and Preservation   Christopher L.T.Brown, Firewall
3. Media Software Forensics   Robert M. Slade

IS553/AC553/CN553 CLUSTER AND GRID COMPUTING

Cluster Computing: Introduction, Hardware for cluster computing, Software architectures for cluster computing based on shared memory (OpenMP) and message-passing (MPI/PVM) models, Performance evaluation tools, Configuring and Tuning Clusters.

Grid Computing: The Evolution Grid Technologies, Programming models - A Look at a Grid Enabled Server and Parallelization Techniques, Grid applications, Grid architecture, Grid relationship to other Distributed Technologies, Computational and Data Grids, Semantic grids, Grid Management systems: Security, Grid-Enabling software and Grid enabling network services, Virtualization Services for Data Grids; Case Study, Setting up Grid, deployment of Grid software and tools.

References:

1. High Performance Cluster Computing   R. Buyya,
2. Parallel Programming with MPI   Peter Pacheco
3. The Grid : Blueprint for a New Computing Infrastructure   I. Foster and C. Kesselman .

IS554/AC554/CN554 OBJECT-ORIENTED DESIGN AND MODELING

Object Orientation, OMT Methodology, Object and Class, Link and Association, Generalization, Aggregation Multiple Inheritance, Packages. Object Meta modelling, Metadata and Metamodels, Functional Modelling. Pseudocode , Pseudocode with the Object Navigation Notation, ONN Constructs, combining ONN Constructs. Analysis: Object Model, Data Dictionary, Dynamic Model, Functional Model, System Design: Devising an Architecture, Database Management Paradigm, Object Identity, Policies for Detailed Design Dealing with temporal data. Detailed Design:- Object Model Transformations, Elaborating the Object Model, Elaborating the Functional Model, Evaluating the Quality of a Design Model.

References

1. Object-Oriented Modeling and Design   Michael Blaha / William Premerlani

DC551 COMPUTATIONAL METHODS FOR COMMUNICATION

Linear algebra, Lagrange multipliers. differential equations of equilibrium; Laplace's equation and potential flow; boundary-value problems; minimum principles and calculus of variations; Fourier series;

discrete Fourier transform; convolution; and applications. Initial-value problems; network flows; and optimization.

Reference

1. Computational Science and Engineering.   Strang, Gilbert.
2. Numerical methods in science & engineering,   M.K Venkataraman,

DC552 NUMERICAL ANALYSIS

Methods for signal differentiation, Stability Analysis for Euler's method. Analytic functions, conformal mapping, Taylor's& Laurent's series, Solution of linear simultaneous and transcendental equations, Eigen values problems, Iterative method , Analytical method, separation of variables orthogonal functions, series expansion with practical applications of communication. Numerical integration, Euler's rule, Trapezoidal rule, Simpson rule, Newton Cote 'smethod, Z Transform, Properties of region of convergence for Z transform , Inverse Z transform, Z transform Properties, Fourier Transforms, Discrete Time Fourier Transform, Fourier Transform of periodic signals, Properties of Discrete Fourier Transform, Sine and Cosine Transforms, Hartley Transform, Laplace Transform, Hilbert transforms, Hilbert Transforms relations for complex sequences, Hankel transform, Mixed Time-Frequency signal Transforms, Wavelet transform, Orthonormal Wavelet Basis Constructions. Undecimated Discrete Wavelet Transform (UDWT), Discrete Wavelet Transform (DWT)

References :

1. Numerical   Methods for Scientific and Engg. Computation

                                M.K. Jain, S.R.K. Iyengar   and R. K. Jain,
2. DiscreteTimeSignalProcessing"Prentice   Oppenheim&Schafer
3. Signal Processing with Fractals: AWavelet-Based Approach   G. W. Wornell

DC553 DATA COMMUNICATION NETWORK

OSI and TCP/IP reference models, circuit, message, packet and hybrid switching, broadband ISDN and ATM, transmission media used in physical layer, LAN, MAN and WAN, LAN protocols, IEEE standards for LAN and MAN, Data link layer protocols, Network layer design issues, Introduction to routing and congestion, routing and congestion control algorithms, inter networking, The transport service, Elements of transport protocols, Data security and cryptography techniques, access management in application layer, virtual terminals. Study of standard networks.

References:

1. Data and Computer Communications   William Stallings
2. Data Networks   Dimitris Bertsekas and Robert Galliger,
3. Computer Networks   Tanenbaum

DC554 INTERNET TECHNOLOGY

Internetworking: - Concept, Architecture and Protocols. IP Addressing scheme, Routers and IP addressing principles, Binding protocol address (ARP). IP Datagrams and Datagram forwarding. IP encapsulation. Fragmentation and reassemble, IPv6- motivation, frame format and addressing.

Internet Control Message Protocol:-Introduction and usage for testing reachability, route tracking, MTU determination, TCP introduction, application, segment format.

Domain name system**:-** Introduction, DNS Client server Model, Server hierarchy, server architectures, optimization of DNS performance, DNS entry types, electronic mail paradigm ,message format, SMTP, Mail Gateways, Mailbox access, FTP commands, Filename translation examples, TFTP, NFS.

World Wide Web**: -** Introduction, HTML format, Client-server interaction, Browser architecture, CGI, Java techniques for Dynamic Web documents, Network Management: - SNMP, NMS.

Network security, protocol startup procedure, BOOTP, DHCP, Intranet contents, security aspects, hardware software features, setting up internet site and troubleshooting, Extranet.

References

1.   Computer Networks and Internet   D.E.Comer
2.   Internet   Coleman & Dyson

DC555 B ISDN and ATM
A conceptual view of ISDN - ISDN standards - Service capabilities. - ISDN protocol architecture - ISDN connections - Terminal adaptation - Addressing – Internetworking. ISDN Physical layer: Line coding techniques - Basic user Network Interface - Primary user role - Network Interface. ISDN Network layer ISDN call control, Frame relay connection control. Signaling system no. Z: SS-Z architecture, Signaling - datalink level, link level, network level, Signaling connection control part-ISDN user part.ATM Networking Capabilities. ATM's position in the OSI model - B-ISDN protocol reference model - ATM functions and layers. The net and its features : main internet features, Data Encryption Techniques:

References
1. Telecommunications Transmission Systems   R.G. Winch,
2. ISDN and B. ISDN   W. Stallings,.
3. , Internet 101 Computing   A.Glosshrenner

VED551 COMPUTATIONAL TECHNIQUES IN DIGITAL SYSTEM DESIGN
 Linear algebra, Lagrange multipliers. Differential equations of equilibrium; Laplace's equation and potential flow; boundary-value problems; minimum principles and calculus of variations. Digital systems modeling and simulation,Integrated logicBoolean algebra and logic,Logic function optimization,Number systems,Combinational logic,VHDL design concepts,Sequential and synchronous sequential logic

References
1. Strang, Gilbert. Computational Science and Engineering. Wellesley, MA: Wellesley-Cambridge Press,
2. Introduction to Digital Systems: Modeling, Synthesis, and Simulation Using VHDL,Mohammed Ferdjallah

VED552NUMERICAL ANALYSIS
Methods for signal differentiation, Stability Analysis for Euler's method. Analytic functions, conformal mapping, Taylor's& Laurent's   series, Solution of linear simultaneous and transcendental equations, Eigen values problems, Iterative method , Analytical method, separation of variables orthogonal functions, series expansion with practical applications of communication. Numerical integration, Euler's rule, Trapezoidal rule, Simpson rule, Newton Cote 'smethod, Z Transform, Properties of region of convergence for Z transform , Inverse Z transform, Z transform Properties, Fourier Transforms, Discrete Time Fourier Transform, Fourier Transform of periodic signals, Properties of Discrete Fourier Transform, Sine and Cosine Transforms, Hartley Transform, Laplace Transform, Hilbert transforms, Hilbert Transforms relations for complex sequences, Hankel transform, Mixed Time-Frequency signal Transforms, Wavelet transform, Orthonormal Wavelet Basis Constructions. Undecimated Discrete Wavelet Transform (UDWT), Discrete Wavelet Transform (DWT)

References
1. Numerical   Methods for Scientific and Engg. Computation
                                      M.K. Jain, S.R.K. Iyengar   and R. K. Jain,
2. DiscreteTimeSignalProcessing   Oppenheim&Schafer
3. Signal Processing with Fractals: A   Wavelet-Based Approach   G. W. Wornell

VED554 CAD OF DIGITAL SYSTEM
Introduction to VLSI Methodologies – Design and Fabrication of VLSI Devices,Fabrication process and its impact on Design. VLSI design automation tools – Data structures and basic algorithms , graph theory and computational complexity, tractable and intractable problems.General purpose methods for combinational optimization – partitioning, floor planning and pin assignment, placement , routing. Simulation – logic synthesis, verification, high level synthesis. MCMS-VHDL-Verilog-implementation of simple circuits using VHDL and verilog.

References
1. Algorithms for VLSI Physical Design Automation   N.A. Sherwani,
2. Algorithms for VLSI Design Automation.   S.H. Gerez

VED555 MICROPROCESSOR AND MICROCONTROLLER

Microprocessor Systems, Overview of 8086/8088, IBM PC Architecture, MASM- assembler directive, exe files, con files, real mode, protected mode, 80386 Processor architecture, SRAM interfacing, DRAM interfacing, interrupt controllers, interfacing and communication with 80387, Memory management: Virtual memory concepts, memory management unit, Pentium processor architectural enhancements. Microcontrollers: overview of 8051 microcontroller architectures, other industrial microcontrollers, architectural features of DSP controllers,

References:
1. The Intel Microprocessors, Architecture, Programming and Interfacing   B. B. Brey
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C

M.A.Mazidi, J.G.Mazidi, Rolin McKinlay

VED-556 ADVANCED COMPUTER ARCHITECTURE

Evolution of computer architecture, taxonomy and models of computers, Instruction set architecture, CISC, RISC processors, pipelined, superscalar , VLIW architecture, case studies, virtual memory technology, Cache memory organization, cache performance, Linear and nonlinear pipelines, Multiprocessors system interconnect, cache coherence and synchronization, message passing mechanisms . **References:**
1. Advanced Computer Architecture   Kai Hwang
2. Computer Architecture: Pipelined and Parallel Processor Design   M.J. Flynn,
3. Computer Architecture & Organizat   J.Hyaes

DC 556 ADVANCED CONTROL SYSTEMS

State variables, state space representation, Transfer matrix, state model for linear continuous time systems. Eigen values, eigen vectors, Diagonalization, Solution of state equation, concept of controllability and observability. Pole placement by state feedback. Introduction to discrete time systems, Time domain, representation & transformation analysis of discrete time systems, time domain approach and z domain approach. Pulse transfer function, Controllability and observability of discrete time systems stability analysis in z plane. Introduction, characteristics limit cycles, singular points, Basic non linear components phase plane methods, Describing functions, Definition, D.F. for basic non linearities, Absolute stability, circle and popov criterion, Liapunov functions.

References
1. Control Engineering .   Appu Kuttan
2. Adaptive and Optimal Control.   A.P.Sage & Landue,
3. Optimal Control.   A.P.Sage,

GT551GREEN BUILDINGS

Need of energy in buildings. Role of building design and building services to evaluate the energy performance in buildings. Study of Climate and its influence in building design for energy requirement. Environmental science of buildings. Study of Thermal environment and visual environment. Heat gain and heal loss phenomenon of buildings. Role of building enclosures, openings and materials in thermal environment.Energy efficient light design of buildings.. Design for visual environment. Energy rating of buildings.

GT552 ENERGY, ENVIRONMENT POLICY AND PLANNING

Energy Action Planning: Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification. Management Principles Organizing location of energy management, top management support, managerial functions, role and responsibilities of energy manager, accountability. Material and Energy Balance Basic Principles-Sankey diagram and its use-Process Flow chart-Method of preparation-Method to carryout M & E Balance Energy & Environmental Acts and Treaties Global scenario -Indian environmental degradation - Environmental laws - Water (prevention & control of pollution) act 1974 - The environmental protection act 1986 - Effluent standards and ambient air quality standards. Decision support systems for energy planning and energy policy simulation.
1. : Energy for a Sustainable World,

J. Goldemberg, T.B. Johansson, A.K.N. Reddy and R.H. Williams
2. IEEE Bronze Book: Energy Auditing, IEEE Publications, 1996
3. Financial Management Theory and Practice   P. Chandra
4. Energy Planning Reports of CMIE, State Governments & Govt. of India
5. : Environmental Impact analysis Handbook,   J. Rau and D.C. Wooten

GT553 BIO-ENERGY CONVERSION SYSTEMS

Bio energy as by product of waste processing, Biomass classification, Environmental significance, Introduction to anaerobic digestion, Energy plantation, Process fundamentals and design considerations, physical method of bioconversion i.e. Briquetting, pelletization, Energy assessment, Types of reactors, Energy farming. Biogas – A rural energy source, Biogas technology, Types of Biogas plants-components , Selection of model of biogas plant, factors affecting biogas yield, Biogas from landfills , Rural & Urban energy loads, Animal waste, Forest & Agro residue,.

References
1. Bio Energy for Rural Energisation   Maheswari R. C
2. Biogas Technology A Practical Handbook   Khandelwal KC, Mahdi SS,
3. Renewable Energy   Sorensen Bent,
4. Renewable Energy: Sources for fuels and electricity Johansson Thomas B
5 The Biomass Assessment Handbook: Bioenergy for a Sustainable Environment
                                        RosilloCalle Frank, Francisco Rosillo,
6. Nonconventional energy sources   Rai G.D,
7. Biogas systems: Principles and applications,   Mittal K. M ,

NT551 ADVANCE LOW TEMPERATURE PHYSICS

Thermodynamics & liquefaction of gases, Cryostat design , Transport Phenomenon, Fermi surface, Magnetism. Conductivity of solids, Technique of measurement, Paramagnetic & Nuclear adiabatic demagnetization. Superconductivity. fundamental phenomena of super conductivity, Meissner effect, London equation, Type I and Type II superconductors, qualitative idea of Cooper pairing and BCS theory. Ginsburg-Landau theory, coherence length, Green's functions of electrons and phonons, isotope effect, The BCS Hamiltonian, the gap parameter, Superconductor in a field, flux quantization effect, SQUIDS, High-T_c materials.

Refrences
1.   Superconductivity   :   Werner Buckel & Reinhold
2.   Thermodynamics   :   M.S.Yadav
3.   Treatise on Heat   :   V.K. Shrivastava

NT552 MOLECULAR ELECTRONICS AND BIOMOLECULES

Organic semiconductors, Organic molecules as switches, motor-molecules and biomimetic components .conducting polymers, light emitting polymers,

The self-assembly of complex organic molecules, Molecular connections and the integration of molecular components into functional devices, Contact issues,

Structure of biomolecules; Biotechnology, recombinant DNA technology, molecular biology

Structural and functional principles of bionanomachines, Interfacing bio with non-bio materials, Porous silicon

References
1.   Molecular Electronics   : T. Helgakar
2.   Semiconductor Quantum Dots   : Masumota Takaga

NT553 INSTRUMENTATION

Resistivity Probing, conductivity, Hall Mobility, Ferroelectric & dielectric measurements. Optical mapping, auto radiography, Electron Micrography. Phase Identification. Chemical assessment, Spectrophotometery, Differential Thermo Analysis. Determination of Physical Structure, use of electrometer. Spectroscopic techniques, NMR, ESR, Photoacousitc spectroscopy. Electron Microprobe Analysis. Measurement of low pressure penning-pirani gauge. Film thickness monitoring & measurement.

Refrences :

1. Crystal Growth and Characterisation   :   R. Ueda and J.B. Mullin
2. Solid State Physics   :   Ibach and Luth
3. Experimental Techniques of Surface Science: Woodruff and Delchar
4. Handbook of Thin Film Technology   :   Leon I Maissel & R Glang

NT553 OPTO ELECTRONICS

Principle of light guidance in optical wave guides. Fabrication and types of Optical fibres, rays and modes, losses in optical fibres and applications. Optical fibre interconnectors, concept of optical waveguides. Nonlinear optics. Second harmonic generation. Birefringence. Electro-optics (Kerr effect, Pockels effect, Faraday effect), Magneto-optics.

Optical Integrated Circuits, Light Emitting Diode, Solar Cells.

Refrences :

1. Optical Electronics   :   A. Ghatak & K. Thyagarajan
2. Quantum Electronics   :   A. Yariv
3. An Introduction to Optical Fibers   :   A.H. Cherin

MAN513 INTELLECTUAL PROPERTY RIGHTS

Introduction to IPR, Importance, need of IPR, Intellectual assets and value realization, Forms of IPR, Patent, Copyright, Trademarks, Protection of IC layout designs, geographical indicators, Protection of undisclosed information, control of anti-competitive practices and Industrial design. International treaties; WTO: International jurisdictions, National Treatment, Technical barriers, Introduction to dispute settlement mechanism of WTO, Indian position in Global IPR structure, Facilitating Technology Transfer and Capability building.

MTH 551A ADVANCED MATHEMATICS

Ordinary and Partial Differential equations: Application to boundary value problems, Laplace and wave equations, time dependent equations with vibratory systems.

Theory of complex variables and conformal mappings: Complex numbers, the elementary functions, cauchy's theorem, infinite series. Elementary conformal mapping - conformal transformation of harmonic functions and boundary conditions. Matrix Theory : System of linear equations, determinate, finite dimensional vector, space matrices- matrix rotation. Calculus of tensors with its applications to differential geometry. Application of matrices and tensors to simple problems. Numerical methods in engineering analysis : Interpolation and relaxation methods. Methods of minimum potential energy, variational principles, Rayleigh-Ritz Method, Galerkin's Method, Treffitz's Prcedure, Pargers Functions. Percubation and collection procedures. Solution of linear and nonlinear equations by numerical methods. Numerical Integration – Newton Cotes, Gauss Integration.

References

  1. Higher Engg. Mathematics   S Grewa
  2. Engineering mathematics   S S Shastri
  3. Advanced Mathematics for Engineers   Gorakh Prasad

MTH511B ADVANCED MATHEMATICS

System mathematics : concept of a system and system analysis, introduction to mathematical programming techniques. linear programming, feasible solutions, solutions, simplex and revised simplex methods, duality, integer programming, Brach and Bount, Cut, transportation and assignment algorithms non-linear programming, single variable and multi variable optimization problems with and without constraints, quadratic programming, geometric programming, goal programming, network analysis, game theory and queuing systems

Mathematical modelling: introduction, development of models, model evaluation, modelling and information content of data. characteristics of distribution, A.M.G.M., H.M., median and mode, mean and standard deviation.

Statistical frequency distributions, common probability functions, confidence intervals, tolerance limits, hypothesis testing, fundamentals of simulation. Binomial normal and Poisson distribution, theory of MPN, calibration and evaluation of linear models, stepwise regression analysis, regression analysis of non-linear models, random sampling, choice of samples and selection, large and small samples, students '+' distribution, vital statistics, mortality tables, birth rate, death rate.

References
 1. Numerical Methods for Scientific & Engg. Computation   Jain, Iyenge and Jain
2. Numerical Methods for Mathematics, Science and Engineering John H Mathews
3. Applied Numerical Analysis   CF Gerld and PO Wheatley
4. Fundamentals of Applied Statistics   S.C. Gupta and V. K. Kapoor,

MTH511C ADVANCED MATHEMATICS

Ordinary and partial differential equations: Application to boundary value problems. Laplace and wave equations, time dependent equations with vibratory systems. Theory of complex variables and conformal mappings:Complex numbers, the elementary functions, cauchy's theorem, infinite series. Elementary conformal mapping – conformal transformation of harmonic functions and boundary conditions.

Matrix Theory: System of linear equations determinate, finite dimensional vector, space matrices- matrix rotation. Calculus of tensors with its applications to differential geometry. Application of matrices and tensors to simple problems in soil mechanics. Numerical methods in engineering analysis: Interpolationand relaxation methods. Methods of minimum potential energy, variational principles, Rayleigh – Ritz Method, Galerkin's Method, Treffitz's Procedure, Pargers Function, Percubation and collection procedures. Solution of linear and nonlinear equations by mechanical methods.

  References:
   1. Higher engg. Mathematics   S Grewal-
   2 Engineering Mathematics   S. S. Shastri
   3. Advance Mathematics for engineers   Gorakh Prasad

MTH 551 PROBABILITY AND STATISTICAL METHODS

One dimensional random variables: Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable, weighting of observations. Two dimensional random variables: Joint distributions– Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

Estimation theory: Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines, Propagation of systematic and accidental errors, theory of least squares and its application to adjustment problems.

Testing of hypotheses:Covariance matrix – Correlation Matrix – Multivariate Normal density function – Principal components – Sample variation by principal components – Principal components by graphing.

Multivariate analysis: Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

References
1. Probability and statistics for Engineering and the Sciences   Jay L. Devore
2. Applied multivariate methods for data analysis   Dallas E Johnson et al
3. Probability and Statistics for Engineers   Richard Johnson
Applied Multivariate Statistical Analysis   Richard A. Johnson and Dean W. Wichern

MASTER OF COMPUTER APPLICATIONS (MCA)

First SEMESTER

MCA 511 MATHEMATICS- 1

Logic Propositions and Logical Operations, First Order Predicate Logic, Fuzzy Sets, Fuzzy Relations, Properties and Operations on Fuzzy Relations. Relations, Equivalence Relations, Posets, Lattices, Complemented Lattices, Sub Lattices. Distributive and Modular Lattices. Boolean Algebra, Group Theory. Graph Theory Directed and Undirected Graphs, Connectedness Algorithms, Shorter Path. Algorithm Euclidian and Hamiltonian Graphs, The Travelling Salesman Problem, Trees: Spanning Trees, Rooted Trees and Binary Trees. Discrete Numeric Functions, Generating Functions, Recursion and Recurrence Relation, Coding Theory, Binary Symmetric Channel, Coding Process, Decoding, Error Detection and Correction Codes. Vector Spaces, Linear Mapping, Linear In-Equality, Inner Products, Norms.

References
1. Applied Discrete Structures For Computer Science Alan Doerr & Kenneth Levasseur
2. Discrete Mathematical Structures For Computer Science Bernard Kolman & Robert C. Busby
3. Discrete Mathematical Structure with applications to Computer Science"

J.P.Trembley & R.P.Manohar

MCA 512 COMPUTER ORGANIZATION & ARCHITECTURE

Fundamentals of Computer & Logic Circuits, Register Transfer and Micro Operations, Input-Output Organization, Memory Hierarchy and Memory Management Schemes & Hardware, Pipeline and Vector Processing, Introduction of Microprocessors, Introduction to 8085 Architecture and Its Extension to 8086, First Generation and Modern Second Generation Processors and Its Comparative Study.

References
1. Computer System Architecture   M. Mano,
2. Advanced Computer Architecture   Kai Hwang,
3. Digital Electronics   Malvino & Leach ;

MCA 513 DATA STRUCTURE

 Introduction to Data Structure, Primitive and Abstract Data Types, Complexity Analysis, Abstract Data Types, Linear Data Structures: Stacks, Queue, Linked List; Non-Linear Data Structures Trees, Graph, Searching & Sorting Techniques.

1. An introduction to data structures and algorithms   Tremblay & Sorenson,
2. Data Structures Using C   Aaron M. Tenenbaum,
3. Introduction to Data Structures   Bhagat Singh & Thomas Naps
4. Fundamentals of Data Structures   Ellis Horowitz & Sartaj Sahni

MCA 514   OPERATING SYSTEM   (3-0-0) 3

Fundamental Concepts of Operating System, Process & Processor Management, Deadlock Handling, Concurrent Processes, Memory Management, File Systems, Device Management, Distributed Systems. Case Studies: Unix, Windows, Linux, Mac.

"Operating System Principles", A. Silberschatz, PB Galvin & G. Gagne, wiley india; "Internal structure of window 95", N.Zipps, PHI; "Operating System" , James L. Patterson, Addison Wesley; "Opearting Systems", Nutt G, Addison Wesley Addison Wesley;

MCA 515 PROGRAMMING Through C & C++

Programming concepts, Data Types, Decision Making and Loop constructs, Arrays, Structures, Pointers, Functions, File Handling, Pointers, Structures, Principles of Object oriented programming, Classes and objects, Polymorphism, Inheritance, Templates, Exception and File Handling,

1. Complete reference in C   Herbert Schield,
2. Let us C   Yashwant Kanetkar,
3. An introduction to object-oriented programming   Timothy Budd,
4. Mastering C++   KR Venugopal & Rajkumar,

MCA 516 PROGRAMMING LAB – I

The students have to carry out the assignment work of the papers MCA101, MCA 103 & MCA 105.

Second Semester

MCA 521 MATHEMATICS 2

Finite Difference, Interpolation and Extrapolation, Inverse Interpolation, Numerical Differentiation Numerical Integration, Gauss-Legendre, Monte Carlo Methods of Integration, Numerical Solution of Ordinary Differential Equations of First And Second Order, Solution of Simultaneous Differential Equation, Solution of Algebraic and Transcendental Equation Solution of Non-Linear Equations. Solution of Linear Simultaneous Equations, Fourier Transform, Sine and Cosine Transform, Laplace Transformation of Elementary Functions, Inverse Transform, Solution of Ordinary Differential Equations Using Laplace Transform Techniques

1. Numerical Algorithms   B.S. Grewal,
2. Numerical Algorithms EWP   Krishnamutrhy & Sen;
3. Numerical Methods for Scientists & Engineers   M.K. Jain & Iyengar;
4. Simulation and Modeling   Gordan,
5. Advanced Engineering Mathematics   Erwin Kreyszig,

MCA 522 ADVANCED COMPUTER ARCHITECTURE.

Review of General Concepts of Computer System Architecture, Overview of Modern Processor Architectures PRAM and VLSI Models, Multiprocessors and Multicomputer. Multivector and SIMD Computers, PRAM and VLSI Models, Basic Parallel Processing Architecture, Taxonomy-SSID.MISD, SIMD, MIMD Structures, CISC Vs.   RISC. Vector Pipeline Architectures and Pipelined CPU Architecture, Connectivity Interconnection Networks: Topology, Routing, Flow Control, Deadlock Avoidance, Static and Dynamic Interconnection Networks, Concurrency and Synchronization, Parallel and Scalable Architectures. Case Study**:** Basic Features Current Architectural Trends .DSP Processor, Dual Core, Intel Core i3, i5, i7.

1. Advanced Computer Architecture   Kai Hwang,
2. Computer Architecture & Organization   John P. Hayes,
3. Computer organization and Design; The hardware/Software interface John Hennessy & David
4. Modern Operating Systems   Andrew S Tanenbaum

MCA 523 SOFTWARE ENGINEERING.

Software Characteristics, Components, Models and Myths, Software Process and Metrics, Software Project Planning, Risk Management, Project Scheduling and Cost Estimation, Quality Assurance, System Engineering Concepts, Analysis, Modelling.

1. Software Engineering   Pressman,
2. Software Engineering   Pankaj Jalote,
3. Software Engineering Concept   Richard Fairley
4. Analysis and design methods   J. Senn,

MCA 524 PRINCIPLES OF PROGRAMMING LANGUAGES.

Concepts & Elements of Programming Languages, Procedures and Processes; Iterative Vs. Recursive, Local Procedures and Local Variables, Programming Language Implementation – Compilation and Virtual Machines, Syntax and Semantics, Data Types, Concept Of Binding, Type Checking, Expressions and Statements, Control Subprograms and Blocks, Scope and Lifetime Of Variable, Overloaded Sub-Programs, Generic Sub-Programs, Co-Routines. Abstract Data Types, Concurrency Semaphores, Monitors, Massage Passing, Threads. Exception Handling, Object Oriented Programming Logic Programming, Functional Programming Languages, Imperative Programming. Case Study: C, C++, C#, JAVA & Other Programming Languages.

1. Concepts of Programming Languages   Robert .W. Sebesta,
2. Programming Languages Louden,   Thomson;
3. Programming Languages Design and Implementation   Pratt & Zelkowitz,
4. Concepts of Programming Languages   Robert Sebesta

MCA 525 THEORY OF COMPUTATION.

Strings Alphabets and Language, Finite State Systems, Deterministic and Nondeterminstic Finite Automata, Two Way Finite Automata, Finite Automata with Output, Finite State System, Regular Expression and Language, Regular Grammar. Properties of Regular Languages, Context Free Grammar & Language, Normal Forms, Pumping Lemma for CFL, Application for CFL Of Pumping Lemma. Closure Properties, Context Sensitive Language, Chomsky Hierarchy, Unrestricted Grammar, Pushdown Automata, Equivalence of PDA's and CFL's Turing Machine. Undecidability & Intractable Problems. Computational Complexity Theory. Case Study: LEX, YACC, JAVA CC.

1. Introduction to Automata Theory Language and Computation
                                                   John E. Hopcraft & Jeffary D. Ullman;
2. Introduction to Automata Theory Language and Computation
                                     John E. Hopcraft Jeffary D. Ullman & Rajeev Motwani;
3. Theory of Computer Science   K.L.P. Mishra & N. ChandraShekaran;

MCA-526 Programming Lab – II

The students have to carry out the assignment work of the papers MCA 201,MCA 204 & MCA 205.

Third Semester

MCA 611 MATHEMATICS–III

Probability Theory Conditional Probability, Baye's Theorem. Non-Linear Regression, Multiple Correlations and Regression, Random Numbers: Algorithms for Generation of Random Numbers,

Discrete Random Variables, Acceptance and Rejection Techniques. Random Variables and Distributions-Random Variables, Continuous Random Variables, Probability Density Functions. The Discrete Uniform, Distributions, Binomial, Poisson, Hyper Geometric Distributions. Continuous Probability Distributions, Uniform, Exponential and Normal Distributions. Hypothesis Testing-Testing of Statistical Hypothesis, Null Hypothesis, Tests of Hypothesis and Significance, One Failed Proportions, Chi-Square, T, Z and F Tests, Losses and Risks. Analysis of Variance- One Way and Two-Way. Matrix Decomposition, Singular Value Decomposition, PCA

1. Mathematical Statistics   J.E. Freund & R.E. Walpole
2. Probability and Statistics with reliability queuing and Computer Science Applications
                                                               K.S. Trivedi
3. ntroduction to Mathematical Statistics   F. Kreyzic
4. Statistical Analysis: Computer Oriented Approach   A.A. Affi
5. Statistics" Schaum's Series,   M.R. Spiegel
6. Basic Principal Component Analysis   I.T. Jouiffe Springer;

MCA612 UNIX AND ITS INTERNALS.
General Overview of The System, Internal Representation of Files, Structures of Processes and Process Control, Process Scheduling, System Calls, Memory Management Policies, I/O Subsystem, The Inter-Process Communication.

1. UNIX Utilities   Tare,
2. UNIX Operating System   Subhajit Das
3. Unix Operating System   Maurice J Bach,
4. Unix Shell Programming   Yashavant P. Kanetkar
5. Unix   Stephen Prata;

MCA 613 WINDOWS PROG AND SCRIPTING LANGUAGE.
Introduction to Windows Program. Message Processing, Menu and Accelerators. Handling Icons, Cursor and Bitmaps, Dialog Box & Child Window Controls, Working With Text and Font and Graphics, Consoles, Multitasking Process and Threads, Advance Window, Advance Features of Windows Programming Like GDI Metafiles, Clipboard Drag and Drops Sound API, Scripting Languages, Programming Through Vbscript, Java Scripts, Web Application Development Using Databases.

1. Windows Programming   Charles Petzold,
2. Windows Programming   Herbett Schildts

MCA 614 ANALYSES AND DESIGN OF ALGORITHM
Algorithm and its characteristics, Asymptotic Notations, Divide and Conquer Approach- Searching and Sorting, Matrix Operations, Recurrence Relations, Augmenting Data Structure, Dynamic Programming, Greedy Algorithm, Amortized Analysis, Branch & Bound Techniques, Linear Programming Problems, Tree and Graph- Minimum Spanning Tree, Shortest Path, NP hard and NP Complete Problems.

1. Fundamentals of Computer Algorithms   Ellis Horowitz & Sartaj sehni galgotia
2. Introduction to Algorithms   Cormen, Leiserson, Rivets,
3. Algorithm Design   Michael T. Goodrich & Roberto Tamassia
4. Introduction to the Design & Analysis of Algorithms   Anany Levitin
5. Analysis and Design of Algorithm   Ullman,

MCA 615 DATA BASE MANAGEMENT SYSTEM
Introduction to Database Design and Data Models, The Relational Model, Relational Algebra and Calculus, SQL, Embedded and Dynamic SQL, Query Processing and Optimization, Database Design

Issues and Normalization, Transaction Processing and Concurrency Control, Failure and Recovery Systems, Security and Authorization, Design af Object Oriented Databases.

1. Data Base Management System　　　　　　Raghu Ramakrishnan & Johannes Gehrke,
2. Database System Concept　　　　　　　　Henry F. Korth Abraham Silber Schatz,
3. Database System Concept　　　　　　　　　　C.J. Date,
4. SQL PL/SQL - The Programming Language of Oracle　　　Ivan bayross
5. Fundamental of Database Systems　　　　　　Elmasi, R. & Navathe,

MCA616MINOR PROJECT – 1

The students are require to develop small projects in Database, Window Programming

Fouirth Semester

MCA 621 COMPUTER ORIENTED OPTIMIZATION

Linear Programming, Mathematical Model, Hungarian Method & Its Algorithm. Transportation Problem, Integer Programming Integer Programming Algorithm, Dynamic Programming Optimal Subdivision Problem, Decomposition, Queuing Theory , Queuing Problem and System, Transient and Steady State Distributions In , Queuing System, Poisson Process, Exponential Process, Classification of Queuing Models, Inventory Theory Economic Deterministic Inventory Models Probabilistic Inventory Models With Instantaneous Demand , Games Theory Minimax-Maxmin Principle for Mixed Strategy Games, , Graphical Method, Solution of (Mxn) Job Sequencing PERT – CPM.

1. Operations Research　　　　　　　　S.D. Sharma,
2. Operations Research　　　　　　　　P.K.Gupta & D.S.Hira,
3. Operations Research　　　　　　　　Kantiswaroop
4. Introduction to Operations Research A Computer-Oriented Algorithmic Approach
　　　　　　　　　　　　　　　　　Billy E. Gillett
5. Introduction to operations Research　　　Hillier

MCA 622 COMPUTER NETWORKS

Introduction: Type of Networks & Protocol Hierarchies. Reference Models: The OSI & TCP/IP Reference Models, Physical Layer: Transmission Media & Related Issues; Analog, Digital & Wireless Transmission, Transmission and Switching, The Data Link Layer: Design Issues: Services Provided, Framing, Error Control, Flow Control; Error Detection and Correction; Elementary and Sliding Window Protocols, Medium Access Sub Layer, Channel Allocation Problem, Multiple Access Protocols, Ethernet, IEEE 802 Standards for Lans And Mans, Network Layer, Design Issues, Routing Algorithms, Congestion Control, QOS, Internetworking, IP & IP Addressing, Transport Layer : Transport Service, Elements Of Transport Protocols, TCP & UDP, Application Layer Overview : Email, DNS, WWW. Case Study: Network Monitoring & Simulation: Study Of Wireshark, NS-2,NS-3, Exata Etc.

1. Computer networks　　　　　　　　　　　　Andrew S. Tanenbaum
2. Communication networks: fundamental concepts and key architectures　　Leon Garcia
3. Local Area Networks　　　　　　　　　　　Gred Keiser,
4. Beginning Programming with C++ For Dummies　　　Stephen R. Davis,
5. Unix Network Programming　　　　　　　　　S. Davis,
6. Computer Networking : A Top-Down Approach Featuring the Internet
　　　　　　　　　　　　　　　　　J.F. Kurose & K.W. Ross

MCA623 COMPILER DESIGN

Introduction to Compiling, Lexical Analysis,Parsing Techniques, Syntax Directed Translation, Symantec Analysis, Symbol Table, Code Generation & Code Optimization Techniques,

1. Art of Compiler Design : The Theory & Practice   Thomas Pittman & James F. Peters,
2. Compiler Design   Renhord Wilhelum & Dieter Mauerl;
3. Compiler design in C"   Allen I. Holub,
4. Building an optimizing compiler   Robert Morga & Butterworth-Heinemann

MCA624 DISTRIBUTED SYSTEMS

Distributed System & Its Architecture. Hardware & Software Issues. Communication: Layered Protocols, Client Server Protocols, RPC, Group Communication. Coordination, Synchronization & Consistency: Logical Clocks, Physical Clocks, Mutual Exclusion, Election Algorithms, Atomic Broadcast, Sequential Consistency Transaction Distributed Consensus, Threads: Thread Synchronization, Implementation Issues, Threads Vs. RPC, Models of Distributed Computing: Client Server and RPC, RPC Architecture & Underlying Protocols, IDL, Marshalling. Group Models and Peer To Peer: Groups For Service Replication/Reliability, Groups for Parallelism / Performance, Client/ Server Vs. Peer-To-Peer, Multicast, Atomic Broadcast, Distributed File System, Distributed Shared Memory & Its Architecture, Fault Tolerant Distributed Systems, Distributed Multimedia System, Security Techniques and Cryptography.

1. Distributed Systems Concepts and Design

                                  George Colouris, Dick Grune Henri E.bal Ceriel .h.jacobs Koen G.la,

2. Distributed System   Sape Mull Ender,

MCA625 WEB BASED APPLICATIONS DEVELOPMENT

Programming with JAVA, Packages, JDBC & ODBC Connectivity, Types of Drivers, Remote Method Invocation RMI, JAVA BEANS, JAVA Security, Concepts of COM, DCOM, Active X, ORB, WAP, Bluetooth, Net Technology, Case Study: Perl, Python, PHP.

1. Complete Reference JAVA2   H.Schildt,
2. Java Servlets   Phil Hanna,
3. Java Thread Programming   Paul Hyde, Sams;
4. Java Virtual Machine   Tim Lindholm & Frank Yellin

MCA626MINOR PROJECT   2

The students are required to develop Web Based Applications.

Fifth Semester

MCA711 COMPUTER GRAPHICS

Graphics System and Primitives, Input and Output Devices, Shapes & Drawing Algorithms, Scan Conversion, Geometric Transformation, Viewing & Clipping, Curves, Lines and Surfaces, Colour & Shading Models, Projection, Hidden Surfaces, Introduction to Multimedia and Animation**.** Case Study: Graphics Tool Kit.

1. Computer Graphics   D.Hearn & M.P. Baker
2. Procedural Elements of Computer Graphics   David F. Rogers,
3. Principles of interactive computer graphics   New Mann & Sprovl,
4. Digital Multimedia Nigel   Chapman & J. Chapman,

MCA712 INTELLIGENT SYSTEMS

Introduction to Intelligent System, Heuristic Search Techniques, Knowledge Representation using Predicate Logic, Semantic Nets, Frames, Conceptual Dependency.

Natural language Processing and Study of its Different Phases, Game Playing, Planning: Nonlinear and Hierarchical planning. Statistical Reasoning: Probability and Bayes Theorem Certainty Factor and Rule Based System Parallel and Distributed AI Psychological Modeling, Learning, Expert System, Common Sense, Ontology.

1. Artificial Intelligence Kevin Knight,   Elaine Rich & B. Nair,
2. Artificial Intelligence: A Modern Approach   Stuart Russell & Peter Norvig,

MCA713 MOBILE APPLICATION DEVELOPMENT

Introduction to Mobile Computing, Factors in Developing Mobile Applications, Mobile Software Engineering Frameworks and Tools, Mobile Application Design :Application Model and Infrastructure, Hardware and Software Architecture Mobile development Environment and Software, Interface Development for Mobile Apps, Intents and Services, Storing and Retrieving Data, Mobility and Location Based Services ,Communications, Web Telephony, Notifications and Alarms, Graphics, Multimedia, Packaging and Deploying, Security and Hacking**.**

Case Study: Android, Symbian /S60, Mac, BREW, JavaME/JavaFX etc.

1. Mobile Design and Development   Brian Fling,
2. Mobile Applications Development   Scott B. Guthery, Mary J. Cronin,
3.   Professional Android Application Development   Reto Meier, Wrox;

MCA714 MINOR PROJECT III

The students are required to develop a small project in any concern area of the study as decided by supervisors.

Sixth Semester

MCA721 FINAL DISSERTATION (MAJOR PROJECT)

The student is required to carry out a major project work during this semester.

MCA722 SEMINAR/PRESENTATION (MAJOR PROJECT)

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

Department Elective

MCA631 DATA WAREHOUSING & MINING.

Data Warehousing & Mining, Data Pre-processing, Mining Association Rules, Classification and Prediction, Classifier Accuracy, Cluster Analysis, Applications and trends in Data Mining, Graph Mining, Text Mining, Case Study: Data Mining Tools.

1. Building Data Ware House   W.H.Inmon,
2. Data Mining Concepts & Techniques   Jiawei Han & Micheline Kamber
3. Oracle 8i Building Data Ware Housing   Michall Corey, M.Abbey
4. Data Mining, Practical Machine Learning tools & techniques with Java

Ian H. Witten & Eibe Frank, Morgan Kanffmen

MCA632 MULTIMEDIA COMPUTING

Introduction to Multimedia, Multimedia Objects, Multimedia Hardware, Software, Presentation Tools, Audio & Video File Formats, Sampling, Digital Audio Concepts, Compression, Multiple Monitors, Bitmaps, Video Representation, MHEG Standard, Recent Development in Multimedia.

1. Multimedia, Making IT Work   Tay Vaughan, Osborne
2. Multimedia Systems   Buford,
3. Multimedia technology and Applications   David Hillman,
4. Data Compression Book   Mark Nelson,

MCA633 ADVANCED SOFTWARE ENGINEERING

Design Concepts and Principles of Software Design and Engineering, Software Testing Methods and Strategies, Object-Oriented Software Engineering, Object-Oriented Testing, Software Quality Assurance,

Web Engineering Client-Server Software Engineering, Reengineering, Computer-AIDED Software Engineering.Case Study: Rational Rose & Other Case Tools.

1. Software Engineering- A Practitioner's Approach   R. S. Pressman,
2. Software Engineering   Ian Sommerville,
3. An integrated approach to software engineering   Pankaj Jalote,
4. Fundamentals of Software Engineering   A. Leon & M. Leon, Vikas;

MCA634 PARALLEL COMPUTING

Computational Demands, Advantages of Parallel Systems, Topologies, PARAM Model of Parallel Computation, PARAM Algorithms, Mapping and Scheduling, Applications of Parallel Computing.

1. Parallel Computing: Theory and Practice   Michael Jay Quinn,
2. Advanced Computer Architecture   Kai Hwang & Naresh Jotwani,

MCA635 ADVANCED RDBMS

The Extended Entity Relationship Model and Object Model, Object-Oriented Databases, Complex Objects, and Database Schema Design for OODBMS, OODBMS Architecture and Storage issues. Object Relational and Extended Relational Databases Query Processing and Optimization, Advance Querying. Parallel and Distributed Databases and Client-Server Architecture and various issues i.e. Data Fragmentation, Replication, and Allocation Techniques for Distributed and Parallel Database. Databases on the Web and Semi Structured Data: Web Data and XML, Temporal Database Concepts, Spatial Databases, Mobile Databases, Geographic Information Systems, Multimedia Databases. Advance Transaction Processing Systems and Multimedia Database. Case Studies: Advance Features in Oracle, Microsoft SQL Server for Multimedia Database,   Web Database.

1. Fundamentals of Database Systems   Elmasri and Navathe,
2. Database System Concepts Korth,   Silberchatz & Sudarshan,
3. Introduction to Database Systems   C.J.Date & Longman,

MCA636 CLOUD COMPUTING

Introduction to Cloud Computing, Cloud Architecture and Service Models, The Economics and Benefits of Cloud Computing, Horizontal/Vertical Scaling, Thin Client, Multimedia Content Distribution, Multiprocessor and Virtualization, Distributed Storage, Security and Federation/ Presence/ Identity/ Privacy in Cloud Computing, Disaster Recovery, Free Cloud Services and Open Source Software and Example Commercial Cloud Services.

1. Cloud Computing Implementation Management and Security

                               J W Rittinghouse & J F ransome,
2. Cloud Application Architecture   George Reese, O'Reilly;

MCA637 INFORMATION RETRIEVAL

Goals and History of IR, Basic IR Models, Experimental Evaluation of IR, IR Forums, Query Languages and Operations, Text and Text Operations, Indexing and Searching, Web Search Engines: Spiderling Met Crawlers.

Multimedia Languages and Properties & IR: Models & Languages, Parallel and Distributed IR, User Interface and Visualization, Digital Libraries, Recommender Systems, Information Extraction and Integration

1. Modern Information Retrieval   Ricardo Baeze & Yates Berthier Ribeiro-Neto
2. Introduction to Information by Manning   Raghavan & Schuetze, Press;

MCA638 IMAGE PROCESSING

Introduction to Image Processing Systems, Digital Image Fundamentals**,** Manipulation on Images**,** Images Transformation, Image Smoothing, Restoration, Image Encoding and Segmentation, Edge linking and boundary detection, Thresh-holding, Filtering, Information Theory. Image Representation Models.

1. Digital Image Processing   Rafael C. Gonzalez, Richard E. Woods
2. Digital Image Processing,   A.K.Jain,
3. Computer Image Processing and Recognition   Hall, E. L
4.   Digital Image Processing   Bernd Jahne,

MCA639 NATURAL LANGUAGE PROCESSING

Introduction to Natural Language Processing: Linguistic Background, Grammar and Parsing: Grammars & Parsing, Ambiguity Resolution. Semantic & Logic Forms, Linking Syntax and Semantics, Ambiguity Resolution, Symantec Interpretation, Knowledge Interpretation Reasoning. Local Discourse Context and References Discourse Structure, Conversational Structure.

1. Natural Language Understanding   James Allen,
2. Foundations of Statistical Natural Language Processing

                                           Christopher D. Manning & Hinrich Schuetze,
3. Statistical Machine Translation   Philipp Koehn

MCA641 NEURAL N/W & FUZZY LOGIC

Introduction to Neural Network Architecture and Basic Models of Neural Network: Mculloh Pit Model, Hopfield Network, Adaline and Madaline, Supervised and Unsupervised learning Learning. Supervised Neural Network, Perceptron, Convergence theorem, Multi-layer Perceptrons, Attractor Neural Network: Bidirectional Associative Memory. Radial Basis Function Networks, Kernel methods for pattern analysis: Support Vector Machines, Support Vector Regression. Self-Organizing Maps, Feedback Neural Network, Adaptive Resonance Theory.Basic Concepts of Fuzzy Logic. Case Study: MATLAB Tool Boxes.

1. Neural Network   Simon Haykin,
2. Satish Kumar, "Neural Networks – A Classroom Approach   Satish Kumar,

MASTER OF BUSINESS ADMINSTRATION (MBA)

FirstSemester

MBA5111 PRINCIPLE AND PRACTICES OF MANAGEMENT

Concept, Art vs Science, Management vs Administration, levels and evolution of management, Hawthorne experiments, planning and its types , process, barriers to effective planning, decision making, and process. Organisation Theories, organisational structure, Span of Control, Authority & responsibility, staffing concept, system approach, Manpower Planing, Direction and Supervision, control and its type, Methods.

Reference

1. Management   Stoner, Freeman & Gilbert Jr
2. Management- A global perspective   Heinz Weinrich & Harold Koontz-

MBA 512 ORGANIZATIONAL BEHAVIOUR

Introduction, goals, elements, scope and historical development of Organizational Behaviour, fundamental concepts, contributing disciplines to OB, Models of OB, social systems and organizational culture, international dimensions of organizational behaviour, limitations of Organizational behaviour, the future of O, Individual behaviours, Personality, Perception, Emotions, Attitudes, Values, Learning,

Theories of Motivation, Behaviour in the organization, Interpersonal behaviour, Group dynamics, Employee stress.

Reference

1. Organizational Behaviour   K. Awathappa, Himalaya Publication.
2. Organizational Behaviour   Robbins, Judge, Sanghi, Pearson.
3. Understanding Organizational Behaviour   Parek

MBA513 MANAGERIAL ECONOMICS

Micro and macro economics, relevance, fundamentals principles, Demand analysis-theory, types , utility analysis, elasticity of demand and its measurement, techniques of demand forecasting, law of variables proportions, cost-output relationship , production functions, Isoquants, Market Structure and products pricing- perfect and imperfect Market Structure, duopoly, oligopoly, National income and methods of measurements.

Reference

1. Managerial Economics- Analysis and cases   PL Mehta

2. Managerial Economics   Pearson and lewis

3. Managerial Economics   GS gupta

MBA 514 BUSINESS STATISTICS

Introduction to Statistics:Measurement of Central Tendency (Mean, Median, Mode). Measurement of Dispersion, Standard Deviation, Variance. Probability Theory and Probability Distributions: additive and multiplicative rules, conditional probability, Baye's Theorem, Binomial, Poisson and Normal distributions. Time Series: Methods of studying Components of Time Series: Measurement of trend, Measurement of seasonal variations, Measurement of cyclic variations. Correlation & Regression: Karl Pearson's and Spearman's Coefficient, Methods of computing simple correlation and regression. Sampling and Sampling Distribution. Theories of Estimation and Hypothesis Testing: Introduction to methodology and Types of errors, sample tests for univariate and bivariate analysis using normal distribution, F-test, t-test, Z-test and chi-square test. Statistical Decision Theory: Decisions under Uncertainty and Decisions under Risk.

Reference

1. Statistics for Management   Richard I. Levin and D.S. Rubin
2. Statistical Methods   S. P. Gupta
3. Business Satistics   P C TulsianBharat Jhunjhunwala

MBA 515 INFORMATION TECHNOLOGY &APPLICATIONS

Evolution of computer and its components, Types of softwares, OS, Languages. Introduction to DBMS,and RDBMS. Data modeling, ER diagrams, Distributed database System, Basics of Data ware housing and Data mining in business.

Computer Networking, types, topologies, Transmission modes, LAN,MAN,WAN, Intranet and Extranet, and wireless networks, introduction to different protocols, OSI/TCP/IP. Internet Banking and Online Shopping.. The IS Security, Security Threats and remedies. (Piracy, Hacking, Cracking, Spamming Etc.), Overview of Antivirus, Firewalls and Overview of IT-ACT 2000.

Reference

1. Introduction to Computers,   Peter Norton,
2. Introduction to Computers,   Turbon, Potter,
3. an Introduction to Computers,   Rajaraman, V.

MBA 516 BUSINESS & CORPORATE LAWS

Basic Principles of Indian Constitution – fundamental rights and Indian Constitution, Contract Act, 1872 ; Partnership Act, 1932; Sale of Good Act, 1930; Negotiable Instrument Act, 1881; Companies Act, 1956; Consumer Protection Act, 1986

Reference

1. Introduction to Constitution of India　　　　　　　　D D Basu
2. Mercantile Law (Sultan Chand)　　　　　　　　　N D Kapoor
3. Legal Aspects of Business　　　　　　　　　　Akhileshwar Pathak

MBA 517 FINANCIAL ACCOUNTING AND ANALYSIS

Accounting concepts, conventions and principles; Accounting Equation, International Accounting principles and standards. . Double entry system of accounting, journalizing of transactions; preparation of final accounts, Profit & Loss Account, Ratio Analysis- solvency ratios, activity ratios, liquidity ratios, market capitalization ratios and profitability ratios. Cash Flow Statement- Various cash and non-cash transactions, flow of cash, preparation of Cash Flow Statement and its analysis.

Reference

1. A text book of Accounting for Management　　　Maheshwari S.N & Maheshwari S K
2. Financial Accounting for Management　　　　　　Mukherjee
3. Management Accounting　　　　　　　　　　Khan and Jain
4. Advanced Accounts Vol 2　　　　　　　　　Shukla and Grewal

MBA518, BUSINESS COMMUNICATION

Communication- definition and types, principles of communication, Barriers to communication; Presentation skills-kinesics, proxemics, chronemics, haptics, paralanguage- knowledge of sounds of a language, features of language , participation in meetings, negotiation skills; Office management-proficiency in business correspondence-letter drafting, business and technical report writing; Time management, Interpersonal skills; Communication styles of legendary leaders from different domains of society.

Second Semestres

MBA 521 FINANCIAL MANAGEMENT

Introduction**:** Concept, scope and objectives of Finance, Functions of Finance Manager in Modern Age, Financial decision areas, Time Value of Money, Risk and Return Analysis. Investment Decision: Appraisal of project; Concept, Process & Techniques of Capital Budgeting and its applications; Risk and Uncertainty in Capital Budgeting; Leverage Analysis – financial, operating and combined leverage along with implications; ; Cost of Capital : Cost of equity, preference shares, debentures and retained earnings, weighted average cost of capital and implications. Dividend Decision

Reference

1. Fundamentals of Financial Management　　　　　Prasanna Chandra
2. Financial Management　　　　　　　　　　Khan and Jain
3. Financial Management　　　　　　　　　　I M Pandey

MBA 522 MARKETING MANAGEMENT

Marketing: Definition, types, basic concepts, approaches to marketing, Functions and importance, Marketing environment, buying behaviours, marketing mix, market segmentation, market targeting and positioning strategies, product and product line: PLC, New product decision process, pricing, packaging, Physical distribution, promotion, market evolution and controls, marketing ethics, International marketing, Relationship marketing.

Reference

1. Principles of marketing　　　　　　Philip kotler and garry Armstrong,
2. Marketing　　　　　　　　　　Bovee and john thill,

MBA 523 HUMAN RESOURCE MANAGEMENT

Human Resources Management (HRM): Basic concepts, Evolution, HRM environment. Human Resources Development in India: evolution and principles of HRD. HR Managers. Strategic Human Resource Management. Human Resources planning; Human Resources Information system: HR accounting and audit, Job Analysis, Job Design and Job Evaluation; Recruitment; Selection. Training and Development; Performance Appraisal. Compensation Administration: Wage Policy in India; Incentive Payments; Incentive Schemes in Indian Industries, Fringe Benefits. Discipline and Grievance Procedures; Industrial Relations; Promotion, Transfer and Separation .

Reference

1. Human Resource and Personnel Management   Aswathappa K
2. Designing and Managing Human Resource Management   Pareekh and Rao:
3. Reinventing of Human Resource Management: Challenges and New Directions
                                                    Ronald J Burke and Cary L Cooper

MBA 524 COST AND MANAGEMENT ACCOUNTING

Accounting for Management, Role of Cost in decision making, Comparison of Management Accounting and Cost Accounting, types of cost, cost concepts, Marginal Costing**:** Marginal Costing versus Absorption Costing, CVP analysis and P/V Ratio Analysis and their implications, Concept and uses of Contribution & Breakeven Point. . Budgeting: Concept of Budget, Budgeting and Budgetary Control, Types of Budget, Advantages and Limitations of Budgetary Control

Reference

1. Management Accounting   I M Pandey
2. Accounting for Management   Bhattacharyya and Dearden
3. Management Accounting   Khan and Jain

MBA 525 MANAGEMENT INFORMATION SYSTEMS (MIS)

Concept and of importance of MIS Various types; TPS,OAS,KWS MMIS,ESS Decision, Programmed and Non- Programmed decisions, DSS, GDSS, factors of success and failure, value and risk of IS. Introduction to different enterprises information systems, financial Information system, marketing information system, HR information system etc. Various Strategic issues in implementation of information systems, and IT infrastructure

Reference

1. MIS: Managing the digital firm,   Kenneth C. Landon, Jane P. Landon
2. Management Information System   W.S Jawadekar,
3. Management Information System,   David Kroenke

MBA 526 BUSINESS ENVIRONMENTS

Concept of Business Environment, Environment scanning, Types of economy, PPF Curve, Overview of Political, Socio-cultural, Legal, Technological and Global environment, FEMA, SEBI, the monetary policy and fiscal policy, RBI- Role and functions, Consumerism, Social Responsibility of business enterprises, Globalization, Foreign trade policy, FDI policy, Multinational Corporation (MNCs) and transnational corporations (TNCs), Global Competitiveness.

Reference

1. Economics   Samuelson, Nordhaus, Sen and Chaudhari
2. Business environment   Suresh Bedi
3. Business Environment   Vivek Mittal

MBA 527 RESEARCH METHODOLOGY

Research : Meaning, Purpose, Types of research, significance of research in social and business sciences, Identification, selection and formulation of research problem, Review of literature, hypothesis testing, Factorial experimental design, basic principles – replication, randomization, blocking, Sampling and Non-

sampling error, Advantages and limitations, primary and secondary data, Processing of data, Analysis, structuring the report.

Reference

1. Business Research Methods   Cooper and Schindler
2. Research Studies for Business   Students Saunders, Lewis and Thornhill
3. Research Methodology & Techniques   C.R. Kothari

MBA 528   OPERATIONS RESEARCH

Operations research: Uses, Scope and Application. Decision Tree: Approach and its applications. Markov Analysis, Linear programming problems: features, formulation and solution. Transportation, Assignment, and Transshipment problem and models: Definition, algorithm and solutions. Game theory: Concept, types, methods and models of solution, Sequencing problem, Queuing Systems. Network models: CPM, PERT.

Reference

1. Introduction to Operations Research   Hillier and Lieberman
2. Quantitative Techniques in Management   N.D. Vohra,
3. Operations Research   Sharma J.K

Third Semester

MBA 611   STRATEGIC MANAGEMENT

Basic concepts and Stakeholders' Issues, Environmental Scanning, Organizational Analysis and Industry Analysis; Strategy formulation – Situational Analysis, Business Strategy, Corporate Strategy and Functional Strategy; Strategy Implementation, Evaluation and control; other strategic issues – Technology Management & Innovation, Small Industries & Entrepreneurship, Globalization and Strategic Management for nonprofit organizations.

Reference

1. Strategic Management & Business Policy   Thomas Wheelen and J D Hunger
2. Strategic Management & Business Policy   Azhar Kazmi
3. Strategic Management : An integrated Approach   Charles W.L Hill & Garrett John, Houghton

MBA 612 SUPPLY CHAIN MANAGEMENT

Basic concept & philosophy of SCM, Key issues and drivers of ScM, Supply chain cycle, Responsiveness and efficiency of supply chain, forecasting, Procurement: Strategic sourcing, Supplier Selection, Supplier relationship, Supplier Quality Management , E-procurement. Various Manufacturing systems. Inventory management system. Distribution and Warehousing Management. Logistics, Transportation Network Manangement. Role of customer relationship in SCM, role of IT in SCM, Green supply Chain Management.

Reference

1. Supply Chain Management   Sunil Chopra and Peter Meindl,
2. Logistics and supply chain Management   Martin Christopherm,
3. A Textbook of Logistics and supply chain management   D.K. Agarwal Macmillan

MBA 613 OPERATION MANAGEMENT AND MATERIAL MANAGEMENT

Operations Management:, Importance and Functions, Evolution, factory system, manufacturing systems, Classification of operations, Responsibilities of Operations Manager, Facilities Location & Layout, Principles and Types of Facilities Layout Forecasting types and methods, Concepts of Quality, TQM, Six Sigma. Production Planning & Control, Inventory Management, Concept & definitions, Factors contributing to productivity improvement, Lean Production System, JIT. Definition and Uses, Methods of work sampling, Time study. Introduction, scope of materials management, MRP, MRP II. Principles of Materials Handling system. Safety issues.

Reference

1. Production and Operations Management   Adam Jr Everetl E. R J
2. Production and Operations Management   Chary
3. Operations Management   McGregor D
4. Production & Operations Management   Bedi Kanishka

MBA 614 SEMINAR 1

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure.

MBA615 SUMMER TRAINING

Summer training project report and defence

Fourth Semester

MBA FM 621 INTERNATIONAL BUSINESS AND TRADE

Growth of International Business: Globalization its effects, benefits and costs; Emergence of MNCs & TNCs and their impact; Dunning's eclectic paradigm. Environment of International Business; Scenario analysis and country wide risk investment decisions. International business competitive strategies: Porter's model, critiquing of Porter's model, Prahalad and Doz strategy model. Foreign investments: FDI, FII and Joint ventures. International organization and control: Bartlett & Ghoshal's model of TNC.
Theories & Models : Balance of trade and balance of payment: Problems and perils for developing and under developed countries. Theories of foreign exchange determination, World Bank, IMF, ADB, OECD, and WTO. Important and critical issues in global trade.

Reference

1. International Business: Environment and Management   V K Bhalla
2. International Marketing   Michael Czinkota

MBA 622 PROJECT MANAGEMENT

Concepts, roles and responsibilities of project team members, division of responsibility and authority, Project Planning and Selection, methods, lifecycle, Time and cost estimates, work breakdown structure network diagrams, gantt chart, critical path Method, programme evaluation review technique, COCOMO model, critical chain scheduling, project crashing, project evaluation and termination, project monitoring, project control, periodic project performance evaluation audits, trade-off analyses, causes associated with project success and failure, Earned value management, risk management, project audit and project terminate

MBA 623 BUSINESS ETHICS, HUMAN VALUES AND CORPORATE GOVERNANCE

Introduction to Business Ethics, Ethics, Morals & Values, Law and Ethics. Nature of Ethics in Management Business Standards and Values, Value Orientation of the Firm. Ethical issues at the top management, Ethics in financial markets and investor protection – Ethical responsibility towards competitors and business partners, ethics in human resource management and marketing management. Conflicts in decision making from ethical and economic point of view. Solving ethical dilemma; Managerial integrity and decision making. Personal Integrity and self development. Wisdom based leadership. Ethical Issues in managing public limited firms. Ensuing sustainable development. Global and National Perspectives – Global Corporate Governance models. Claims of Various Stakeholders, Cadbury Report, Changes over the last few decades, OECD Committee Recommendations – SOX Act (of USA). Internal Corporate Governance Mechanism: Board of Directors, Functional Committees of Board; Code of conduct, whistle blowers. External Corporate Governance Mechanism: Regulators, Institutional Investors, Corporate raiders. Corporate Governance in India: corporate form in India 50s to 90s – developments in Corporate Governance in India in nineties and 2000s – CII, Kumaramangalam, Narayanamoorthy, Naresh Chandra, J J Irani Committee reports – Legal and Regulatory Changes – introduction and modification of Clause 49, Corporate governance in practice in India and cases.

Reference
1. Business Ethics: Cases & Concepts   Manuel Velasquez
2. The New Corporate Governance in Theory and Practice   Stephaine Bainbridge
3.   Corporate Governance in India: An Evaluation   Subash Chandra

MBA 624 SEMINAR 2

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure.

MBA625 PROJECT WORK

Department Electives

Finance:-

MBA FM 631 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

Overview of Capital Market: Market of securities, Stock Exchange and New Issue Markets, . Regulatory Mechanism: SEBI guidelines; Investor Protection. Risk and Return**:** Concept of Risk, Measures of risk and return, calculation, trade off, systematic and unsystematic risk components. Valuation of Equity, Debentures and Bonds. Portfolio Analysis and Selection**:** Portfolio concept, Portfolio risk and return, Beta as a measure of risk, calculation of beta, Portfolio Management and Mutual Fund Industry.

Reference

1. Investment Analysis and Portfolio Management   Chandra P
2. Security Analysis and Portfolio Management   Fischer and Jordan
3. Theory and Problem of Investments   Francis and Taylor

MBA FM 632 CORPORATE TAX PLANNING AND MANAGEMENT

Nature and Scope of Tax Planning**:** Nature, Objectives of Tax Management, Tax Planning, Tax Avoidance & Tax Evasion, Assessment Year, Previous Year, Assessee – types, Residential status, Non-resident Indians. Tax on Individual Income**:** Computation of tax under the various heads. Corporate Income Tax

Central Excise Act and Excise planning; Customs Act and Customs Duties Planning,

VAT, Service Tax. Tax treaties at bilateral and multilateral levels, GST and DTC.

Reference

1. Direct Taxes, Law & Practice   Singhania V K
2. Income Tax Law & Practice   Prasad Bhagwati
3. Income Tax.   Kanga J B and Palkhivala N A

MBA 633 MANAGEMENT OF FINANCIAL INSTITUTIONS AND MARKET

Financial System and Markets: RBI- Role and functions. Monetary and fiscal policies, Techniques of regulation and rates; Overview of Foreign Exchange Market, Financial Sector Reforms in India, Overview of Financial Services,. Banking Industry in India, banking sector reforms, commercial interest rates, capital adequacy norms, Liquidity Management, Asset Liability Management, Management of Non-performing assets.

Securitization: Securitization in India. DFIs in India, Exim Bank. State Level Institutions; Insurance & Mutual Fund organizations.

Leasing and Hire Purchase, Hire purchase and lease. Factoring, Forfaiting, Discounting and Re Discounting of Bills, Consumer Credit and Plastic Money.

Reference

1. Foundations of Financial Markets and Institutions   Fabozzi
2. Financial Services   Khan M Y
3. Lease Financing, Hire Purchase including Consumer Credit   Kothari V

MBA 634 INTERNATIONAL FINANCE MANAGEMENT

Institutions/Development Banks – World Bank – IBRD – IDA – IFC – MIGA – International Monetary Fund, The Foreign Exchange Market – SWIFT – Arbitrage – Spot market – Forward market – Cross rates of exchange – Bid – Ask spreads – Balance of payments – Foreign exchange rates – Theories of Foreign Exchange Rate. Foreign exchange exposure and management, Financial Management of the Multinational Firm Financing Foreign Operations – Eurocurrency markets – Instruments – Interest rate swaps – Currency swaps and its pricing – Depository receipts – GDR and ADR – Euro and its implications for India.

Reference

1. Multinational Finance,   Buckley, A.
2. International Financial Markets: Prices and Policies,   Levich. R.M.
3. International Financial Management   Apte, P.G.

MBA 635 WORKING CAPITAL MANAGEMENT

Factors Determining Working Capital Requirements, Importance of Optimum Working Capital, Working Capital Policy and Management, Permanent-Temporary, Financing Working Capital, Working Capital Monitoring and Control. Different Components of Working Capital, Estimation of Working Capital Requirements. Cash Management, Factors Affecting Cash Needs, Cash Budget, Control Aspects, Managing Types Of Bank Credit, Other Sources of Short Term Financing, Regulation of Bank Credit In India.

Reference

1. Working capital management   V. E. Ramamoorthy
2. Working Capital Management   Leo R. Cheatham

MBA 636 FINANCIAL AUDITING

Principles of Auditing, The Accounting System, Its importance to lndependent Audit, Internal Control, Internal Audit. Rights and Duties of Auditors. Professional Liabilities of an Auditor. Application of Auditing Principles and Techniques to all Types of Trading, Commercial. Industrial, Banking, Insurance and Investment under-takings, Audit programme. Limitations of Audit, Audit Report

Books

1. Modern Auditing: Assurance Services and the Integrity of Financial Reporting
                                    William C. Boynton and Raymond N. Johnson
2. Auditing and Assurance Services,   Pearson

Marketing

MBA 641   PRODUCT AND BRAND MANAGEMENT

Product: Basic concept, product planning and development: Product lifecycle Management, Product Portfolio Analysis and Management. Brand: concept, role of brand, brand awareness, brand management. Brand Equity:, Brand Positioning, Brand Marketing Programs, Choosing Brand Elements to Build Brand Equity, Designing Marketing Programs to Build Brand Equity. Branding Strategies: Designing and Implementing Branding Strategies, Managing Brands, Brand leveraging strategies, Brand identity system, Brand valuation and Failure of brands.

Reference

1. Strategic Brand Management   Kevin Keller
2. Managing Brand Equity   David Aakers,
3. Brand Positioning   sengupta Subroto

MBA 642 MARKETING RESEARCH

Marketing Research – Conceptual framework, process, and Data Collection, Marketing Mix Research, qualitative, quantitative research, Exploratory Research, Causal Research, Research Design, Scaling techniques, Questionnaire, Sampling types. Data Analysis Techniques – Univariatae, Bivariate, Multivariate, Regression Analysis, Factor Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Web based marketing research, report generation.

Reference

1. Marketing Research" , Third Edition,   Beri, G. C.,
2. Marketing Research: Within a Changing Information Environment

                                       Hair, Joseph, Robert Bush, and David Ortinau
3. Essentials of Marketing Research   Proctor, Tony,
4. Marketing Research   Malhotra, K.N.,Dash S

MBA 643 SALES & DISTRIBUTION MANAGEMENT

Sales Management; Objectives and Functions, Setting up a sales organization, Personal Selling, Management of Sales force, Recruitment & Selection, Training, Motivation and Evaluation, Compensating Sales Force, Sale forecasting, Territory Management, Sales Budget, Sales Quota.

Distribution Management, Design of Distribution Channel, Channel Conflict, Co-operation & Com Petition, Vertical marketing system, Horizontal Marketing system, Designing Customer Oriented Marketing Channels: Wholesaling, Retailing. Order Processing, Transportation, Warehousing, Inventory, Market Logistics Decision, SCM, Emerging Trends.

Reference

1. Sales Management   Still, Cundifts, Govani
2. Sales & Distribution Management ,   Chunnwala
3. Sales & Distribution Management,   Panda and Sahadev

MBA 644 CONSUMER BEHAVIOR

Theories of Consumer Behaviour: Learning theory, Psychoanalytic theory, Gestalt, Cognitive theory, Psychological field, Models of Consumer Behaviour; Howard-Seth Model, Angle-Blackwell-Kollat, Nicosia Model. Seth's Family Decision-making Model, Factors influencing consumer decision making, Segmentation, Psychographics Individual Determinants of Behaviour- Personality, perception, attitude, Motivation, Group influence on consumer behaviour-Social class, Social groups, Opinion leaders. Culture, Sub-culture, Cultural relevance to marketing decisions, Cultural Values, Cultural Changes, Cross cultural understandings. Family: Role & Structure, Family Life Cycle, Purchasing decisions, changing role of families.

Reference

1. Consumer Behaviour   Schiffmen, Kanuk
2. Consumer Behaviour   Suja R. Nair
3. Consumer Behaviour   Blackwell / Minlard / Engel
4. Consumer Behaviour   Batra & Karmi

MBA 646 RURAL MARKETING & AGRI-BUSINESS

Rural market structure, rural consumer behaviour, rural marketing information system, research & forecasting rural demand, problems of rural marketing, rural marketing agencies, rural marketing mix. agri- marketing: - scope, role in economic development, demand supply of farm products, marketing of agriculture inputs and farm products, strategy for agriculture marketing.

Reference

1. Rural Marketing   K. Ramkrishnan
2. Rural Marketing   kshyap, Raut Biztantra

Human Resource

MBA 651 HUMAN RESOURCE DEVELOPMENT

HRD concepts, Evolution of HRD from Personnel management, Importance of HRD, Subsystems of HRD: Human Resource Planning, Potential Appraisal, Assessment Center, Performance appraisal including 360 degree appraisal. Organizational Culture and Climate: Role of HRD in promoting a development oriented Culture and climate in the Organizations. Developing Human Capability**:** Aptitude, Knowledge, Values, Skills of Human Relations, Responsiveness, Loyalty and Commitment, Transparency, Leadership development.

Training and Development; Training need analysis, Types of training Internal and external, Evaluating HRD: Human Resource Accounting, HR Audit and Bench marking, Impact-assessment of HRD initiatives on the bottom-line of an organization. Quality of Work life and, Grid training, Benefits of OD. Organizational Development Process. Recent Trends in HRD and OD.

Reference

1. Human Resource Management,   Dressler and Gary
2. Human Resource Management,   Fisher, Schoenfedlt and Shaw
3. Human Resource Management,   Leap, Terry L and Michael D Crino
4. Designing and Managing Human Resource Systems,   T V Rao and Udai Pareek

MBA 652 INDUSTRIAL RELATIONS AND LABOUR LEGISLATIONS

Industrial Relation:- Origin & overview, factors affecting IR in changing Environment, Approaches to the study of IR. Trade Union: – Functions, Types & structure, Impact of globalization on Trade union movement. Industrial Dispute- Overview, Industrial Relation Machinery to solve Industrial Dispute. Collective Bargaining- Process of Collective Bargaining causes for failure, Grievance management. Workers Participation in Management- Concept, Pre-Requisites, Levels Of Participation, Benefits of Participation. Impact of Globalization & Information Technology on IR, Role of Human Resource Development in Developing Industrial Relation-Industrial Relation Democracy, Industrial peace. Salient features of Industrial Employment (Standing order) Act1946 and Indian Trade Union Act **1926.**

Reference

1. Industrial Relations Shifting Paradigms   Ratna Sen,
2. Dynamic Personnel Administration   M.N.Rudrabasavraj.
3. Personnel Management and Industrial Relations   P.C.Shejwalkar and S.B.Malegaonkar
4. Labour Management Relations in India   K.M.Subramanian
5. Trade Unionism. Myth and Reality, New Delhi, Oxford University Press, 1982.

MBA 653 COMPENSATION AND PERFORMANCE MANAGEMENT

INTRODUCTION TO PERFORMANCE APPRAISAL: Importance and Process of appraising performance, Traditional and modern methods. Performance management process, Competency mapping, 360 degree feedback and its variants, Current trends in performance management. INTRODUCTION TO WAGES AND SALARY: Minimum wages, Need based minimum wages, fair wages and living wages. Monetary wages and real wages. Factors affecting wages and salary levels. Wage policy: Objectives & need, formulation of wage policy in India. Recommendation in wage policy. Labour market and compensation management . WAGE DETERMINATION : Principles of wage and salary, administration, Job Evaluation: Methods and techniques, Performance based pay systems, Knowledge based pay system & market based pay system. Wage Policy in India, Methods of wage determination in India, Wage Boards. The minimum wages Act, The Pay Commission, Payment of Wages Act & Payment of Bonus Act. EMPLOYEE BENEFITS: Incentive Payment and types of incentive plans. Compensation practices of multinational and global organizations, Incentive based pay systems, Executive compensation Practices of MNCs.

Reference

1. Compensation   Milkvich & Newman
2. Compensation Management inknowledge based world,   Henderson
3. Human resource management   Gary Deseler
4. Performance Appraisal   T.V.Rao,

MBA 654 STRATEGIC HUMAN RESOURCE PLANNING

Introduction to business and corporate strategies, Traditional Vs strategic HR, Strategic Human Management, Linkages between HRM and Strategic management process, Role of HRM in Strategy formulation. Human resource management Model, Toyoto model, Ten C model, Michigan Model , Harward Model, Core competencies model for HRM, Professional David Guest model. Efficient utilization of human resource– Cross training and flexible work assignment-world teams-non unionization, strategies for employee shortages, surpluses, performance and development. Typology of performance types-marginal performers, under achievers, stars, solid citizens, managing employee ability-recruitment and selection strategy typology, incentive alignment, psychological contracting. Introduction to 0 HRM-Jeffery Mello,Thompson publication,New Delhi

Reference

1. Strategic HRM   Charles Greer,
2. Srtategic HRM   Ararwal,

MBA 655 ORGANIZATION DEVELOPMENT & CHANGE MANAGEMENT.

Organizational Development Conceptual frame work of OD, History of OD, First order and second order Change, Values, assumptions and believes in OD, Participation and Empowerment, Teams and teamwork, Parallel learning structures, Managing the OD Process , OD interventions, models of organizational change Force Field, Kurt Lewis, Systems, Managerial approaches for implementing change, perspectives on change, understanding the change process, facilitating change, dealing with individual and group resistances, intervention strategies, Organizational Culture & Change, Corporate Culture, emerging trends in Organizational culture, Organizational Constraints for Creativity & Innovation

Reference

1. Organization Development, behavioral science interventions for Organization Improvement,
                                       Wendell L.French, Cecil H.Bell, Veena,
2. Organization Development, & Transformation, Managing Effective Change,
                                       Wendell L.French, Cecil H.Bell, Jr,
3. Organization Change and Development,   Kavith Singh,
4. Managing organizational change   Palmer, Dunford, Akin,

MBA656 INTERNATIONAL HUMAN RESOURCE MANAGEMENT

Introduction to IHRM: Emergence, Approaches, Models, Organizational dynamics and IHRM, Organizational processes in IHRM, Linking HR to International expansion strategies, Challenges. Strategies for International Growth: mastering expatriation, Becoming locally responsive: understanding diversity, the challenges of localization. Managing alliances and joint ventures. Recruitment, selection and staffing in International context: International Managers, different approaches to multinational staffing decisions. Performance Management: performance management cycle, models, performance appraisal in IHRM, appraisal of expatriate. Current scenario in international training and development, types of expatriate training, developing international staff and multinational teams. Key components of international compensation, compensation practices across the countries, social security systems across the countries, global compensation. HRM practices in different countries.

Reference

1. International Human Resource Management   Peter J Dowling & Denice E Welsch
2. International Human Resource Management - Dennis R. Briscoe, Randall S. Schuler

3. Management - Third Edition   Anne-Wil Harzing

Information Technology

MBA 671 DATA WAREHOUSING & DATA MINING

Introduction,, characteristics, and Evolution of DW and architecture & components. Process of ETL, Aggregation, Meta data and its architecture, Granularity, Dimensional data modeling, OLAP Star Schema and Snowflake Schema. Data warehouse lifecycle, various issues and challenges faced during DW lifecycle, Vertical and Horizontal Partitioning, Capacity planning, back–up strategies. Concept of data mining. Knowledge (KDD process, Virtuous, query tools, database processing vs data mining processing, Application of data mining in management decision making. Business Intelligence, Classification technique & Association rule technique for data mining. K-nearest neighbor, neural networks, decision trees,CRM and fraud detection, Web mining and text mining.

Reference
   1. "Data warehousing Fundamentals"   Paulraj Ponniah,
   2. "Modern Data Warehousing, Mining and Visualization   George M. Marakas,
   3. "Data Mining for Business Intelligence"   Shmueli, G. Patel, N and Bruce, P;

MBA 672 TECHNOLOGY & INNOVATION MANAGEMENT

Concept & Classification of Technology and its management, Critical Parameters in managing Technology, Life cycle of Innovation & Technology, Process of Technological & Non Technological Innovation, competitiveness of Firm/ industry, a Nation. Technology Strategy in reference to business and IT strategy. Technology Audit model. Creativity, idea, and innovation process. Research & development (R&D) Management Innovation and firm capability, Value creation through Innovation, Technology Transfer & Legal frame/IPR/ Patents/copy rights/cyber law etc. Case studies focused with Indian cases in Global Paradigm.

Reference
   1. Technology Management authored   Megantz, Robert C
   2. Hand Book of global technology Policy Authored   Nagel, Stuart S.
   3. Management of Technology authored   Tarek khalil
   4. Innovation Strategies for knowledge economy authored   Emidon, Debra M

MBA 673 E – BUSINESS

Fundamentals in E-Commerce, commerce – meaning, nature, limitation. e-commerce- – Origin, nature, meaning, definitions, features, need, advantages & disadvantages, essential requirements, e-Commerce Vs traditional Commerce. Business Models for e Commerce, e-business: meaning, definition, importance, e-business models based on the relationships of transaction parties, B2C, B2B, C2C, and C2B. E-Payment System, Modes of e-payment, Risks & e payment system: Data protection, risk from mistakes & disputes-Consumer protection, Management Information Privacy, Managing Credit Risk.

Reference
   1. Introduction to e-commerce" by Jeffrey F. Rayport & Bernard J. Jaworski; TATA Mcgraw Hill Publications.
   2. Creating a Winning E – Business   Napier Rivers, Wagner & Napier,
   3. Internet Business Models & Strategies"   Alan Afuah & Christopher L. Tucci

MBA 674 SOFTWARE PROJECT MANAGEMENT

Concept Software project Management, SDLC, and process models, requirement analysis. Quality and testing issues, Process and project metrics. Triple constraints, framework for project management. Strategic Planning and Project Selection methods. Project Integration Management, Project Scope Management, creep, scope planning, WBS. Activity sequencing, CPM, PERT, Schedule Development, critical Chain Scheduling and other Project Time Management processes. cost estimation, budgeting,

Control, Earned Value Management Project Quality Management: Concept of Quality, waste, six sigma, and other project quality management processes. Risk and Change Management. Project Communication, HR issues of Software project management.

Reference

1. IT Project Management   Kathy Schwalbe
2. Project Management: A Managerial Approach   Jack Meredith & Samuel J Mantel Jr,
3. Project Management for Business and Technology   John M Nicholas,

MBA 675 ENTERPRISE RESOURCE PLANNING

Integration of business activities, dependent Vs independent items, Different planning horizons viz strategic, tactical and operational, MRP inputs, bill of Materials, Master production schedule and inventory master file, MRP process, Evolution of ERP, Benefits of ERP. ERP, Reengineering- need and challenges, Management concerns about BPR. BPR to build business Model for ERP, ERP & competitive advantage Basic constituent of ERP, Selection criteria for ERP Packages. Procurement process for ERP Package, ERP packages SAP R/3, PEOPLE SOFT, BAAN IV, MFG/PRO, ORACLE-FINANCIAL. ERP Implementation- issues, Role of Consultants, Vendors, Users, Need for training, customization. ERP implementation methodology and post, implementation issues ERP and cases.

Reference

1. ERP Demystified.   Alexis, Leon
2. ERP Concepts and Practices.   Garg, V.K. and Venket, Krishna, N.K.
3. ERP: A Managerial perspective.   Sadagopan, S.

Abbreviations

GOI   -   Government of India

MHRD   -   Ministry of Human Resource Devlopment

SPRC   -   Senate Postgraduate Research Committee

DPRC   -   Departmental Postgraduate Research Committee

ARC   -   Academic Reforms Committee

SGPA   -   Semester Grade Performance Average

CGPA   -   Cumulative Grade Performance Average

NIMCET   -   National Institute of Technology Master of Computer Application
                     Entrance Test

NIT   -   National Institute of Technology

DRPC   -   Department Research Programme Committee

RDC   -   Research Degree Committee