Course Structure and Detailed Syllabus

for

Bachelor of Technology

in

Civil Engineering

Computer Science & Engineering

Electrical Engineering

Electronics & Communication Engineering

Information Technology

Mechanical Engineering

(Effective from 2015-16
(Updated as per 16th Senate)

Department of Electrical Engineering

राष्ट्रीय प्रौद्योगिकी संस्थान पटना

NATIONAL INSTITUTE OF TECHNOLOGY PATNA

PATNA 800005, BIHAR

Course Code Format for UG and PG Program:

Semester Code	Course Code				
1	2	3	4	5	6
5	E	E	6	1	5
Semester:	**Department Code:**		**Program Code with Course S. No:**		
1st Sem: 1 2nd Sem: 2 3rd Sem: 3 4th sem: 4 5th Sem: 5 6th Sem: 6 7th Sem: 7 8th Sem: 8 9th Sem: 9 10th Sem: A	Architecture: AR Chemistry: CH Civil Engg: CE Computer Sc Engg: CS Eletro & Comm Engg: EC Electrical Engg: EE Humanities: HS Information Tech: IT Mathematics: MA Mechanical Engg: ME Physics: PH		UG Program: 101 to 599 PG Program: 601 to 799 For different specializations different slots may be allocated, such that identification becomes identifiable.		

Any course may be offered in odd or even semester of a program. Therefore <u>Semester code is to be pre fixed to the Course Code</u> to identify course offed for any program and for purpose of registration

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9.5 Minimum requirement for promotion to higher Semester and continue in the program *(Applicable to students admitted from session 2013-14)*[1]

(i) All students admitted in B. Tech/ B. Arch Program form first semester can continue to second semester.

(ii) A student should earn not less **than the minimum credit threshold as stated in Table 9.5-1**, at the end of the each year for registration to the higher semester, and he/ she must have **passed minimum two courses from each semesters** of course credit not less than 3 (three) each.

Table 9.5-1 Percentage Credit Threshold based on Total credit offered at the end of each year of B. Tech and B. Arch Program

Check Point	Credit Threshold at end of each year	Credit Threshold as per New Course Structure #
End of FIRST year	75% of 1st Yr credit	34
End of SECOND year	1st Yr Threshold Credit + 75% of 2nd Year Credit	64
End of THIRD year	2nd Yr Threshold credit +75% of 3rd Year Credit	96
End of FOURTH year (Only B. Arch)	3rd Yr Threshold Credit + 75% of 4th Year Credit	131

The data in the last Column of above table is as per present Course structure and may change if Course credit offered in different semesters is changed/ modified.

(iii) If any student fails to satisfy the above minimum credit threshold requirement to continue in the programme, he/she shall be on **academic probation for one year**, during which he/she is allowed to register for all failed and debarred courses only to earn/makeup the deficit credits during Odd/ Even Semester and Summer Quarter Semesters of the session.

(iv) If any student wants to get readmitted i.e. attend all Courses of any Semester in next Session may be permitted, for improvement of CGPA.

(v) At the end of the academic probation period, if any student still does not qualify/ earn credit threshold as per Table 9.5-1 to register for the higher semester, he/she has to discontinue from the programme.

(vi) The credit requirements mentioned above does not include courses, which are Pass/ Fail courses and are not considered for CGPA calculations.

(vii) A student must become eligible for award of degree in maximum period as detailed under section 12.12.

Note: The CGPA for a set of p subjects will be calculated as follows:

$$\text{CGPA} = \sum_{i=1}^{p} c_i g_i \Big/ \sum_{i=1}^{p} c_i$$

Where 'c_i' is the number of credits allotted to a particular subject 'i' in the set, and 'g_i' is the grade - point carried by the letter grade awarded to the student in that subject 'i'.

[1] Amendments approved by 13th Senate applicable to students admitted from Session 2013-14 and onward. Students admitted during session 2011-12 and 2012-13 who do not get promotion under previous rule shall be governed by transitory rules.

UG Program Course Credit of New courses Structure in Semester & its Percentage Contribution

Credit in any Semester is based on Lecture, Tutorial and Practical (L – T – P) hours assigned for the subject, as indicated in column 2, 3 and 4 of the Table below.

Lecture/ Tutorial: One hour per week in a semester will be equivalent to one credit.

Practice: Three hours per week in a semester will be equivalent to one credits.

Credit of a course offered in a Semester = L + T + (P /3)

Credit of any subject will be an integer number. If Credit calculated as stated above has any fractional part that needs to be rounded off to an integer number. In case the course credit is a fractional number greater than or equal to 0.5, then it should be rounded up to next higher integer. If fractional part is less than 0.5 then should be ignored.

Full Marks for Theory & Practical Components Evaluation & its Contribution

L	T	P	Credits	Course Full Marks (FM)	Theory Marks Distribution				Practical Marks Distribution (P)		
					Class Assessment : FM	Mid Sem Exam: FM	End Sem Exam: FM	Total Theory: FM	Class Assessment : FM	End Sem Exam: FM	Total Practical: FM
0	0	1	**0**	**0**	0	0	0	**0**	0	0	**0**
0	0	3	**1**	**100**	0	0	0	**0**	40	60	**100**
0	0	4	**1**	**100**	0	0	0	**0**	40	60	**100**
0	0	6	**2**	**100**	0	0	0	**0**	40	60	**100**
0	0	60	**20**	**100**	0	0	0	**0**	40	60	**100**
0	1	3	**2**	**100**	0	0	0	**0**	40	60	**100**
1	0	3	**2**	**100**	0	0	0	**0**	40	60	**100**
1	0	4	**2**	**100**	0	0	0	**0**	40	60	**100**
1	0	6	**3**	**100**	0	0	0	**0**	40	60	**100**
1	0	8	**4**	**100**	0	0	0	**0**	40	60	**100**
1	1	0	**2**	**100**	20	20	60	**100**	0	0	**0**
1	1	6	**4**	**150**	20	20	60	**100**	20	30	**50**
2	0	0	**2**	**100**	20	20	60	**100**	0	0	**0**
2	0	2	**3**	**150**	20	20	60	**100**	20	30	**50**
2	0	4	**3**	**150**	20	20	60	**100**	20	30	**50**
2	1	0	**3**	**100**	20	20	60	**100**	0	0	**0**
2	1	3	**4**	**150**	20	20	60	**100**	20	30	**50**
3	0	0	**3**	**100**	20	20	60	**100**	0	0	**0**
3	0	3	**4**	**150**	20	20	60	**100**	20	30	**50**
3	1	0	**4**	**100**	20	20	60	**100**	0	0	**0**

Please refer to section 11.2 for details of weightage of different components for evaluation of course having Theory only, Practical only and Theory & practical

Common Course Structure for B. Tech Program

S. No.	Sem	Course	TH/ PT	L	T	P	Credit	Total Credit	Cumm Credit
1	1	PARICHAY	PT	0	0	1	0		
	1	English Literature[2]	TH	2	1	0	3		
3	1	Engineering Physics- I	TH	3	1	0	4		
4	1	Engineering Physics- I Lab	PT	0	0	3	1		
5	1	Engineering Mathematics - I	TH	3	1	0	4		
6	1	Introduction to Computing	TH	2	1	0	3		
7	1	Computing Lab	PT	0	0	3	1		
8	1	Workshop Practice	PT	0	0	3	1		
9	1	Elements of Electrical Engg	TH	3	1	0	4		
10	1	Elements of Electrical Engg Lab	PT	0	0	3	1		
				14/13	5	15/12	22	22	22
1	2	Communication Skill Development & Technical Writing	PT	0	1	3	2		
2	2	Engineering Mechanics	TH	3	1	0	4		
3	2	Engineering Graphics	PT	0	0	4	2		
4	2	Science, Society & Ethical Values	TH	1	1	0	2		
5	2	Chemical Science	TH	3	0	0	3		
6	2	Chemical Science Lab	PT	0	0	3	1		
7	2	Elements Of Electronics Engg	TH	3	1	0	4		
8	2	Elements Of Electronics Engg Lab	PT	0	0	3	1		
9	2	Engineering Mathematics -II	TH	3	1	0	4		
				13	5	13	23	23	45
1	3	Departmental Core-I	TH	3	1	0	4		
2	3	Departmental Core-II	TH	3	1	0	4		
3	3	Departmental Core-I Lab	PT	0	0	3	1		
4	3	Departmental Core-II Lab	PT	0	0	3	1		
5	3	Departmental Core-III	TH	3	1	0	4		
6	3	Materials Science & Technology	TH	3	0	0	3		
7	3	Engineering Mathematics- III (Elective)	TH	3	0	0	3		
				15	3	6	20	20	65
1	4	Departmental Core-IV	TH	3	1	0	4		
2	4	Departmental Core-V	TH	3	1	0	4		
2	4	Departmental Core-VI	TH	3	1	0	4		
3	4	Departmental Core-IV Lab	PT	0	0	3	1		
4	4	Departmental Core-V Lab	PT	0	0	3	1		
5	4	Green Chemistry (Environmental Science)	TH	3	0	0	3		
6	4	Engineering Mathematics- IV (Elective)	TH	3	0	0	3		
7	4	EAA – I NSS					0		

[2] **In First Year the faculties of HSS department is required to evaluate student's proficiency in English communication skill. If Communication Skill (Spoken and Written) of the students is found to be below normal standard, then all such students shall be offered following course in lieu of English Literature (HS101) in that semester as detailed below:**

Prog	Sem	Course Title	Code	TH/ PT	L	T	P	Credits
GR_A/ GR_B/ ARUG	1 or 2	Remedial English	HS103	TH	2	0	0	2
		Language Lab	HS104	PT	0	0	3	1

S. No.	Sem	Course	TH/ PT	L	T	P	Credit	Total Credit	Cumm Credit
				15	3	6	20	20	85
1	5	Departmental Core-VII	TH	3	1	0	4		
2	5	Departmental Core-VIII	TH	3	1	0	4		
3	5	Departmental Core-IX	TH	3	1	0	4		
4	5	Departmental Core-VII Lab	PT	0	0	3	1		
5	5	Departmental Core-VIII Lab	PT	0	0	3	1		
6	5	Departmental Lab	PT	0	0	3	1		
7	5	Departmental Elective - I	TH	3	0	0	3		
8	5	Engineering- I (Elective)	TH	3	0	0	3		
9	5	Industrial Interaction & Skill Development	PT				0		
				15	3	12	21	21	106
1	6	Departmental Core-X	TH	3	1	0	4		
2	6	Departmental Core-XI	TH	3	1	0	4		
3	6	Departmental Core-XII	TH	3	1	0	4		
4	6	Departmental Core-X Lab	PT	0	0	3	1		
5	6	Departmental Core-XI Lab	PT	0	0	3	1		
6	6	Minor Project-I	PT	0	0	3	1		
7	6	Departmental Elective - II	TH	3	0	0	3		
8	6	Engineering- II (Elective)	TH	3	0	0	3		
9	6	Industrial Interaction & Soft Skill Development					0		
10	6	EAA – II NSS					0		
				15	3	9	21	21	127
1	7	Departmental Elective - III	TH	3	0	0	3		
2	7	Departmental Elective - IV	TH	3	0	0	3		
6	7	Bio Science	TH	3	0	0	3		
3	7	Engineering -III/ HSS/ Science/ Department (Elective)	TH	3	0	0	3		
4	7	Engineering -IV/HSS/ Science/ Department (Elective)	TH	3	0	0	3		
6	7	Minor Project-II	PT	0	0	6	2		
7	7	Industrial Training (4 to 6 weeks after 6th Sem)	PT				1		
8	7	General Seminar	PT	0	0	6	2		
							20	20	147
1	8	Major Project	PT				20		
2	8	Comprehensive Viva	PT				2		
							22	22	169

Common Curricula for 1st & 2nd Semester of B. Tech Program

Prog	Sl. No.	Sem	Code	Course Title	TH/ PT	L	T	P	Credits
Group – A (1stSem)									
GR_A	1	1	GE101	PARICHAY[3]	PT	0	0	1	0
GR_A	2	1	HS101	English Literature[4]	TH	2	1	0	3
GR_A	3	1	MA101	Engineering Mathematics – I	TH	3	1	0	4
GR_A	4	1	PH101	Engineering Physics	TH	3	1	0	4
GR_A	5	1	PH102	Engineering Physics Lab	PT	0	0	3	1
GR_A	6	1	CS101	Introduction to Computing	TH	2	1	0	3
GR_A	7	1	CS102	Computing Lab	PT	0	0	3	1
GR_A	8	1	EE101	Elements of Electrical Engg	TH	3	1	0	4
GR_A	9	1	EE102	Elements of Electrical Engg Lab	PT	0	0	3	1
GR_A	10	1	ME102	Workshop Practice	PT	0	0	3	1
						14	**4**	**13**	**22**
Group – A (2ndSem)									
GR_A	1	2	HS102	Communication Skill Development & Technical Writing	PT	0	1	3	2
GR_A	2	2	MA102	Engineering Mathematics –II	TH	3	1	0	4
GR_A	3	2	CH101	Chemical Science	TH	3	0	0	3
GR_A	4	2	CH102	Chemical Science Lab	PT	0	0	3	1
GR_A	5	2	HS105	Science, Society & Ethical Values	TH	1	1	0	2
GR_A	6	2	CE101	Engineering Mechanics	TH	3	1	0	4
GR_A	7	2	EC101	Elements of Electronics Engg	TH	3	1	0	4
GR_A	8	2	EC102	Elements of Electronics Engg Lab	PT	0	0	3	1
GR_A	9	2	ME101	Engineering Graphics	PT	1	0	3	2
						15	**4**	**12**	**23**

[3] In First semester PARICHAY program shall be conducted in each section for 1st two weeks of admission

4 In First Year the HSS department faculties are required to evaluate student's proficiency in English communication. If Communication Skill (Spoken and Written) of the students is found to be below normal standard, then all such students shall be offered following course in lieu of English Literature (HS101) in that semester as detailed below:

Prog	Sem	Code	Course Title	TH/ PT	L	T	P	Credits
GR_A/ B/ ARUG	**1 or 2**	HS103	Remedial English	TH	2	0	0	2
		HS104	Language Lab	PT	0	0	3	1

Prog	Sl. No.	Sem	Code	Course Title	TH/ PT	L	T	P	Credits
Group- B (1stSem)									
GR_B	1	1	GE101	PARICHAY	PT	0	0	1	0
GR_B	2	1	HS102	Communication Skill Development & Technical Writing	PT	0	1	3	2
GR_B	3	2	MA102	Engineering Mathematics -I	TH	3	1	0	4
GR_B	4	2	CH101	Chemical Science	TH	3	0	0	3
GR_B	5	2	CH102	Chemical Science Lab	PT	0	0	3	1
GR_B	6	2	HS105	Science, Society & Ethical Values	TH	1	1	0	2
GR_B	7	2	CE101	Engineering Mechanics	TH	3	1	0	4
GR_B	8	2	EC101	Elements of Electronics Engg	TH	3	1	0	4
GR_B	9	2	EC102	Elements of Electronics Engg Lab	PT	0	0	3	1
GR_B	10	2	ME101	Engineering Graphics	PT	1	0	3	2
						15	**4**	**13**	**23**
Group- B (2ndSem)									
GR_B	1	2	HS101	English Literature	TH	2	1	0	3
GR_B	2	2	MA102	Engineering Mathematics –II	TH	3	1	0	4
GR_B	3	2	PH101	Engineering Physics- I	TH	3	1	0	4
GR_B	4	2	PH102	Engineering Physics- I Lab	PT	0	0	3	1
GR_B	5	2	CS101	Introduction to Computing	TH	2	1	0	3
GR_B	6	2	CS102	Computing Lab	PT	0	0	3	1
GR_B	7	2	EE101	Elements Of Electrical Engg	TH	3	1	0	4
GR_B	8	2	EE102	Elements Of Electrical Engg Lab	PT	0	0	3	1
GR_B	9	2	ME102	Workshop Practice	PT	0	0	3	1
						14	**4**	**12**	**22**

Note:

- First and Second semester courses have been divided in two groups: Group A and Group B. Any set of student of any branch is offered Group A of 1st semester then same set of students will be offered Group A of 2nd Semester; likewise set of students of any branch is offered Group B of 1st semester then they will be offered Group B of 2nd semester.
- **Group A**: Electrical Engineering, Civil Engineering and Mechanical Engineering (for re-admitted students).
- **Group B**: Electronics & Communication Engineering, Computer Sc.& Engineering and Information Technology (for readmitted students).
- In Course Code column 'x' represents Semester Code - to be substituted by the department based of subject being offered either in 1st or 2nd Semester.

Course Structure for B. Tech (Civil Engineering) Program (2014 Batch Onward)

Prog	S. No.	Sem	Course Code	Course Title	L	T	P	Credit	Sem Credit	Cumm Credit
CEUG	1	3	CE105	Fluid Mechanics & Hydraulics	3	1	0	4		
CEUG	2	3	CE106	Fluid Mechanics & Hydraulics lab	0	0	3	1		
CEUG	3	3	CE107	Mechanics of Solids	3	1	0	4		
CEUG	4	3	CE108	Surveying	3	1	0	4		
CEUG	5	3	CE109	Surveying Lab	0	0	3	1		
CEUG	6	3	CH104	Green Technology (Environmental Science)	3	0	0	3		
CEUG	7	3	MA1xx	Engineering Mathematics- III (Elective-3)	3	0	0	3		
CEUG	8	3	PH103	Materials Science & Technology	3	0	0	3		
CEUG	9	3			15	3	6	20	20	65
CEUG										
CEUG	1	4	CE110	Design of Concrete Structures	3	1	0	4		
CEUG	2	4	CE111	Cement Concrete Lab	0	0	3	1		
CEUG	3	4	CE112	Geotechnical Engineering -I	3	1	0	4		
CEUG	4	4	CE113	Geotechnical Engineering - I Lab	0	0	3	1		
CEUG	5	4	CE114	Environmental Engineering - I	3	1	0	4		
CEUG	6	4	CH105A	Bio Science	3	0	0	3		
CEUG	7	4	MA108	Numerical Methods for Engineers (Maths Elective-2)	3	0	0	3		
CEUG	8	4	GE105	EAA - I NSS				0		
CEUG	9	4			15	3	6	20	20	85
CEUG										
CEUG	1	5	CE116	Design of steel structures	3	1	0	4		
CEUG	2	5	CE117	Design of steel structures lab	0	0	3	1		
CEUG	3	5	CE118	Geotechnical Engineering - II	3	1	0	4		
CEUG	4	5	CE119	Material Testing Lab	0	0	3	1		
CEUG	5	5	CE121	Transportation Engineering -I	3	1	0	4		
CEUG	6	5	CE122	Transportation Engineering –I Lab	0	0	3	1		
CEUG	7	5	CE1xx	Departmental Elective - I	3	0	0	3		
CEUG	8	5	xx1xx	Engineering- I (Elective)	3	0	0	3		
CEUG	9	5			15	3	12	21	21	106
CEUG										
CEUG	1	6	CE125	Hydrology and Open channel Flow	3	1	0	4		
CEUG	2	6	CE126	Hydrology and OCF Lab	0	0	3	1		
CEUG	3	6	CE127	Transportation Engg -II	3	1	0	4		
CEUG	4	6	CE128	Environmental Engg-II	3	1	0	4		
CEUG	5	6	CE129	Environmental Engg-II Lab	0	0	3	1		
CEUG	6	6	CE191	Minor Project-I	0	0	3	1		
CEUG	7	6	CE1xx	Departmental Elective - II	3	0	0	3		
CEUG	8	6	CE1xx	Engineering- II (Elective)	3	0	0	3		
CEUG	9	6	GE103	Industrial Interaction & Soft Skill Development				0		
CEUG	10	6	GE106	EAA - II NSS				0		
CEUG	11	6			15	3	9	21	21	127
CEUG										
CEUG	1	7	CE1xx	Departmental Elective - III	3	0	0	3		
CEUG	2	7	CE1xx	Departmental Elective - IV	3	0	0	3		
CEUG	3	7	xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		
CEUG	4	7	xx1xx	Engineering -IV/HSS/ Science/ Department (Elective)	3	0	0	3		
CEUG	5	7	GE102	Bio Science	3	0	0	3		
CEUG	6	7	CE193	Minor Project-II	0	0	6	2		
CEUG	7	7	CE192	Industrial Training (4 to 6 weeks after 6th Sem)				1		

Prog	S. No.	Sem	Course Code	Course Title	L	T	P	Credit	Sem Credit	Cumm Credit
CEUG	8	7	CE194	General Seminar	0	0	6	2		
CEUG	9	7						20	20	147
CEUG										
CEUG	1	8	CE195	Major Project				20		
CEUG	2	8	CE196	Comprehensive Viva				2		
CEUG	3	8						22	22	169
CEUG										
CEUG	1	EL-1	CE141	Design of Dams	3	0	0	3		
CEUG	2	EL-1	CE142	Pre-stressed Concrete Design	3	0	0	3		
CEUG	3	EL-1	CE143	Water and Land Management	3	0	0	3		
CEUG	4	EL-2	CE145	Advanced Design of Steel Structures	2	0	2	3		
CEUG	5	EL-2	CE146	Advanced Soil Mechanics	3	0	0	3		
CEUG	6	EL-2	CE147	Air Pollution Engineering	3	0	0	3		
CEUG	7	EL-2	CE148	Computer Aided Design	3	0	0	3		
CEUG	8	EL-2	CE149	Environmental Impact Assessments	3	0	0	3		
CEUG	9	EL-2	CE150	Land Drainage	3	0	0	3		
CEUG	10	EL-2	CE151	River Hydraulics and Sediment Transport	3	0	0	3		
CEUG	11	EL-2	CE152	Traffic engineering	3	0	0	3		
CEUG	12	EL-2	CE153	Water Power Engineering	3	0	0	3		
CEUG	13	EL-3	CE155	Advanced Foundation Engineering	3	0	0	3		
CEUG	14	EL-3	CE156	Advanced Structural Analysis	3	0	0	3		
CEUG	15	EL-3	CE157	Advanced surveying	3	0	0	3		
CEUG	16	EL-3	CE158	Airport Planning and design	3	0	0	3		
CEUG	17	EL-3	CE159	Finite Element Method	3	0	0	3		
CEUG	18	EL-3	CE160	Floods and Droughts	3	0	0	3		
CEUG	19	EL-3	CE161	Irrigation Engineering and Design of Hydraulic Structure	3	0	0	3		
CEUG	20	EL-3	CE162	Mechanics of Composite Materials	3	0	0	3		
CEUG	21	EL-3	CE163	Solid Waste Management	3	0	0	3		
CEUG	22	EL-3	CE164	Transportation Systems and Planning	3	0	0	3		
CEUG	23	EL-4	CE168	Bridge Engineering	3	0	0	3		
CEUG	24	EL-4	CE169	Design of Plate and Shell Structures	3	0	0	3		
CEUG	25	EL-4	CE170	Disaster Management and Mitigation	3	0	0	3		
CEUG	26	EL-4	CE171	Ground Water Engineering	3	0	0	3		
CEUG	27	EL-4	CE172	Industrial Waste Treatment	3	0	0	3		
CEUG	28	EL-4	CE173	Rock Mechanics	3	0	0	3		
CEUG	29	EL-4	CE174	Soil Dynamics	3	0	0	3		
CEUG	30	EL-4	CE175	Structural Dynamics & Earthquake Resistant Design	3	0	0	3		
CEUG	31	EL-4	CE176	System Engineering						
CEUG	32	EL-4	CE177	Water Resources Planning and Management						
CEUG	33	EL	HS107	Engineering Economics	3	0	0	3		

Course Structure for B. Tech (Civil Engineering) Program (2013 Batch)

Prog	S. No.	Sem	Course Code	Course Title	L	T	P	Credit	Sem Credit	Cumm Credit
CEUG	1	3	CE105	Fluid Mechanics & Hydraulics	3	1	0	4		
CEUG	2	3	CE106	Fluid Mechanics & Hydraulics lab	0	0	3	1		
CEUG	3	3	CE108	Surveying	3	1	0	4		
CEUG	4	3	CE107	Structural Analysis	3	1	0	4		
CEUG	5	3	CE109	Surveying Lab	0	0	3	1		
CEUG	6	3	PH103	Materials Science & Technology	3	0	0	3		
CEUG	7	3	MA1xx	Engineering Mathematics- III (Elective-3)	3	0	0	3		
CEUG	8	3			15	3	6	20	20	65
CEUG										
CEUG	1	4	CE110	Design of Concrete Structures	3	1	0	4		
CEUG	2	4	CE111	Cement Concrete Lab	0	0	3	1		
CEUG	3	4	CE112	Geotechnical Engineering -I	3	1	0	4		
CEUG	4	4	CE113	Geotechnical Engineering - I Lab	0	0	3	1		
CEUG	5	4	CE114	Environmental Engineering - I	3	1	0	4		
CEUG	6	4	CH104	Green Technology (Environmental Science)	3	0	0	3		
CEUG	7	4	MA108	Numerical Methods for Engineers (Maths Elective-2)	3	0	0	3		
CEUG	8	4	GE105	EAA - I NSS				0		
CEUG	9	4			15	3	6	20	20	85
CEUG										
CEUG	1	5	CE116	Design of steel structures	3	1	0	4		
CEUG	2	5	CE117	Design of steel structures lab	0	0	3	1		
CEUG	3	5	CE118	Geotechnical Engineering - II	3	1	0	4		
CEUG	4	5	CE119	Material Testing Lab	0	0	3	1		
CEUG	5	5	CE121	Transportation Engineering -I	3	1	0	4		
CEUG	6	5	CE122	Transportation Engineering –I Lab	0	0	3	1		
CEUG	7	5	CE1xx	Departmental Elective - I	3	0	0	3		
CEUG	8	5	xx1xx	Engineering- I (Elective)	3	0	0	3		
CEUG	9	5			15	3	12	21	21	106
CEUG										
CEUG	1	6	CE125	Hydrology and Open channel Flow	3	1	0	4		
CEUG	2	6	CE126	Hydrology and OCF Lab	0	0	3	1		
CEUG	3	6	CE127	Transportation Engg -II	3	1	0	4		
CEUG	4	6	CE128	Environmental Engg-II	3	1	0	4		
CEUG	5	6	CE129	Environmental Engg-II Lab	0	0	3	1		
CEUG	6	6	CE191	Minor Project-I	0	0	3	1		
CEUG	7	6	CE1xx	Departmental Elective - II	3	0	0	3		
CEUG	8	6	CE1xx	Engineering- II (Elective)	3	0	0	3		
CEUG	9	6	GE103	Industrial Interaction & Soft Skill Development				0		
CEUG	10	6	GE106	EAA - II NSS				0		
CEUG	11	6			15	3	9	21	21	127
CEUG										
CEUG	1	7	CE1xx	Departmental Elective - III	3	0	0	3		
CEUG	2	7	CE1xx	Departmental Elective - IV	3	0	0	3		
CEUG	3	7	xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		
CEUG	4	7	xx1xx	Engineering -IV/HSS/ Science/ Department (Elective)	3	0	0	3		
CEUG	5	7	GE102	Bio Science	3	0	0	3		
CEUG	6	7	CE193	Minor Project-II	0	0	6	2		
CEUG	7	7	CE192	Industrial Training (4 to 6 weeks after 6th Sem)				1		
CEUG	8	7	CE194	General Seminar	0	0	6	2		
CEUG	9	7						20	20	147

Prog	S. No.	Sem	Course Code	Course Title	L	T	P	Credit	Sem Credit	Cumm Credit
CEUG										
CEUG	1	8	CE195	Major Project				20		
CEUG	2	8	CE196	Comprehensive Viva				2		
CEUG	3	8						22	22	169
CEUG	1	EL-1	CE141	Design of Dams	3	0	0	3		
CEUG	2	EL-1	CE142	Pre-stressed Concrete Design	3	0	0	3		
CEUG	3	EL-1	CE143	Water and Land Management	3	0	0	3		
CEUG	4	EL-2	CE145	Advanced Design of Steel Structures	2	0	2	3		
CEUG	5	EL-2	CE146	Advanced Soil Mechanics	3	0	0	3		
CEUG	6	EL-2	CE147	Air Pollution Engineering	3	0	0	3		
CEUG	7	EL-2	CE148	Computer Aided Design	3	0	0	3		
CEUG	8	EL-2	CE149	Environmental Impact Assessments	3	0	0	3		
CEUG	9	EL-2	CE150	Land Drainage	3	0	0	3		
CEUG	10	EL-2	CE151	River Hydraulics and Sediment Transport	3	0	0	3		
CEUG	11	EL-2	CE152	Traffic engineering	3	0	0	3		
CEUG	12	EL-2	CE153	Water Power Engineering	3	0	0	3		
CEUG	13	EL-3	CE155	Advanced Foundation Engineering	3	0	0	3		
CEUG	14	EL-3	CE156	Advanced Structural Analysis	3	0	0	3		
CEUG	15	EL-3	CE157	Advanced surveying	3	0	0	3		
CEUG	16	EL-3	CE158	Airport Planning and design	3	0	0	3		
CEUG	17	EL-3	CE159	Finite Element Method	3	0	0	3		
CEUG	18	EL-3	CE160	Floods and Droughts	3	0	0	3		
CEUG	19	EL-3	CE161	Irrigation Engineering and Design of Hydraulic Structure	3	0	0	3		
CEUG	20	EL-3	CE162	Mechanics of Composite Materials	3	0	0	3		
CEUG	21	EL-3	CE163	Solid Waste Management	3	0	0	3		
CEUG	22	EL-3	CE164	Transportation Systems and Planning	3	0	0	3		
CEUG	23	EL-4	CE168	Bridge Engineering	3	0	0	3		
CEUG	24	EL-4	CE169	Design of Plate and Shell Structures	3	0	0	3		
CEUG	25	EL-4	CE170	Disaster Management and Mitigation	3	0	0	3		
CEUG	26	EL-4	CE171	Ground Water Engineering	3	0	0	3		
CEUG	27	EL-4	CE172	Industrial Waste Treatment	3	0	0	3		
CEUG	28	EL-4	CE173	Rock Mechanics	3	0	0	3		
CEUG	29	EL-4	CE174	Soil Dynamics	3	0	0	3		
CEUG	30	EL-4	CE175	Structural Dynamics & Earthquake Resistant Design	3	0	0	3		
CEUG	31	EL-4	CE176	System Engineering						
CEUG	32	EL-4	CE177	Water Resources Planning and Management						
CEUG	33	EL	HS107	Engineering Economics	3	0	0	3		

Course Structure for B. Tech (Computer Sc. & Engineering) Program (2014 Batch Onward)

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
CSUG	1	3	3CS103	Data Structures and Algorithms	3	1	0	4		
CSUG	2	3	3CS105	Object Oriented Methodology	3	1	0	4		
CSUG	3	3	3CS106	Programming lab	0	0	3	1		
CSUG	4	3	3EC103	Digital Logic and Circuits	3	1	0	4		
CSUG	5	3	3EC104	Digital logic and Circuits Lab	0	0	3	1		
CSUG	6	3	3PH103	Materials Science & Technology	3	0	0	3		
CSUG	7	3	3CH105A	Bio Science	3	0	0	3		
CSUG	8	3	3MA106	Discrete Mathematical Structures (Elective-I)	3	0	0	3		
					18	3	6	23	23	68
CSUG	1	4	4CS107	Computer Organization & Architecture	3	1	0	4		
CSUG	2	4	4CS109	Database Management Systems	3	1	0	4		
CSUG	3	4	4CS110	Database Management Systems Lab	0	0	3	1		
CSUG	4	4	4CS111	Formal Languages & Automata Theory	3	1	0	4		
CSUG	5	4	4CS112	UNIX Admin and Shell Programming Lab	0	0	3	1		
CSUG	6	4	4CH104A	Green Technologies (Environmental Science)	3	0	0	3		
CSUG	7	4	4MA109	Linear Algebra (Elective-II)	3	0	0	3		
CSUG	8	4	4GE105	EAA - I NSS				0		
					15	3	6	20	20	88
CSUG	1	5	5CS113	Compiler Design	3	0	0	3		
CSUG	2	5	5CS114	Compiler Design lab	0	0	3	1		
CSUG	3	5	5CS115	Operating Systems	3	1	0	4		
CSUG	4	5	5CS116	Operating Systems lab	0	0	3	1		
CSUG	5	5	5CS117	Graph Theory & Combinatorics	3	1	0	4		
CSUG	6	5	5EE125	Microprocessor & Microcontrollers	3	1	0	4		
CSUG	7	5	5EE126	Microprocessor & Microcontrollers lab	0	0	3	1		
CSUG	8	5	xx1xx	Engineering Elective - I	3	0	0	3		
					15	3	9	21	21	109
CSUG	1	6	6CS119	Computer Networks	3	1	0	4		
CSUG	2	6	6CS120	Computer Networks lab	0	0	3	1		
CSUG	3	6	6CS121	Software Engineering	3	1	0	4		
CSUG	4	6	6CS122	Software Engineering lab	0	0	3	1		
CSUG	5	6	6CS123	Design & Analysis of Algorithms	3	1	0	4		
CSUG	6	6	6CS1xx	Departmental Elective - I	3	0	0	3		
CSUG	7	6	6CS191	Minor Project-I	0	0	3	1		
CSUG	8	6	xx1xx	Engineering Elective - II	3	0	0	3		
CSUG	9	6	6GE103	Industrial Interaction & Soft Skill Development				0		
CSUG	10	6	6GE106	EAA - II NSS				0		
					15	3	9	21	21	130
CSUG	1	7	7CS1xx	Departmental Elective - II	3	0	0	3		
CSUG	2	7	7CS1xx	Departmental Elective – III	3	0	0	3		
CSUG	4	7	xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		
CSUG	5	7	xx1xx	Engineering -IV/ HSS/ Science/	3	0	0	3		

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
				Department (Elective)						
CSUG	6	7	7CS193	Minor Project-II	0	0	6	2		
CSUG	7	7	7CS192	Industrial Training (4 to 6 weeks after 6th Sem)				1		
CSUG	8	7	7CS194	General Seminar	0	0	6	2		
					12	0	12	17	17	147
CSUG	1	8	8CS195	Major Project				20		
CSUG	2	8	8CS196	Comprehensive Viva				2		
								22	22	169
	Departmental Electives									
CSUG	1	EL	CS151	Wireless Networks	3	0	0	3		
CSUG	2	EL	CS152	Mobile Computing	3	0	0	3		
CSUG	3	EL	CS153	Semantic Web	3	0	0	3		
CSUG	4	EL	CS154	Pattern recognition	3	0	0	3		
CSUG	5	EL	CS155	Image Processing	3	0	0	3		
CSUG	6	EL	CS156	Natural Language Processing	3	0	0	3		
CSUG	7	EL	CS157	Soft & Evolutionary Computing	3	0	0	3		
CSUG	8	EL	CS158	Bio Inspired Computing	3	0	0	3		
CSUG	9	EL	CS159	Machine learning	3	0	0	3		
CSUG	10	EL	CS160	Information Retrieval	3	0	0	3		
CSUG	11	EL	CS161	Genetic Algorithms	3	0	0	3		
CSUG	12	EL	CS162	Neural Networks & its Applications	3	0	0	3		
CSUG	13	EL	CS163	Data & Text Mining	3	0	0	3		
CSUG	14	EL	CS164	VLSI & Evolutionary Computing	3	0	0	3		
CSUG	15	EL	CS165	Real Time Systems	3	0	0	3		
CSUG	16	EL	CS166	Distributed Operating System	3	0	0	3		
CSUG	17	EL	CS167	Cyber Security	3	0	0	3		
CSUG	18	EL	CS168	Intrusion Detection Systems	3	0	0	3		
CSUG	19	EL	CS169	PKI & Trust Management	3	0	0	3		
CSUG	20	EL	CS170	Network Security	3	0	0	3		
CSUG	21	EL	CS171	Information Security	3	0	0	3		
CSUG	22	EL	CS172	Wireless & Mobile Security	3	0	0	3		
CSUG	23	EL	CS173	Object Oriented Analysis & Design	3	0	0	3		
CSUG	24	EL	CS174	Introduction to Computer	3	0	0	3		
CSUG	25	EL	CS175	Cryptography & Network Security	3	0	0	3		

Course Structure for B. Tech (Computer Sc. & Engineering) Program (2013 Batch)

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit		
CSUG	1	3	CS103	Data Structures and Algorithms	3	1	0	4		
CSUG	2	3	CS105	Object Oriented Methodology	3	1	0	4		
CSUG	3	3	CS106	Programming lab	0	0	3	1		
CSUG	4	3	EC103	Digital Logic and Circuits	3	1	0	4		
CSUG	5	3	EC104	Digital logic and Circuits Lab	0	0	3	1		
CSUG	6	3	PH103	Materials Science & Technology	3	0	0	3		
CSUG	7	3	MA106	Discrete Mathematical Structures (Elective-I)	3	0	0	3		
CSUG	8	3			15	3	6	20	20	65
CSUG										
CSUG	1	4	CS107	Computer Organization & Architecture	3	1	0	4		
CSUG	2	4	CS109	Database Management Systems	3	1	0	4		
CSUG	3	4	CS110	Database Management Systems Lab	0	0	3	1		
CSUG	4	4	CS111	Formal Languages & Automata Theory	3	1	0	4		
CSUG	5	4	CS112	UNIX Admin and Shell Programming Lab	0	0	3	1		
CSUG	6	4	CH104	Green Technologies (Environmental Science)	3	0	0	3		
CSUG	7	4	MA109	Linear Algebra (Elective-II)	3	0	0	3		
CSUG	8	4	GE105	EAA - I NSS				0		
CSUG	9	4			15	3	6	20	20	85
CSUG										
CSUG	1	5	CS113	Compiler Design	3	0	0	3		
CSUG	2	5	CS114	Compiler Design lab	0	0	3	1		
CSUG	3	5	CS115	Operating Systems	3	1	0	4		
CSUG	4	5	CS116	Operating Systems lab	0	0	3	1		
CSUG	5	5	CS117	Graph Theory & Combinatorics	3	1	0	4		
CSUG	6	5	EE125	Microprocessor & Microcontrollers	3	1	0	4		
CSUG	7	5	EE126	Microprocessor & Microcontrollers lab	0	0	3	1		
CSUG	8	5	xx1xx	Engineering Elective - I	3	0	0	3		
CSUG	9	5			15	3	12	21	18	106
CSUG										
CSUG	1	6	CS119	Computer Networks	3	1	0	4		
CSUG	2	6	CS120	Computer Networks lab	0	0	3	1		
CSUG	3	6	CS121	Software Engineering	3	1	0	4		
CSUG	4	6	CS122	Software Engineering lab	0	0	3	1		
CSUG	5	6	CS123	Design & Analysis of Algorithms	3	1	0	4		
CSUG	6	6	CS1xx	Departmental Elective - I	3	0	0	3		
CSUG	7	6	CS191	Minor Project-I	0	0	3	1		
CSUG	8	6	xx1xx	Engineering Elective - II	3	0	0	3		
CSUG	9	6	GE103	Industrial Interaction & Soft Skill Development				0		
CSUG	10	6	GE106	EAA - II NSS				0		
CSUG	11	6			15	3	9	21	21	127
CSUG										
CSUG	1	7	CS1xx	Departmental Elective - II	3	0	0	3		
CSUG	2	7	CS1xx	Departmental Elective – III	3	0	0	3		
CSUG	3	7	GE102	Bio Science	3	0	0	3		
CSUG	4	7	Xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		
CSUG	5	7	Xx1xx	Engineering -IV/ HSS/ Science/	3	0	0	3		

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit		
				Department (Elective)						
CSUG	6	7	CS193	Minor Project-II	0	0	6	2		
CSUG	7	7	CS192	Industrial Training (4 to 6 weeks after 6th Sem)				1		
CSUG	8	7	CS194	General Seminar	0	0	6	2		
CSUG	9	7						20	20	147
CSUG										
CSUG	1	8	CS195	Major Project				20		
CSUG	2	8	CS196	Comprehensive Viva				2		
CSUG	3	8						22	22	169
				Departmental Electives						
CSUG	1	EL	CS151	Wireless Networks	3	0	0	3		
CSUG	2	EL	CS152	Mobile Computing	3	0	0	3		
CSUG	3	EL	CS153	Semantic Web	3	0	0	3		
CSUG	4	EL	CS154	Pattern recognition	3	0	0	3		
CSUG	5	EL	CS155	Image Processing	3	0	0	3		
CSUG	6	EL	CS156	Natural Language Processing	3	0	0	3		
CSUG	7	EL	CS157	Soft & Evolutionary Computing	3	0	0	3		
CSUG	8	EL	CS158	Bio Inspired Computing	3	0	0	3		
CSUG	9	EL	CS159	Machine learning	3	0	0	3		
CSUG	10	EL	CS160	Information Retrieval	3	0	0	3		
CSUG	11	EL	CS161	Genetic Algorithms	3	0	0	3		
CSUG	12	EL	CS162	Neural Networks & its Applications	3	0	0	3		
CSUG	13	EL	CS163	Data & Text Mining	3	0	0	3		
CSUG	14	EL	CS164	VLSI & Evolutionary Computing	3	0	0	3		
CSUG	15	EL	CS165	Real Time Systems	3	0	0	3		
CSUG	16	EL	CS166	Distributed Operating System	3	0	0	3		
CSUG	17	EL	CS167	Cyber Security	3	0	0	3		
CSUG	18	EL	CS168	Intrusion Detection Systems	3	0	0	3		
CSUG	19	EL	CS169	PKI & Trust Management	3	0	0	3		
CSUG	20	EL	CS170	Network Security	3	0	0	3		
CSUG	21	EL	CS171	Information Security	3	0	0	3		
CSUG	22	EL	CS172	Wireless & Mobile Security	3	0	0	3		
CSUG	23	EL	CS173	Object Oriented Analysis & Design	3	0	0	3		
CSUG	24	EL	CS174	Introduction to Computer	3	0	0	3		
CSUG	25	EL	CS175	Cryptography & Network Security	3	0	0	3		

Course Structure for B. Tech (Information Technology) Program (2014 Batch Onward)

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
ITUG	1	3	3CS103	Data Structures and Algorithms	3	1	0	4		
ITUG	2	3	3CS105	Object Oriented Methodology	3	1	0	4		
ITUG	3	3	3CS106	Programming Lab	0	0	3	1		
ITUG	4	3	3EC103	Digital Logic and Circuits	3	1	0	4		
ITUG	5	3	3EC104	Digital logic and Circuits Lab	0	0	3	1		
ITUG	6	3	3PH103	Materials Science & Technology	3	0	0	3		
ITUG	7	7	3CH105A	Bio Science	3	0	0	3		
ITUG	7	3	3MA106	Discrete Mathematical Structures (Elective – I)	3	0	0	3		
					18	3	6	23	23	68
ITUG	1	4	4CS107	Computer Organization & Architecture	3	1	0	4		
ITUG	2	4	4CS109	Database Management Systems	3	1	0	4		
ITUG	3	4	4CS110	Database Management Systems Lab	0	0	3	1		
ITUG	4	4	4CS112	UNIX Admin and Shell Programming Lab	0	0	3	1		
ITUG	5	4	4IT101	IT Services Management	3	1	0	4		
ITUG	6	4	4CH104A	Green Technologies (Environmental Science)	3	0	0	3		
ITUG	7	4	4MA109	Linear Algebra (Elective – II)	3	0	0	3		
ITUG	8	4	4GE105	EAA - I NSS				0		
					15	3	6	20	20	88
ITUG	1	5	5CS115	Operating Systems	3	1	0	4		
ITUG	2	5	5CS116	Operating Systems Lab	0	0	3	1		
ITUG	3	5	5EC156	Communication Systems	3	1	0	4		
ITUG	4	5	5IT103	Web Technology	3	1	0	4		
ITUG	5	5	5IT102	Web Technology Lab	0	0	3	1		
ITUG	6	5	5IT1xx	Departmental Elective - I	3	0	0	3		
ITUG	7	5	xx1xx	Engineering Elective – I	3	0	0	3		
					15	3	6	20	20	108
ITUG	1	6	6CS119	Computer Networks	3	1	0	4		
ITUG	2	6	6CS120	Computer Networks Lab	0	0	3	1		
ITUG	3	6	6CS121	Software Engineering	3	1	0	4		
ITUG	4	6	6CS122	Software Engineering Lab	0	0	3	1		
ITUG	5	6	6CS123	Design & Analysis of Algorithms	3	1	0	4		
ITUG	6	6	6IT105	Cloud Computing	3	1	0	4		
ITUG	7	6	6IT191	Minor Project-I	0	0	3	1		
ITUG	8	6	xx1xx	Engineering Elective – II	3	0	0	3		
ITUG	9	6	6GE103	Industrial Interaction & Soft Skill Development				0		
ITUG	10	6	6GE106	EAA - II NSS				0		
					15	4	9	22	22	130
ITUG	1	7	7IT1xx	Departmental Elective - II	3	0	0	3		
ITUG	2	7	7IT1xx	Departmental Elective - III	3	0	0	3		
ITUG	4	7	xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		
ITUG	5	7	xx1xx	Engineering -IV/ HSS/ Science/ Department (Elective)	3	0	0	3		

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
ITUG	6	7	7IT193	Minor Project-II	0	0	6	2		
ITUG	7	7	7IT192	Industrial Training (4 to 6 weeks after 6th Sem)				1		
ITUG	8	7	7IT194	General Seminar	0	0	6	2		
					12	0	12	17	17	147
ITUG	1	8	8IT195	Major Project				20		
ITUG	2	8	8IT196	Comprehensive Viva				2		
								22	22	169
				Departmental Electives						
ITUG	1	EL	CS151	Wireless Networks	3	0	0	3		
ITUG	2	EL	CS152	Mobile Computing	3	0	0	3		
ITUG	3	EL	CS155	Image Processing	3	0	0	3		
ITUG	4	EL	CS157	Soft & Evolutionary Computing	3	0	0	3		
ITUG	5	EL	CS166	Distributed Operating System	3	0	0	3		
ITUG	6	EL	CS167	Cyber Security	3	0	0	3		
ITUG	7	EL	CS173	Object Oriented Analysis & Design	3	0	0	3		
ITUG	8	EL	EC142	Information Theory & Coding	3	0	0	3		
ITUG	9	EL	EC154	Broadband Access Network	3	0	0	3		
ITUG	10	EL	IT161	VLSI & Embedded System	3	0	0	3		
ITUG	11	EL	IT162	Pattern Recognitions & Image Processing	3	0	0	3		
ITUG	12	EL	IT163	IT Project Management	3	0	0	3		
ITUG	13	EL	IT164	XML and Web Applications	3	0	0	3		
ITUG	14	EL	IT165	Computer Graphics	3	0	0	3		
ITUG	15	EL	IT166	Data Mining and Warehousing	3	0	0	3		
ITUG	16	EL	IT167	Server Side Programming	3	0	0	3		
ITUG	17	EL	IT168	E-Commerce and ERP	3	0	0	3		
ITUG	18	EL	IT169	E-Governance	3	0	0	3		
ITUG	19	EL	IT170	Optimization Techniques	3	0	0	3		
ITUG	20	EL	IT171	Servers & Storage	3	0	0	3		

Course Structure for B. Tech (Information Technology) Program (2013 Batch)

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit		
ITUG	1	3	CS103	Data Structures and Algorithms	3	1	0	4		
ITUG	2	3	CS105	Object Oriented Methodology	3	1	0	4		
ITUG	3	3	CS106	Programming Lab	0	0	3	1		
ITUG	4	3	EC103	Digital Logic and Circuits	3	1	0	4		
ITUG	5	3	EC104	Digital logic and Circuits Lab	0	0	3	1		
ITUG	6	3	PH103	Materials Science & Technology	3	0	0	3		
ITUG	7	3	MA106	Discrete Mathematical Structures (Elective – I)	3	0	0	3		
ITUG	8	3			15	3	6	20	20	65
ITUG										
ITUG	1	4	CS107	Computer Organization & Architecture	3	1	0	4		
ITUG	2	4	CS109	Database Management Systems	3	1	0	4		
ITUG	3	4	CS110	Database Management Systems Lab	0	0	3	1		
ITUG	4	4	CS112	UNIX Admin and Shell Programming Lab	0	0	3	1		
ITUG	5	4	IT103	IT Services Management	3	1	0	4		
ITUG	6	4	CH104	Green Technologies (Environmental Science)	3	0	0	3		
ITUG	7	4	MA109	Linear Algebra (Elective – II)	3	0	0	3		
ITUG	8	4	GE105	EAA - I NSS				0		
ITUG	9	4			15	3	6	20	20	85
ITUG										
ITUG	1	5	CS115	Operating Systems	3	1	0	4		
ITUG	2	5	CS116	Operating Systems Lab	0	0	3	1		
ITUG	3	5	EC156	Communication Systems	3	1	0	4		
ITUG	4	5	IT105	Web Technology	3	1	0	4		
ITUG	5	5	IT106	Web Technology Lab	0	0	3	1		
ITUG	6	5	IT1xx	Departmental Elective - I	3	0	0	3		
ITUG	7	5	xx1xx	Engineering Elective – I	3	0	0	3		
ITUG	**8**	**5**			**15**	**3**	**12**	**21**	**21**	**106**
ITUG										
ITUG	1	6	CS119	Computer Networks	3	1	0	4		
ITUG	2	6	CS120	Computer Networks Lab	0	0	3	1		
ITUG	3	6	CS121	Software Engineering	3	1	0	4		
ITUG	4	6	CS122	Software Engineering Lab	0	0	3	1		
ITUG	5	6	CS123	Design & Analysis of Algorithms	3	1	0	4		
ITUG	6	6	IT107	Cloud Computing	3	1	0	4		
ITUG	7	6	IT191	Minor Project-I	0	0	3	1		
ITUG	8	6	xx1xx	Engineering Elective – II	3	0	0	3		
ITUG	9	6	GE103	Industrial Interaction & Soft Skill Development				0		
ITUG	10	6	GE106	EAA - II NSS				0		
ITUG	**11**	**6**			**15**	**3**	**9**	**21**	**21**	**127**
ITUG										
ITUG	1	7	IT1xx	Departmental Elective - II	3	0	0	3		
ITUG	2	7	IT1xx	Departmental Elective - III	3	0	0	3		
ITUG	3	7	GE102	Bio Science	3	0	0	3		
ITUG	4	7	xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		
ITUG	5	7	xx1xx	Engineering -IV/ HSS/ Science/ Department (Elective)	3	0	0	3		

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit		
ITUG	6	7	IT193	Minor Project-II	0	0	6	2		
ITUG	7	7	IT192	Industrial Training (4 to 6 weeks after 6th Sem)				1		
ITUG	8	7	IT194	General Seminar	0	0	6	2		
ITUG	9	7						20	20	147
ITUG										
ITUG	1	8	IT195	Major Project				20		
ITUG	2	8	IT196	Comprehensive Viva				2		
ITUG								22	22	169
				Departmental Electives						
ITUG	1	EL	CS151	Wireless Networks	3	0	0	3		
ITUG	2	EL	CS152	Mobile Computing	3	0	0	3		
ITUG	3	EL	CS155	Image Processing	3	0	0	3		
ITUG	4	EL	CS157	Soft & Evolutionary Computing	3	0	0	3		
ITUG	5	EL	CS166	Distributed Operating System	3	0	0	3		
ITUG	6	EL	CS167	Cyber Security	3	0	0	3		
ITUG	7	EL	CS173	Object Oriented Analysis & Design	3	0	0	3		
ITUG	8	EL	EC142	Information Theory & Coding	3	0	0	3		
ITUG	9	EL	EC154	Broadband Access Network	3	0	0	3		
ITUG	10	EL	IT161	VLSI & Embedded System	3	0	0	3		
ITUG	11	EL	IT162	Pattern Recognitions & Image Processing	3	0	0	3		
ITUG	12	EL	IT163	IT Project Management	3	0	0	3		
ITUG	13	EL	IT164	XML and Web Applications	3	0	0	3		
ITUG	14	EL	IT165	Computer Graphics	3	0	0	3		
ITUG	15	EL	IT166	Data Mining and Warehousing	3	0	0	3		
ITUG	16	EL	IT167	Server Side Programming	3	0	0	3		
ITUG	17	EL	IT168	E-Commerce and ERP	3	0	0	3		
ITUG	18	EL	IT169	E-Governance	3	0	0	3		
ITUG	19	EL	IT170	Optimization Techniques	3	0	0	3		
ITUG	20	EL	IT171	Servers & Storage	3	0	0	3		

Course Structure for B. Tech (Electronics & Comm. Engineering) Program (2014 Batch Onward)

Prog	S. No.	Sem	Code	Course	TH/ PT	L	T	P	Credit	Total Credit	Cumm Credit
ECUG	1	3	CH105A	Bio Science	TH	3	0	0	3		
ECUG	2	3	EC107	Semiconductor Devices	TH	3	0	0	3		
ECUG	3	3	EC108	Seminductor Devices Lab	PT	0	0	3	1		
ECUG	4	3	EC109	Signals & System Analysis	TH	3	1	0	4		
ECUG	5	3	EC110	Passive & Active Network Analysis & Synthesis	TH	3	0	0	3		
ECUG	6	3	PH103	Materials Science & Technology	TH	3	0	0	3		
ECUG	7	3	MAxxx	Tools of Applied Mathematics	TH	3	0	0	3		
						15	3	6	20	20	65
ECUG	1	4	EC111	Analog Electronics	TH	3	1	0	4		
ECUG	2	4	EC103	Digital Logic and Circuits	TH	3	1	0	4		
ECUG	3	4	EC112	Digital & Analog Electronics Lab	PT	0	0	3	1		
ECUG	4	4	EC105	Electromagnetic Field Theory	TH	3	0	0	3		
ECUG	5	4	CE104A	Green Chemistry (Environmental Science)	TH	3	0	0	3		
ECUG	6	4	MA106	Linear Algebra	TH	3	0	0	3		
ECUG	7	4	GE105	EAA - I NSS					0		
ECUG						15	3	6	18	18	83
ECUG	1	5	EC115	Analog Communication	TH	3	1	0	4		
ECUG	2	5	EE125	Microprocessor & Microcontroller	TH	3	1	0	4		
ECUG	3	5	EC117	Digital Signal Processing	TH	3	1	0	4		
ECUG	4	5	EC116	Analog Communication Lab	PT	0	0	3	1		
ECUG	5	5	EE126	Micrprocessor & Microcontroller Lab	PT	0	0	3	1		
ECUG	6	5	EC118	DSP Lab	PT	0	0	3	1		
ECUG	7	5	CE1xx	Departmental Elective - I	TH	3	0	0	3		
ECUG	8	5	xxxxx	Engineering- I (Elective)	TH	3	0	0	3		
ECUG						15	3	12	21	21	104
ECUG	1	6	EC119	Digital Communication	TH	3	1	0	4		
ECUG	2	6	EC121	VLSI Design	TH	3	1	0	4		
ECUG	3	6	EE122	Control System Engineering	TH	3	1	0	4		
ECUG	4	6	EC120	Digital Communication Lab	PT	0	0	3	1		
ECUG	5	6	EC122	VLSI Design Lab	PT	0	0	3	1		
ECUG	6	6	EC191	Minor Project-I	PT	0	0	3	1		
ECUG	7	6	EC1xx	Departmental Elective - II	TH	3	0	0	3		

Prog	S. No.	Sem	Code	Course	TH/ PT	L	T	P	Credit	Total Credit	Cumm Credit
ECUG	8	6	xxxxx	Engineering- II (Elective)	TH	3	0	0	3		
ECUG	9	6	GE103	Industial Interaction & Soft Skill Development	PT				0		
ECUG	10	6	GE106	EAA - II NSS					0		
ECUG						15	3	9	21	21	125
ECUG											
ECUG	1	7	EC1xx	Departmental Elective - III	TH	3	0	0	3		
ECUG	2	7	EC1xx	Departmental Elective - IV	TH	3	0	0	3		
ECUG	3	7	EC113	RF & Microwave Engineering	TH	3	1	0	4		
ECUG	4	7	EC114	RF & Microwave Engineering Lab	PT	0	0	3	1		
ECUG	5	7	xxxxx	Engineering -III/ HSS/ Science/ Department (Elective)	TH	3	0	0	3		
ECUG	6	7	#N/A	Engineering -IV/ HSS/ Science/ Department (Elective)	TH	3	0	0	3		
ECUG	7	7	EC193	Minor Project-II	PT	0	0	6	2		
ECUG	8	7	EC192	Industrial Training (4 to 6 weeks after 6th Sem)	PT				1		
ECUG	9	7	EC194	General Seminar	PT	0	0	6	2		
ECUG	10								22	22	147
ECUG											
ECUG	1	8	EC195	Major Project	PT				20		
ECUG	2	8	EC196	Comprehensive Viva	PT				2		
ECUG									22	22	169
ECUG											
ECUG				List of Electives							
ECUG	1	**EL-1**	EC141	Antenna & Propagation	TH	3	0	0	3	I	
ECUG	2	**EL-1**	EC142	Information Theory & Coding	TH	3	0	0	3	I	
ECUG	3	**EL-1**	EC143	Fuzzy Logic & Neural Network	TH	3	0	0	3	I	
ECUG	4	EL-1	EE112	Electrical Measurements and Instruments	TH	3	0	0	3	I	
ECUG	5	EL-2	EC144	Optical Fibre Communication	TH	3	0	0	3	II	
ECUG	6	EL-2	EC145	EMI& EMC	TH	3	0	0	3	II	
ECUG	7	EL-2	EC146	Embeded System	TH	3	0	0	3	II	
ECUG	8	EL-2	CS163	Information Security	TH	3	0	0	3	II	
ECUG	9	EL-2	EC147	Adaptive Signal Processing	TH	3	0	0	3	II	
ECUG	10		EE169	Advanced Instruments	TH	3	0	0	3	II	
ECUG	11	EL-3/4	EC148	Wireless & Mobile Communication	TH	3	0	0	3	III/IV	
ECUG	12	EL-3/4	EC149	Communication Networks	TH	3	0	0	3	III/IV	
ECUG	13	EL-3/4	EC150	Satellite & Radar Engineering	TH	3	0	0	3	III/IV	
ECUG	14	EL-3/4	EC151	Software Defined & Cognitive Radios	TH	3	0	0	3	III/IV	
ECUG	15	EL-3/4	EC152	Voice & video Processing	TH	3	0	0	3	III/IV	

Prog	S. No.	Sem	Code	Course	TH/ PT	L	T	P	Credit	Total Credit	Cumm Credit
ECUG	16	EL-3/4	EC153	CMOS & VLSI	TH	3	0	0	3	III/IV	
ECUG	17	EL-3/4	EC154	BROADBAND ACESS NETWORK	TH	3	0	0	3	III/IV	
ECUG	18	EL-3/4	EC155	MEMS	TH	3	0	0	3	III/IV	
ECUG	19	EL-3/4	EE119	Power Electronics	TH	3	0	0	3	III/IV	
ECUG	20	EL-3/4	EE163	Process Control	TH	3	0	0	3	III/IV	
ECUG	21	EL-3/4	CS151	WIRELESS NETWORK	TH	3	0	0	3	III/IV	
CS/ ITUG	1		EC104	Digital Logic and Circuit Lab	PT	0	0	3	1	CSE/ IT	
EE/ ITUG	2		EC156	Communication Systems	TH	3	0	0	3	EE/ IT	

Course Structure for B. Tech (Electronics & Comm. Engineering) Program (2013 Batch)

Prog	S. No.	Sem	Code	Course	TH/ PT	L	T	P	Credit	Total Credit	Cumm Credit
ECUG	1	3	GE102	Bio Science	TH	3	0	0	3		
ECUG	2	3	EC107	Semiconductor Devices	TH	3	0	0	3		
ECUG	3	3	EC108	Semiconductor Devices Lab	PT	0	0	3	1		
ECUG	4	3	EC109	Signals & System Analysis	TH	3	1	0	4		
ECUG	5	3	EC110	Passive & Active Network Analysis & Synthesis	TH	3	0	0	3		
ECUG	6	3	PH103	Materials Science & Technology	TH	3	0	0	3		
ECUG	7	3	MAxxx	Tools of Applied Mathematics	TH	3	0	0	3		
						15	3	6	20	20	65
ECUG	1	4	EC111	Analog Electronics	TH	3	1	0	4		
ECUG	2	4	EC103	Digital Logic and Circuits	TH	3	1	0	4		
ECUG	3	4	EC112	Digital & Analog Electronics Lab	PT	0	0	3	1		
ECUG	4	4	EC105	Electromagnetic Field Theory	TH	3	0	0	3		
ECUG	5	4	CE104	Green Chemistry (Environmental Science)	TH	3	0	0	3		
ECUG	6	4	MA106	Linear Algebra	TH	3	0	0	3		
ECUG	7	4	GE105	EAA - I NSS					0		
ECUG						15	3	6	18	18	83
ECUG	1	5	EC115	Analog Communication	TH	3	1	0	4		
ECUG	2	5	EE125	Microprocessor & Microcontroller	TH	3	1	0	4		

Prog	S. No.	Sem	Code	Course	TH/ PT	L	T	P	Credit	Total Credit	Cumm Credit
ECUG	3	5	EC117	Digital Signal Processing	TH	3	1	0	4		
ECUG	4	5	EC116	Analog Communication Lab	PT	0	0	3	1		
ECUG	5	5	EE126	Microprocessor & Microcontroller Lab	PT	0	0	3	1		
ECUG	6	5	EC118	DSP Lab	PT	0	0	3	1		
ECUG	7	5	CE1xx	Departmental Elective - I	TH	3	0	0	3		
ECUG	9	5	xxxxx	Engineering- I (Elective)	TH	3	0	0	3		
ECUG						15	3	12	21	21	104
ECUG	1	6	EC119	Digital Communication	TH	3	1	0	4		
ECUG	2	6	EC121	VLSI Design	TH	3	1	0	4		
ECUG	3	6	EE122	Control System Engineering	TH	3	1	0	4		
ECUG	4	6	EC120	Digital Communication Lab	PT	0	0	3	1		
ECUG	5	6	EC122	VLSI Design Lab	PT	0	0	3	1		
ECUG	6	6	EC191	Minor Project-I	PT	0	0	3	1		
ECUG	7	6	EC1xx	Departmental Elective - II	TH	3	0	0	3		
ECUG	8	6	xxxxx	Engineering- II (Elective)	TH	3	0	0	3		
ECUG	9	6	GE103	Industrial Interaction & Soft Skill Development	PT				0		
ECUG	10	6	GE106	EAA - II NSS					0		
						15	3	9	21	21	125
ECUG	1	7	EC1xx	Departmental Elective - III	TH	3	0	0	3		
ECUG	2	7	EC1xx	Departmental Elective - IV	TH	3	0	0	3		
ECUG	3	7	EC113	RF & Microwave Engineering	TH	3	1	0	4		
		7	EC114	RF & Microwave Engineering Lab	PT	0	0	3	1		
ECUG	4	7	xxxxx	ngineering -III/ HSS/ Science/ Department (Elective)	TH	3	0	0	3		
ECUG	5	7	#N/A	Engineering -IV/ HSS/ Science/ Department (Elective)	TH	3	0	0	3		
ECUG	6	7	EC193	Minor Project-II	PT	0	0	6	2		
ECUG	7	7	EC192	Industrial Training (4 to 6 weeks after 6th Sem)	PT				1		
ECUG	8	7	EC194	General Seminar	PT	0	0	6	2		
ECUG	9								22	22	147
ECUG	1	8	EC195	Major Project	PT				20		
ECUG	2	8	EC196	Comprehensive Viva	PT				2		

Course Structure for B. Tech (Electrical Engineering) Program (Mod 2014 Batch onward)[5]

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
EEUG	1	3	CH104A	Green Technologies (Environmental Science)	3	0	0	3		
EEUG	2	3	EC105	Electromagnetic Field Theory	3	0	0	3		
EEUG	3	3	EC107	Semiconductor Devices	3	0	0	3		
EEUG	4	3	EE103	Electrical Machine - I	3	0	0	3		
EEUG	5	3	EE104	Electrical Machine - I Lab	0	0	3	1		
EEUG	6	3	EE105A	Network Analysis and Synthesis	3	1	0	4		
EEUG	7	3	MA105	Transform Calculus (Elective-1)	3	0	0	3		
EEUG	8	3		Semester Total	15	3	6	20	20	65
EEUG										
EEUG	1	4	CH105A	Bio Science	3	0	0	3		
EEUG	2	4	EC103	Digital Logic and Circuits	3	1	0	4		
EEUG	3	4	EC111	Analog Electronics	3	1	0	4		
EEUG	4	4	EC112	Digital & Analog Electronics Lab	0	0	3	1		
EEUG	5	4	EE110	Electrical Machine -II	3	1	0	4		
EEUG	6	4	EE111	Electrical Machine -II Lab	0	0	3	1		
EEUG	7	4	MA108	Numerical Methods for Engineers (Elective-2)	3	0	0	3		
EEUG	8	4	GE105	EAA - I NSS				0		
EEUG	9	4		Semester Total	15	3	6	20	20	85
EEUG										
EEUG	1	3	EC109	Signal & Systems Analysis	3	1	0	4		
EEUG	2	5	EC156	Communication Systems	3	1	0	4		
EEUG	3	5	EE112	Electrical Measurement and Instruments	3	0	0	3		
EEUG	4	5	EE113	Electrical Measurement and Instruments Lab	0	0	3	1		
EEUG	5	5	EE114	Control Systems	3	1	0	4		
EEUG	6	5	EE115	Control Systems Lab	0	0	3	1		
EEUG	7	5	EE118	Power System - I	3	1	0	4		
EEUG	8	5		Semester Total	15	3	12	21	21	106
EEUG										
EEUG	1	6	EE116	Power Electronics	3	0	0	3		
EEUG	2	6	EE117	Power Electronics Lab	0	0	3	1		
EEUG	3	6	EE119	Power System - II	3	1	0	4		
EEUG	4	6	EE123	Microprocessor & Its Application	3	1	0	4		
EEUG	5	6	EE124	Microprocessor & Its Application Lab	0	0	3	1		
EEUG	6	6	EE191	Minor Project-I	0	0	3	1		
EEUG	7	6	EE1xx	Departmental Elective - I	3	0	0	3		
EEUG	8	6	EE1xx	Departmental Elective - II	3	0	0	3		
EEUG	9	6	GE103	Industrial Interaction & Soft Skill Development	0	0	3	0		
EEUG	10	6	GE106	EAA - II NSS				0		
EEUG	11	6		Semester Total	15	3	9	20	20	126
EEUG										
EEUG	1	7	EE121	Power System Protection	3	1	0	4		
EEUG	2	7	EE122	Power System Protection Lab	0	0	3	1		
EEUG	3	7	EE1xx	Departmental Elective - III	3	0	0	3		
EEUG	4	7	EE1xx	Departmental Elective - IV	3	0	0	3		
EEUG	5	7	Xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		

[5] 3rd Sem and 4th Sem B. Tech (EE) Revised structure shall be implemented from Session 2015-16., as per direction of Dean(s) and HoD(s) meeting held on 07-05-2015

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
EEUG	6	7	Xx1xx	Engineering -IV/HSS/ Science/ Department (Elective)	3	0	0	3		
EEUG	7	7	EE193	Minor Project-II	0	0	6	2		
EEUG	8	7	EE192	Industrial Training (4 to 6 weeks after 6th Sem)	0	0	3	1		
EEUG	9	7	EE194A	General Seminar (EE)	0	0	3	1		
EEUG	10	7		Semester Total				21	21	147
EEUG										
EEUG	1	8	EE195	Major Project				20		
EEUG	2	8	EE196	Comprehensive Viva				2		
EEUG	3	8		Semester Total				22	22	169
EEUG										
EEUG				Departmental Electives						
EEUG	1	EL	CS155	Computer Architecture	3	0	0	3	TH	
EEUG	2	EL	EE151	Utilization & Traction	3	0	0	3	TH	
EEUG	3	EL	EE152	Electrical Drawing, Estimation & Costing	3	0	0	3	TH	
EEUG	4	EL	EE153	Special Electrical Machines	3	0	0	3	TH	
EEUG	5	EL	ME1xx	Energy Conversion	3	0	0	3	TH	
EEUG	6	EL	PH103	Materials Science & Technology	3	0	0	3	TH	
EEUG	7	EL	EC119	Digital Communication	3	0	0	3	TH	
EEUG	8	EL	EE154	Electrical Machines Design	3	0	0	3	TH	
EEUG	9	EL	EE155	Industrial Drives and Control	3	0	0	3		
EEUG	10	EL	EE156	Power Plant Engineering	3	0	0	3	TH	
EEUG	11	EL	EE157	Modern Control Theory	3	0	0	3	TH	
EEUG	12	EL	EE158	Power Systems Dynamics & Reliability	3	0	0	3	TH	
EEUG	13	EL	EE159	Computer Aided Power System Design	3	0	0	3	TH	
EEUG	14	EL	EE160	Power System Design	3	0	0	3	TH	
EEUG	15	EL	EE161	Microprocessor & Microcontrollers	3	0	0	3	TH	
EEUG	16	EL	EE162	Microcontrollers & Its Applications	3	0	0	3	TH	
EEUG	17	EL	EE163	Digital Control System	3	0	0	3	TH	
EEUG	18	EL	EE164	Advance Control Theory	3	0	0	3	TH	
EEUG	19	EL	CS158	Image Processing	3	0	0	3	TH	
EEUG	20	EL	EC117	Digital Signal Processing	3	0	0	3	TH	
EEUG	21	EL	EE165	Modern Power Operation & Control	3	0	0	3	TH	
EEUG	22	EL	EE166	HVDC Transmission	3	0	0	3	TH	
EEUG	23	EL	EE167	Flexible AC Transmission Systems (FACTS)	3	0	0	3	TH	
EEUG	24	EL	EE168	PLC and SCADA	3	0	0	3	TH	
EEUG	25	EL	EE169	SCADA and Energy Management Systems	3	0	0	3	TH	
EEUG	26	EL	EE170	Advance Instrumentation	3	0	0	3	TH	
EEUG	27	EL	EE171	Process Control	3	0	0	3	TH	
EEUG	28	EL	EE172	Process Control & Instrumentation	3	0	0	3	TH	
EEUG	29	EL	EE173	Performance Specifications & Control System Design	3	0	0	3	TH	

Course Structure for B. Tech (Electrical Engineering) Program (Mod 2013 Batch) [6]

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
EEUG	1	3	EC105	Electromagnetic Field Theory	3	0	0	3		
EEUG	2	3	EC107	Semiconductor Devices	3	0	0	3		
EEUG	3	3	EC109	Signal & Systems Analysis	3	1	0	4		
EEUG	4	3	EE103	Electrical Machine - I	3	0	0	3		
EEUG	5	3	EE104	Electrical Machine - I Lab	0	0	3	1		
EEUG	6	3	EE105	Network Analysis and Synthesis	3	0	0	3		
EEUG	7	3	MA105	Transform Calculus (Elective-1)	3	0	0	3		
EEUG	8	3		Semester Total	15	3	6	20	20	65
EEUG										
EEUG	1	4	CH104	Green Technology (Environmental Science)	3	0	0	3		
EEUG	2	4	EC103	Digital Logic and Circuits	3	1	0	4		
EEUG	3	4	EC111	Analog Electronics	3	1	0	4		
EEUG	4	4	EC112	Digital & Analog Electronics Lab	0	0	3	1		
EEUG	5	4	EE110	Electrical Machine -II	3	1	0	4		
EEUG	6	4	EE111	Electrical Machine -II Lab	0	0	3	1		
EEUG	7	4	GE105	EAA - I NSS	0	0	3	0		
EEUG	8	4	MA108	Numerical Methods for Engineers	3	0	0	3		
EEUG	9	4		Semester Total	15	3	6	20	20	85
EEUG										
EEUG	1	5	CH105	Bio Science	3	0	0	3		
EEUG	2	5	EC156	Communication Systems	3	1	0	4		
EEUG	3	5	EE112	Electrical Measurement and Instruments	3	0	0	3		
EEUG	4	5	EE113	Electrical Measurement and Instruments Lab	0	0	3	1		
EEUG	5	5	EE114	Control Systems	3	1	0	4		
EEUG	6	5	EE115	Control Systems Lab	0	0	3	1		
EEUG	7	5	EE118	Power System - I	3	1	0	4		
EEUG	8	5		Semester Total	15	3	12	~~20~~	20	105
EEUG										
EEUG	1	6	EE116	Power Electronics	3	0	0	3		
EEUG	2	6	EE117	Power Electronics Lab	0	0	3	1		
EEUG	3	6	EE119	Power System - II	3	1	0	4		
EEUG	4	6	EE123	Microprocessor & Its Application	3	1	0	4		
EEUG	5	6	EE124	Microprocessor & Its Application Lab	0	0	3	1		
EEUG	6	6	EE191	Minor Project-I	0	0	3	1		
EEUG	7	6	EE1xx	Departmental Elective - I	3	0	0	3		
EEUG	8	6	EE1xx	Departmental Elective - II	3	0	0	3		
EEUG	9	6	GE103	Industrial Interaction & Soft Skill Development	0	0	3	0		
EEUG	10	6	GE106	EAA - II NSS				0		
EEUG	11	6		Semester Total	15	3	9	~~20~~	20	125
EEUG										
EEUG	1	7	EE121	Power System Protection	3	1	0	4		

[6] 3rd Sem and 4th Sem B. Tech (EE) Revised structure shall be implemented from Session 2015-16., as per direction of Dean(s) and HoD(s) meeting held on 07-05-2015

Prog	S. No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm Credit
EEUG	2	7	EE122	Power System Protection Lab	0	0	3	1		
EEUG	3	7	EE1xx	Departmental Elective - III	3	0	0	3		
EEUG	4	7	EE1xx	Departmental Elective - IV	3	0	0	3		
EEUG	6	7	Xx1xx	Engineering -III/ HSS/ Science/ Department (Elective)	3	0	0	3		
EEUG	7	7	Xx1xx	Engineering -IV/HSS/ Science/ Department (Elective)	3	0	0	3		
EEUG	8	7	EE193	Minor Project-II	0	0	6	2		
EEUG	9	7	EE192	Industrial Training (4 to 6 weeks after 6th Sem)				1		
EEUG	10	7	EE194	General Seminar (EE)	0	0	6	2		
EEUG	11	7		Semester Total				~~22~~	22	147
EEUG										
EEUG	1	8	EE195	Major Project				20		
EEUG	2	8	EE196	Comprehensive Viva				2		
EEUG	3	8		Semester Total				22	22	169
EEUG										
EEUG				Departmental Electives						
EEUG	1	EL	CS155	Computer Architecture	3	0	0	3	TH	
EEUG	2	EL	EE151	Utilization & Traction	3	0	0	3	TH	
EEUG	3	EL	EE152	Electrical Drawing, Estimation & Costing	3	0	0	3	TH	
EEUG	4	EL	EE153	Special Electrical Machines	3	0	0	3	TH	
EEUG	5	EL	ME1xx	Energy Conversion	3	0	0	3	TH	
EEUG	6	EL	PH103	Materials Science & Technology	3	0	0	3	TH	
EEUG	7	EL	EC119	Digital Communication	3	0	0	3	TH	
EEUG	8	EL	EE154	Electrical Machines Design	3	0	0	3	TH	
EEUG	9	EL	EE155	Industrial Drives and Control	3	0	0	3		
EEUG	10	EL	EE156	Power Plant Engineering	3	0	0	3	TH	
EEUG	11	EL	EE157	Modern Control Theory	3	0	0	3	TH	
EEUG	12	EL	EE158	Power Systems Dynamics & Reliability	3	0	0	3	TH	
EEUG	13	EL	EE159	Computer Aided Power System Design	3	0	0	3	TH	
EEUG	14	EL	EE160	Power System Design	3	0	0	3	TH	
EEUG	15	EL	EE161	Microprocessor & Microcontrollers	3	0	0	3	TH	
EEUG	16	EL	EE162	Microcontrollers & Its Applications	3	0	0	3	TH	
EEUG	17	EL	EE163	Digital Control System	3	0	0	3	TH	
EEUG	18	EL	EE164	Advance Control Theory	3	0	0	3	TH	
EEUG	19	EL	CS158	Image Processing	3	0	0	3	TH	
EEUG	20	EL	EC117	Digital Signal Processing	3	0	0	3	TH	
EEUG	21	EL	EE165	Modern Power Operation & Control	3	0	0	3	TH	
EEUG	22	EL	EE166	HVDC Transmission	3	0	0	3	TH	
EEUG	23	EL	EE167	Flexible AC Transmission Systems (FACTS)	3	0	0	3	TH	
EEUG	24	EL	EE168	PLC and SCADA	3	0	0	3	TH	
EEUG	25	EL	EE169	SCADA and Energy Management Systems	3	0	0	3	TH	
EEUG	26	EL	EE170	Advance Instrumentation	3	0	0	3	TH	
EEUG	27	EL	EE171	Process Control	3	0	0	3	TH	
EEUG	28	EL	EE172	Process Control & Instrumentation	3	0	0	3	TH	
EEUG	29	EL	EE173	Performance Specifications & Control System Design	3	0	0	3	TH	

Course Structure for B. Tech (Mechanical Engineering) Program (2013 Batch)

Prog	S.No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm. Credit
MEUG	1	3	ME103	Strength of Materials	3	1	0	4		
MEUG	2	3	ME104	Manufacturing Process	3	1	0	4		
MEUG	3	3	ME105	Manufacturing Process Lab.	0	0	3	1		
MEUG	4	3	ME106	Strength of Materials Lab.	0	0	3	1		
MEUG	5	3	ME107	Thermodynamics	3	1	0	4		
MEUG	6	3	PH103	Material Science & Technology	3	0	0	3		
MEUG	7	3	MA104	Tools for Applied Mathematics: (Engineering Mathematics-III Elective – 1))	3	0	0	3		
MEUG	8	3		Semester Total	15	3	6	20	20	65
MEUG										
MEUG	1	4	MA108	Numerical Methods for Engineers (Engineering Mathematics- III Elective-2)	3	0	0	3		
MEUG	2	4	ME109	Applied Thermodynamics	3	1	0	4		
MEUG	3	4	ME110	Applied Thermodynamics Lab	0	0	3	1		
MEUG	4	4	ME111	Fluid Mechanics & Machinery	3	1	0	4		
MEUG	5	4	ME112	Fluid Mechanics & Machinery Lab	0	0	3	1		
MEUG	6	4	ME113	Kinematics of Machinery	3	1	0	4		
MEUG	7	4	CH104	Green Technologies (Environmental Science)	3	0	0	3		
MEUG	8	4	GE105	EAA - I NSS				0		
MEUG	9	4		Semester Total	15	3	6	20	20	85
MEUG										
MEUG	1	5	ME115	Dynamics of Machinery	3	1	0	4		
MEUG	2	5	ME116	Dynamics of Machinery Lab	0	0	3	1		
MEUG	3	5	ME117	Heat Transfer	3	1	0	4		
MEUG	4	5	ME118	Heat Transfer Lab	0	0	3	1		
MEUG	5	5	ME119	Machine Design-I	2	1	3	4		
MEUG	6	5	ME120	Mechanical Engineering Lab	0	0	3	1		
MEUG	7	5	ME1xx	Departmental Elective I	3	0	0	3		
MEUG	8	5	xx1xx	Engineering I (Elective)	3	0	0	3		
MEUG	9	5		Semester Total	14	3	12	21	21	106
MEUG										
MEUG	1	6	ME121	Internal Combustion Engine	3	1	0	4		
MEUG	2	6	ME122	Internal Combustion Engine Lab	0	0	3	1		
MEUG	3	6	ME123	Machine Design-II	2	1	3	4		
MEUG	4	6	ME125	Machine Tools & Machining	3	1	0	4		
MEUG	5	6	ME126	Machine Tools & Machining Lab	0	0	3	1		
MEUG	6	6	ME191	Minor project I	0	0	3	1		
MEUG	7	6	ME1xx	Departmental Elective II	3	0	0	3		
MEUG	8	6	Xx1xx	Engineering II (Elective)	3	0	0	3		
MEUG	9	6	GE103	Industrial Interaction & Soft Skill Development				0		
MEUG	10	6	GE106	EAA - II NSS				0		
MEUG	11	6		Semester Total	14	3	12	21	21	127
MEUG										
MEUG	1	7	GE102	Bio science	3	0	0	3		
MEUG	2	7	ME192	Industrial Training (4 to 6 weeks after 6th Sem)				1		
MEUG	3	7	ME193	Minor project II	0	0	6	2		
MEUG	4	7	ME194	General Seminar	0	0	6	2		
MEUG	5	7	ME1xx	Departmental Elective -III	3	0	0	3		

Prog	S.No.	Sem	Course Code	Course	L	T	P	Credit	Total Credit	Cumm. Credit
MEUG	6	7	ME1xx	Departmental Elective –IV	3	0	0	3		
MEUG	7	7	xx1xx	Engineering III/HSS/Science/Dept Elective	3	0	0	3		
MEUG	8	7	xx1xx	Engineering III/HSS/Science/Dept Elective	3	0	0	3		
MEUG	9	7		Semester Total	15	0	12	20	20	147
MEUG										
MEUG	1	8	ME195	Major Project				20		
MEUG	2	8	ME196	Comprehensive Viva				2		
MEUG	3	8		Semester Total				22	22	169
MEUG										
MEUG	EL-1	5	ME141	CAD/CAM	**3**	0	0	3		
MEUG	EL-1	5	ME142	Advanced Strength of Materials	**3**	0	0	3		
MEUG	EL-1	5	ME143	Production & Operations Management	**3**	0	0	3		
MEUG	EL-1	5	ME144	Statistical Quality Control	**3**	0	0	3		
MEUG	EL-2	6	ME145	Refrigeration & Air Conditioning	**3**	0	0	3		
MEUG	EL-2	6	ME146	Measurement & Instrumentation	**3**	0	0	3		
MEUG	EL-2	6	ME147	Automobile Engineering	**3**	0	0	3		
MEUG	EL-2	6	ME148	Mechanical Vibrations	**3**	0	0	3		
MEUG	EL-3	7	ME149	TPM & Value Engineering	**3**	0	0	3		
MEUG	EL-3	7	ME150	Non-Conventional Manufacturing	**3**	0	0	3		
MEUG	EL-3	7	ME151	Finite Element Methods	**3**	0	0	3		
MEUG	EL-4	7	ME152	Gas Turbine & Jet Propulsion	**3**	0	0	3		
MEUG	EL-4	7	ME153	Mechatronics & Robotics	**3**	0	0	3		
MEUG	EL-4	7	ME154	Tribology	**3**	0	0	3		
MEUG	OPEL	5	ME161	Renewable Energy Systems	**3**	0	0	3		
MEUG	OPEL	6	ME162	Operations Research	**3**	0	0	3		
MEUG	OPEL	6	ME163	Computational Fluid Dynamics	**3**	0	0	3		
MEUG	OPEL	7	ME164	Power Plant Engineering	**3**	0	0	3		
MEUG	OPEL	7	ME165	Supply Chain Management	**3**	0	0	3		
MEUG	OPEL	7	ME166	Safety Management	**3**	0	0	3		
MEUG	OPEL	7	ME167	Advanced Materials and Tools	**3**	0	0	3		

Department of Mathematics

Following Core and Elective(s) Courses shall be offered by the department in different semesters. List of core and Electives from the department is detailed below for B. Tech Program:

S. No.	Course for Prog	Sem	Course Code	Course	L	T	P	Credit
1	B. Tech Core Course	1	MA101	Mathematics - I	3	1	0	4
2		2	MA102	Mathematics - II	3	1	0	4
3	B. Arch	1	MA103	Engineering Mathematics	3	1	0	4
4	B. Tech Elective - I	3	MA104	Tools of Applied Mathematics	3	0	0	3
5		3	MA105	Transform Calculus	3	0	0	3
6		3	MA106	Discrete Mathematical Structure	3	0	0	3
7		3	MA107	Probability & Statistics for Engineers	3	0	0	3
8	B. Tech Elective -II	4	MA108	Numerical Methods for Engineers	3	0	0	3
9		4	MA109	Linear Algebra	3	0	0	3
10		4	MA111	Numerical Solutions of ODE and PDE	3	0	0	3

MA101 Mathematics – I

L-T-P-Cr: 3-1-0-4

Objective:

Pre Requisites: 10+2 Mathematics

Syllabus:

Unit 1. **Matrix Algebra:** Elementary row & column transformation, Inverse of the matrix , Cannonical form ,Reduction to Canonical form , rank of the matrix , solution of simultaneous linear equations, characteristic equation, eigen values & eigen vectors, Caley-Hamilton theorem, Similarity transformation **10 lectures**

Unit 2. **Differential Calculus:** Successive differentiation, Leibnitz theorem, indeterminate form, Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutatively, Euler s theorem on homogeneous functions, harmonic functions, Taylor s expansion of functions of two variables, maxima and minima of functions of two variables , Lagrange s method of multipliers **12 lectures**

Unit 3. **Differential equation:** Ordinary Differential Equations: First order differential equations - separable variable, homogeneous, exact, linear and Bernoulli s form. Second and higher order differential equations with constant coefficients, method of variation of parameters, Euler s equations, system of linear differential equations. **12 lectures**

Unit 4. **Infinite Series:** Notion of convergence and divergence of infinite series – Ratio test, comparison test, Raabe's test, Root test, alternating series –Leibnitz test , absolute and conditional convergence, Power series . **8 lectures**

Suggested Readings:

1. Advance Engineering Mathematics – R. K. Jain & S.R.K. Iyenger, Narosa Publishing House
2. Differential Calculus – Das & Mukherjee – U.N. Dhar & Sons.
3. Advance Engineering Mathematics - E. Kreyszig, 8th Edition, John Wiley & Sons, New York
4. Advance Engineering Mathematics – Wylie & Barrett – Tata McCraw Hill
5. Linear Algebra – K. Hoffmann and R. Kunze – Prentice Hall

MA102 Mathematics – II

L-T-P-Cr: 3-1-0-4

Objective:
Pre Requisites: 10+2 Mathematics and Mathematics - I

Syllabus:

Unit 1. **Integral Calculus:** Convergence of improper integrals – comparison test, Beta & Gamma functions (definition & related problems), differentiation under integral sign – Leibnitz rule. Double & Triple integrals, Change of Variables in double integrals, Computation of surfaces & volumes, Rectifications, Jacobians of Transformations. **12 lectures**

Unit 2. **Vector Calculus:** Scalar & Vector field, level surface, directional derivatives, concept of gradient, divergence & curl with examples, line integral, Green's theorem in plane, Gauss & Stroke's theorem with applications. **10 lectures**

Unit 3. **Complex Analysis:** Function of complex variables – limit, continuity, differentiability and analyticity of functions, Cauchy-Riemann equations, Laplace's equation, harmonic function, Cauchy's integral theorem, Cauchy's integral formula, Taylor's and Laurent series, Residues and its applications to evaluating real integrals. **12 lectures**

Unit 4. **Probability and Statistics:** Random Variable – cumulative distribution function, probability mass function, probability density function, mathematical expectation, mean, variance.
8 lectures

Suggested Readings:

1. Advance Engineering Mathematics – R. K. Jain & S.R.K. Iyenger, Narosa Publishing House
2. Advance Engineering Mathematics - E. Kreyszig, 8th Edition, John Wiley & Sons, New York

Reference Books:

1. Advance Engineering Mathematics – Wylie & Barrett – Tata McGraw Hill
2. Complex Variables and Applications – Churchill & Brown - McGraw Hill
3. Vector Analysis 2nd editions – Chatterjee, Prentice Hall of India
4. Introduction to Probability & Statistics for Engineers – S. M. Ross – John Wiley and Sons, New York

MA104 Tools of Applied Mathematics (Elective-I)

L-T-P-Cr: 3-0-0-3

Course objectives: The aim of the course is to expose basic tools of Applied Mathematics to students from various branches.

Syllabus:

Unit 1. **Introduction:** Modelling various physical processes lead to either ODE or PDE. Examples like bending of elastic beam, heated rod/lamina, and electrical networks may be discussed. Some real life examples like manufacturing products and defect estimation, estimation of rainfall over a specific period etc. may be discussed which give an idea as on use of probability. 2 Lectures

Unit 2. **Partial differential equations:** Basic concepts, 1st& 2nd order linear, quasi-linear partial differential equations, classification of 2nd order PDE, Boundary and initial conditions, wave equations, separation of variables, use of Fourier series, D'Alembert's solution of wave equation, Heat equations, solution by Fourier series, Laplace equation .
14 Lectures

Unit 3. **Differential equations and Special functions:** Series solution of differential equations (Frobenius method). Bessel's equation, its solution, Bessel's function of first & second kind, Recurrence formula, Legendre's equation, its solution, Legendre Polynomials, Rodrigue's formula, Orthogonality of Legendre Polynomials. 14 Lectures

Unit 4. **Probability & Statistics:** Probability distribution: Binomial, Poison, Exponential, normal and lognormal, Sampling & sampling distributions, t, chi-square and F distributions. 12 Lectures

Suggested Readings:

1. R. K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics –Narosa Publishing House
2. Peter V O'Neil, Advanced Engineering Mathematics, Thomson India Education
3. E. Kreyszig, Advanced Engineering Mathematics - 8th Edition, John Wiley & Sons, New York
4. V.K. Kapoor & S.C. Gupta, Fundamentals of Mathematical Statistics – Sultan & Sons
5. Ian N. Sneddon , Elements of Partial Differential Equations –McGraw Hill
6. S. M. Ross, Introduction to Probability & Statistics for Engineers – John Wiley and Sons, New York

MA105 Transform Calculus (Elective-I)

L-T-P- Cr: 3-0-0-3

Course objectives: It may be noted that different electrical and electronic systems, methods in signal processing are based on various transformation techniques. This course aims to give required theory and exposure to applications related to the above mentioned topics.

Syllabus:

Unit 1. **Introduction:** Basic introduction of the course using precise examples like periodic functions, signal propagation, solving mathematical models corresponding to Electrical Circuits, wave propagation be discussed. **2 Lectures**

Unit 2. **Fourier Series:** Periodic function, Fourier representation of a functions, Even & Odd functions-Half Range Expansions – sine and cosine series, Parseval's identity, Harmonic Analysis . **8 Lectures**

Unit 3. **Laplace Transforms:** Definition and properties of Laplace Transform, Conditions for existence of Laplace transform, Shifting Theorems, Transforms of derivatives and integrals, Multiplications by t^n, Division by t, Evaluations of integrals by L.T., Inverse Transforms, Unit step function, Dirac delta-function, Differentiation and integration of transforms, convolution theorem, periodic functions. Solution of initial and boundary value problems. **16 Lectures**

Unit 4. **Fourier Transform:** Fourier transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self-reciprocity of Fourier Transform, convolution theorem. Application to boundary value problems. **10 Lectures**

Unit 5. **Z-Transform**. **6 Lectures**

Suggested Readings:

1. Advanced Engineering Mathematics – R. K. Jain & S.R.K. Iyengar, Narosa Publishing House
2. Advanced Engineering Mathematics – Peter V O'Neil, Thomson India Education
3. Integral Transform and their Applications, L. Debnath and D. Bhatta, Taylor & Francis, 2nd ed-

MA106 Discrete Mathematical Structures (Elective-I)

L-T-P- Cr: 3-0-0-3

Course objectives: *Most of the advanced topics of computer science are based on basic discrete mathematical structures. The basic aim of this course is to make students understand various Discrete Mathematical structures.*

Syllabus:

Unit 1. **Introduction:** Applications of functions and relations to databases; applications of Group theory to cryptography with examples like RSA public key crypto systems; use of recurrence relations to estimate computational complexity of algorithms. **2 Lectures**

Unit 2. **Sets, Relations and Functions:-** Basic operations of sets, Cartesian Product, Disjoint Union(Sum) and Power sets, Different types of relations, Properties of Reflexive, Symmetric, anti-symmetric and Transitive relations. Partial Order relation and Equivalence relation. **8 Lectures**

Unit 3. **Partial ordered sets:-** Complete partial ordering, chain, lattice, Complete, Distributive, Modular and Complemented lattices, Boolean lattices, sub lattices. **6 Lectures**

Unit 4. **Propositional Logic:-** Syntax and semantics, connectives, conditional and bi-conditional connectives, Functionally complete sets of connectives, Two-state Devices and Statement Logic, satisfiability tautology, normal forms of Predicate calculus. **6 Lectures**

Unit 5. **Algebraic Structures:-** Algebraic structures with one binary operation- semigroup, monoid and group, Congruence relation, Permutation group, Subgroup, Cosets and Lagrange's Theorem, Formal definition of a ring, zero divisors, units and subrings, Polynomial rings, Division algorithm, factoring and the Euclidean algorithm for polynomials. **8 Lectures**

Unit 6. **Introduction to Counting:-**Basic counting techniques- Permutations and Combinations with or without replacement. Binomial Theorem, Multinomial Theorem and Pascal's triangle. Inclusion and Exclusion Principle, Pigeon-Hole principle. **6 Lectures**

Unit 7. **Recurrence relations, generating functions:-** First and Second order linear recurrence relation. Example and Applications. **6 Lectures**

Suggested Readings:

1. Discrete Mathematics (For Computer Scientist) - John Truss- Pearson Education
2. Discrete Mathematics for Computer Scientists - Cliff L Stein- Pearson Education.
3. Discrete Mathematics- T. Veerarajan- Tata McGraw-Hill
4. Introductory Discrete Mathematics – V K Balakrishnan, Dover Books on Computer Science
5. Discrete Mathematics- Richard Johnson Baugh- Pearson Education
6. Discrete Mathematical Structures- Bernard Kolmar, Robert C Busby, Sharon Cutter Ross
7. Discrete Mathematics- Norman L. Biggs- Oxford University, USA.
8. Discrete Mathematics - R. Manohar and Tremblay- McGraw-Hill Book Co.

MA107 Probability & Statistics for Engineers (Elective-I)

L-T-P-Cr: 3-0-0-3

Course objectives*: Various engineering applications require decision making depending on the behavior of the sample data. One cannot perform experiments for a large number of test cases. Probability and Statistics introduces various techniques to analyze the behavior of a system based on data available.*

Syllabus:

Unit 1. **Introduction**: Modern Mathematical Statistics has various engineering applications, for instance, testing materials, and automatization in general, production planning marketing analysis. Field of applications, for instance, in Computer Science, demography, Management of natural resources, traffic control, urban planning etc be discussed. 2 Lectures

Unit 2. **Moments**, moments generating function, Chebyshev's inequality, correlation and regression. 6 **Lectures**

Unit 3. **Special Distributions:** Discrete, uniform, Binomial, Geometric, Poisson, Exponential, gamma, Normal distribution. Functions of a random variable. **6 Lectures**

Unit 4. **Joint Distributions:** joint, marginal and conditional distributions, product moments, independent of random variables, bivariate normal distribution. **6 Lectures**

Unit 5. **Sampling Distributions:** The central limit theorem, distributions of the sample mean and the sample variance for a normal population, Chi-square, t and F distributions. **6 Lectures**

Unit 6. **Estimation:** The methods of moments and the of maximum likelihood estimation, confidence intervals for the mean(s) and variance(s) of Normal populations. **6 Lectures**

Unit 7. **Testing of Hypothesis:** Null and Alternative hypotheses, the critical and acceptance regions, types of errors, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample problems for normal populations, ANOVA I & ANOVA II. **8 Lectures**

Suggested Readings:

1. Probability and Statistics in Engineering by W.W. Hines, D.C. Montgomery, D.M. Goldsman, C.M. Borror
2. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross
3. Introduction to Probability and Statistics by J.S. Milton & J.C. Arnold.
4. Introduction to Probability Theory and Statistical Inference by H.J. Larson
5. Probability and Statistics for Engineers and Scientists by R.E. Walpole, R.H. Myers, S.L. Myers, Keying Ye
6. An Introduction to Probability and Statistics by V.K. Rohatgi & A.K. Md. E. Saleh.
7. Modern Mathematical Statistics by E.J. Dudewicz & S.N. Mishra
8. Introduction to the Theory of Statistics by A.M. Mood, F.A. Graybill and D.C. Boes

MA108 Numerical Methods for Engineers (Elective-II)

L-T-P-Cr: 3-0-0-3

Course objectives: At the end of the course, a student will be equipped with basic techniques of numerical methods like root finding, numerical integration, differentiation and will be able to attempt solving ODEs numerically. If they can implement these by writing codes, they will be ready to handle projects in their respective fields.

Syllabus:

Unit 1. **Introduction**: When a fixed data is available for a process, how interpolation can help estimating the value at any other desired print where data is not available be highlighted. For example, estimating population, prey – predator models be discussed. **2 Lectures**

Unit 2. **Iterative Techniques for solution of equations:** Solutions of Non - linear equations – Simple iteration schemes, Bisection method, Newton-Raphson method, Secant method, order and rate of convergence of each of these methods. **8 Lectures**

Unit 3. **Solutions of linear equations** – Gaussian elimination, Gaussian Jordan Method, LU decomposition and Jacobi & Gauss Seidal iteration methods. **6 Lectures**

Unit 4. **Interpolation** – Interpolation, various forms of interpolating polynomials like Lagrangian interpolation of polynomials, Newton's Divided Interpolation and Newton's forward & backward difference formula, curve fitting**.** **8 Lectures**

Unit 5. **Numerical Integration** – Newton Cotes type methods, Trapezoidal methods, Simpson's rule $1/3^{rd}$, $3/8^{th}$ rule, order of errors in integration, Numerical Differentiation, derivation and error of methods. **6 Lectures**

Unit 6. **Solution of initial value problems**– Single step methods: Euler's method and Modified Euler's method, Runge– Kutta Second order method(with proof) &Runge's Kutta Fourth order methods(without proof); Multi step Methods: Predictor Corrector (Milne's) Methods, Solution of Boundary value problems using finite difference methods, definition of convergence and stability. **10 Lectures**

Suggested Readings:

1. Numerical Methods for Scientific & Engineering Computations, M.K.Jain, S.R.K.Iyengar & R.K.Jain, New Age International Publishers, New Delhi
2. Introductory Methods of Numerical Analysis – S.S.Sastry – Prentice Hall of India Pvt. Ltd.
3. Advance Engineering Mathematics - E.Kreyszig, 8^{th} edition , John Wiley & Sons, New York
4. A friendly introduction to Numerical Analysis, Brain Bradie, Pearson Education Low Price Edition

MA109 Linear Algebra (Elective-II)

L-T-P-Cr: 3-0-0-3

42 Lectures

Course Objective: Mathematical modelling of various electrical/electronic circuits systems leads to linear and non-linear system of equations. The properties of these depend on the structure of vector spaces and matrix properties. This course is expected to give exposure to these fundamental concepts.

Syllabus:

Unit 1. **Introduction:** Examples from electrical networks, economic models, and mechanical systems be given leading to linear systems. Precise examples like Kirchoff's current law be discussed.

Unit 2. Vector spaces over any arbitrary field, linear combination, linear dependence and independence, basis and dimension, inner-product spaces,

Unit 3. Linear transformations, matrix representation of linear transformations, linear functional, dual spaces, eigen values and eigen vectors, rank and nullity, inverse and linear transformation,

Unit 4. Cayley-Hamilton Theorem, norms of vectors and matrices, transformation of matrices, adjoint of an operator, normal, unitary, hermitan and skew-hermitan operators, quadratic forms.

Text Book:

1. Introduction to linear Algebra- Gilbert Strang, Wellesley-Cambridge Press
2. Matrix and Linear Algebra- Kanti Buhsan Datta, PHI Learning Pvt. Ltd.
3. Linear Algebra by Kenneth M Hoffman and Ray Kunze, Pearson
4. Linear Algebra – Serge Lang, Springer Undergraduate Texts in Mathematics

MA111 Numerical Solutions of ODE and PDE (Elective-II)

L-T-P-Cr: 3-0-0-3

Course objectives: With the current day challenges, most of the problems in engineering based on mathematical modelling are to be handled numerically due to their complex structure. This course provides necessary knowledge to a student to handle either ODEs or PDEs numerically. At the end of this course they will be ready to handle projects in the respective fields.

Syllabus:

Unit 1. **Introduction:** Examples of heated rod, lamina; vibrating strings, membranes. Difficulties in handling analytically the governing equations; the use of numerical techniques to handle linear and non-linear processes to be discussed. 2 Lectures

Unit 2. **Ordinary Differential Equations:** Numerical solutions of IVP-Difference equations, stability, error and convergence analysis. Single step methods- Taylor series method, Euler method, Picard's method of successive approximation, 10 Lectures

Unit 3. Runge-Kutta method. Multistep methods – Predictor-Corrector method, Euler PC method, Milne and Adams Moulton PC method. System of 1^{st} order ODE, higher order IVPs. Numerical solution of BVP- Linear BVP, finite difference methods, shooting methods, Newton's method for system of equations, stability, error and convergence analysis, nonlinear BVP, higher order BVP.

10 Lectures

Unit 4. **Partial Differential Equations:** Classification of PDEs, Finite difference approximations to partial derivatives. Explicit and Implicit schemes for parabolic and hyperbolic equations, tri-diagonal systems. 10 Lectures

Unit 5. Solution of one dimensional heat equation by Schmidt and Crank- Nicolsan methods. Laplace equation using standard five point formula and diagonal five point formula, convergence and stability analysis, Introduction to ADI schemes. 20 Lectures

Suggested Readings:

1. Numerical Solutions of Differential Equations, M.K. Jain, 2nd Ed., Wiley Eastern
2. Computational Methods for PDE, M.K. Jain, S.R.K. Iyengar and R.K. Jain, Wiley Eastern
3. Introductory Methods of Numerical Analysis – S.S.Sastry – Prentice Hall of India Pvt. Ltd.
4. Numerical Solution of Partial Differential Equations: Finite Difference Methods- G.D. Smith, Oxford Applied Mathematics & Computing Science Series

Department of Chemistry

CH101A Chemical Sciences - I

L-T-P-Cr: 3-0-0-3 ***(Effective From Session 2015-16)***

Objective: Chemical Science involves the structure of substances, their properties & transformation. Chemical Science like physics is a fundamental science. A person without the basic knowledge of chemistry is unable to understand the notes on labels that accompany foodstuffs. Profession directly connected with chemistry are included in the first ten most prestigious and most well paid profession.

PREREQUISITES: Chemical Science is often referred to as the central science because it joins together physics, mathematics & Biology. Knowledge of the nature of chemicals & Chemical processes therefore provide insights into variety of physical & Biological phenomenon. Chemical science encourages innovative, fundamental, Strategic & applied research.

OUTCOMES:

1. Use of foundational principles to analyse problems in nature.
2. Develop hypotheses & Test them using quantitative techniques.
3. Articulate application of chemical Science in the Modern World.
4. Effectively communicate scientific concept both verbally & in willing.

Syllabus:

Unit - 1. **Gases**:

(a) Concept of Ideal gas, Kinetic theory of gases, interpretation of pressure and temperature, Maxwell's distribution of speeds and Kinetic energy distribution – average, root mean square and most probable values. Principles of equipartition of energy and calculation of molar heat capacities of ideal gases (5 Lectures)

(b) Deviation from ideal behavior, compressibility factor, intermolecular interactions. van der Waals equation and its characteristics, critical states and critical constants in terms of a and b (van der Waals constants), reduced state, Law of corresponding states, virial theorem. (7 Lectures)

Unit - 2. **Principles of Organic Chemistry**:

Electronegativity, dipole moment, hydrogen bond, electron displacement effects-inductive effect, mesomeric effect or resonance, electromeric effect, hyperconjugation. Concepts of acids & bases.

Chirality, optical activity and its measurement, stereoismerism. Enantiomer, diastereomer, configuration, conformation (ethane, n-butane, cyclohexane, etc.), geometrical isomerism. Projection formula of a tetrahedral carbon, symmetry elements, R/S, D/L, E/Z, threo/ erythro nomenclature. Geometrical and optical isomerism in co-ordination compounds. (14 Lectures)

Unit - 3. Atomic Structure:

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers. Introduction to the concept of atomic orbitals; shapes, radial and angular probability diagrams of s, p and d orbitals (qualitative idea). Many electron atoms and ions: Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle. Electronic energy level diagram and electronic configurations of hydrogen-like and polyelectronic atoms and ions. (7 Lectures)

Unit - 4. **Periodicity of elements**:

Periodic table, group trends and periodic trends in physical properties. Classification of elements on the basis of electronic configuration. Modern IUPAC Periodic table. General

characteristic of s, p, d and f block elements. Effective nuclear charges, screening effects, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii. Ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties. Inert pair effect. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. (9 Lectures)

Books:

1. Chawla, S. *A Textbook of Engineering Chemistry*
2. Jain, P. C.; Jain, M. *Engineering Chemistry*
3. Atkins, P.A. *Physical Chemistry*, Oxford, 5th Ed.
4. Sykes, P. *A guide book to Mechanism in Organic Chemistry*.
5. Morrison, R. T., Boyd, R. N., *Organic Chemistry*, 6th ed.
6. Sarkar, R. *General Chemistry* Part-I and Part-II, New Central Book Agency (P) Ltd.
7. Huheey, J. H.; Keiter, E. A.; Keiter, R. L.; Medhi, O. K. *Inorganic Chemistry: Principle of structure and reactivity*, 4th Ed., Pearson, New Delhi.

CH102A Chemical Sciences Lab - I

L-T-P-Cr: 0-0-3-1 *(Effective From Session 2015-16)*

1. Estimation of Cu (II) in a Brass sample or a given solution
2. Estimation of Fe(II) in Hematite ore or a given solution
3. Determination of hardness of water by EDTA method
4. Determination of amount of NaOH and Na_2CO_3 in a mixture of their solution
5. Preparation of Aspirin
6. Preparation of Paracetamol
7. Determination of number of components in an organic mixture and R_f of each component using Thin Layer Chromatographic Technique
8. Synthesis and Characterization of Tris (acetylacetonato)manganese(III)
9. Preparation of buffer solution and measurement of dissociation constant of a weak acid by pH meter.

Suggested Readings:

Essential of Experimental Engineering Chemistry by Shashi Chawla.

CH101 Chemical sciences

(Effective till Session 2014-15)

L-T-P-Cr: 3-1-0-4

Unit 1. **Chemical bonding:** Ionic bonding, Factors which governs ionic bonding. Lattice energy, Born - Haber cycle. Covalent bond Hybridisation, VSPER theory, bond order, bonding in coordination compounds .Molecular orbital theory of homo- and Hetero-Nuclear diatomic molecules. Bonding in coordination compound, Ligand field theory and crystal field theory.
6 Lecture

Unit 2. **Stereochemistry:** Stereoisomerism, optical activity, geometrical isomerism, enantiomers, diastereomers, optical activity without asymmetric carbon atom. Conformational isomerism. Geometrical and optical isomerism in coordination compounds. 8 Lecture

Unit 3. **Unit 3 Electrochemistry:** Ionic conductivity and its measurements. Conductivity of electrolytes, Kohlrausch's law. Galvanic cell, electrode potential, Nernst equation, galvanic series, Fuel cells. 6 Lecture

Unit 4. **Gases:** Kinetic theory of gases, kinetic gas equation, most probable velocity, average velocity, root- mean square velocity, Vander-Walls gas equation. Liquefaction of gases. 6 Lecture

Unit 5. **Chemical kinetics:** Reaction rates, order of reaction, molecular of reaction, first and second order reaction, pseudo-order reaction. Reversible reaction, consecutive reactions and parallel reaction. Homogeneous and heterogeneous catalysts and its applications in chemical industries. 8 Lecture

Unit 6. **Chemical thermodynamics:** First law : statement, work done in isothermal, adiabatic, conditions work and heat path dependent function, heat changes, isochoric and isobaric conditions, heat capacity, C_p and C_v relations, Kirchoffs relation. Second Law: Need of 2^{nd} Law, spontaneous process, Reversible process, Carnot cycle, Concept of energy, Entropy changes as function of temperature, entropy changes during the phase transformation, Gibbs free energy, free energy changes under various conditions, free energy change as reversible and irreversible process, Gibbs Helmholtz equation. 8 Lecture

Suggested Readings:

1. Peter Atkin & Julio De Paula, Element of Physical Chemistry, Oxford University Press, 2009
2. Bruce M. Mahan & Rollie J Meyers, University Chemistry, 4^{th} Edition, Pearson, 2009
3. Puri, Sharma & Pathania, |Principle of Physical Chemistry, Vishal Publication, 2008
4. H. K. Moudgil, Text Book of Physical Chemistry, PHI Learning Pvt Ltd, 2010

CH102 Chemical sciences Lab

(Effective till Session 2014-15)

L-T-P-Cr: 0-0-3-1

1. Estimation of Cu(II) in given solution by iodiometric titration.
2. Estimation of Fe(II) in given solution by Redox titration..
3. Determination of hardness of water by EDTA method.
4. Determination of NaOH and Na_2CO_3 in a mixture of their solution.
5. Proximate analysis of coal.
6. Determination of Drop point of grease.
7. Determination of rate constant of acid catalyzed hydrolysis of ester-titrimetry.
8. Determination of Flash point of lubricating oil by Penskey-Marten's apparatus.
9. Determination of Red Wood number of oil by Red Wood viscometer.
10. To determine the dissolved carbon dioxide in given water sample.

Suggested Readings:

Essential of Experimental Engineering Chemistry by Shashi Chawla.

CH103 Industrial Chemistry

L-T-P-Cr: 3-1-0-4

Objective: Industrial chemistry is application of chemical knowledge to a wide range of industrial endeavours. Pharmaceutical, Petrochemical, Soap & detergents, paints, dyes & Textile, insecticides, food and biochemical industries are just some of the endeavours where

industrial chemistry is applied. Proper training of students and equipping them with sound knowledge of chemical principles & Laboratory practice will make it possible for them to help solve problems in such industries. This undergraduate programme in chemistry will help to cater needs of students who not only wishes to continue further academic studies but also who wish for an employment in these industries

PREREQUISITES: This programme aims to produce graduates who can contribute to agencies that are based on chemistry or require the knowledge of chemistry, such as the private sectors (Especially the chemical industries), Public or Government industries.

OUTCOMES:

1. Development of chemical processes, from laboratory to industry.
2. Knowledge of the structure of Chemical materials on Scales ranging from the electronic level to macroscopic level.
3. Understanding the factors affecting the location of a chemical plant.
4. Understand the physio-chemical aspects of an industrial process.

Syllabus: Industrial chemistry

Unit 1. **Water treatment:** Hardness of water, units of water, disadvantage of hard water, scale and sludge formation in boilers, caustic- ebrittlement, boiler corrosion. Priming and foaming in boilers, softening methods. Desalination of Brackish water. 6 Lecture

Unit 2. **Fuels:** Classification of fuels, calorific value, classification of coal, Analysis of coal. Proximate and ultimate analysis and their significance. Carbonization of coal, Petroleum cracking, reforming, synthetic petrol, knocking in petrol and diesel engines. Additives used to improve the quality of fuels (gasoline and diesel). Natural gas, water gas producer gas. Combustion calculations, Non-conventional sources of energy, Fuel cells, solar energy, wind energy and bio-diesels. 8 Lecture

Unit 3. **Ceramics and refractory:** Materials used as ceramics, Requirement of good refractories, manufacture of refractories. Classification properties of refractories and selection of refractories. Composition of glass and cement, setting of cement. 6 Lecture

Unit 4. **Polymers:** Polymers, reaction and mechanism of polymerization. Preparation of some commercially important polymers (Fibers, elastomers, adhesives and plastics).Engineering uses of polymeric materials. 4 Lecture

Unit 5. **Corrosion and corrosion control:** Law of dry corrosion (Parabolic law, linear law and logarithmic law), wet corrosion (Electrochemical theory). Factors influencing corrosion, types of corrosion: drop corrosion, crevice corrosion, deposit corrosion, water-line corrosion, stray current corrosion, stress corrosion, pitting and erosion Corrosion. Protective measures against corrosion by (i) Modification of environment (ii) modification of the properties of the metal (iii) use of protective coatings and (iv) Cathodic protection. 7 Lecture

Unit 6. **Explosive and propellants:** Explosive, classification of explosives, oxygen balance, preparation and application explosive, precautions using storage of explosives. Blasting fuses, Rocket propellants, properties and classification of propellants.
6 Lecture

Unit 7. **Dye & Pigments:** Colour and constitution, Classification of Dyes, Nitro Dyes, Nitroso Dyes, Azo Dyes, Acridine dyes, Quinoline Dyes, Vat dyes, Fluorescent brightening agent.
4 Lecture

Suggested Readings:

1. B. K. Sharma, Industrial Chemistry (Including Chemical Enggnering), Goel Publishing House, Merrut,
2. A. Arora, Industrial Chemistry, Sonali Publication, 2009

3. H. K.Vaid, Industrial Chemistry, 01 Edition, Anmol Publication Pvt Ltd 2007
4. K. H. Davis & F.S. Berner, Hand Book of Industrial Chemistry Vol-1, CBS Publisher, 2005
5. Clerk Ranken, Industrial Chemistry, General Book, 2010

CH104A Green Technology (Environmental Science)

L-T-P-Cr: 3-0-0-3 (Effective from Session 2015-16)

Objectives: Green Technology is an approach to the design, manufacture and use of chemical products so as to reduce or eliminate chemical hazards intentionally. The goal of Green Technology is to create better, safer, chemicals while choosing the safest, most efficient ways to synthesise them. The main goal of Green Technology is to eliminate hazards right at the design stage. The principles of Green Technology demonstrate how chemical production could be achieved without posing hazard to human health and environment while at the same time being efficient and profitable.

Prerequisites: Green Technology is a new and rapidly emerging branch of chemistry. Green Technology came into light with the goal of reducing the damage caused to the environment by man–made materials and the processes used to produce them. Green Technology could include anything from reducing waste to even disposing of waste in an appropriate manner. All chemical waste should be disposed of in the best possible manner, without causing any damage to the environment and its various life forms.

Outcomes: Green Chemists are trained to integrate this information into design of molecules to avoid or reduce toxic properties. Green Chemists also take a life cycle approach to reduce the potential risks throughout the production process. They work to ensure that a product will pose minimal amount of threat to human health and the environment during production and moreover, its disposal and reuse and at the end of its useful life. A Green Technology approach is one of continual improvement, discovery and innovation that tends to bring us even closer to processes and products that are much safer to natural ecosystem. Ultimately a product should either be able to safely degrade as a biological nutrient or it should have better recyclability.

Syllabus:

Unit - 1. *Introduction of Green protocol:* Need, Goal and Limitation of Green Technology, Principles of Green Technology with their explanations and examples. Sustainable development, atom economy, reduction of toxicity. (5 Lectures)

Unit - 2. *Waste:* Production, Prevention, Problems and Source of waste, cost of Waste, Waste minimization technique, waste treatment and recycling. (5 Lectures)

Unit - 3. *Environmental chemicals:* Chemical speciation – speciation of lead, mercury, arsenic and chromium. Structure and property-activity relationship, fate of organics in the environment – transformation reactions (hydrolysis, elimination, oxidation-reduction etc). Risk evaluation of environmental chemicals, Biochemical effects of arsenic, lead, mercury and pesticides. (6 Lectures)

Unit - 4. *Water and Biodegradation:* Analysis of water and water quality parameters – concept of pH, measurement of acidity, alkalinity, hardness, residual chlorine, chlorides, DO, BOD, COD, fluoride and nitrogen.
Biodegradation – biodegradation of carbohydrates, proteins, fats and oils and detergents. (5 Lectures)

Unit - 5. *Atmosphere:* Structure of atmosphere, chemical and photochemical reactions in the atmosphere. Ozone Chemistry: formation and depletion of ozone layer, oxides of nitrogen and sulphur. Acid rain mechanism of formation and effects. Photochemical smog, and sulfurous smog. Greenhouse effect, global warming, greenhouse gases. (7 Lectures)

Unit - 6. *Green Synthesis and Catalysis:* Green oxidation and photochemical reactions, Microwave and Ultrasound assisted reactions, Synthesis of Green Reagents, Green solvents.

Classification of catalysts, heterogeneous and homogeneous catalysis, bio-catalysis. (7 Lectures)

Unit - 7. *Green Industrial Processes:* Pollution statistics from various industries, polymer industry, textile industry, greener approach of dyeing, ecofriendly pesticides, pharmaceutical industry, waste water treatment. (7 Lectures)

Text:

1. 1. C.N Sawyer, P.L McCarty and G.F Parkin, Chemistry for Environmental Engineering and Science, 5th ed. Tata McGraw-Hill, 2003
2. 2. Das, A. K. Environmental Chemistry with Green Chemistry, Books and allied (P) Ltd.
3. 3. Ahluwalia, V.K. Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
4. Sanghi, R. and Srivastava, M.M. Green chemistry: Environment Friendly Alternatives, Narosa Publishing House.
5. Paul Anastas, John C. Warner, John Warner Joint; Green Chemistry: Theory and Practice New Ed Edition; Oxford University press, USA, 2000

CH104 Green Technologies (Environmental Science)

(Effective till Session 2014-15)

L-T-P-Cr: 3-1-0-4

Syllabus:

Unit 1. **Introduction of Green Technologies**: Ecosystem, need, Goal & Limitation of Green Technology, Principle with their explanation and examples of sustainable development, atom economy, reaction of Toxicity.

Unit 2. **Waste:** Quantification of different waste products, analysis technique, production, prevention, problems Bio waste, chemical, industrial, electronics, agricultural waste, waste minimum technique & 3R technique (3R=Reduce, Reuse, Recycle) waste treatment and recycling.

Unit 3. **Green reagents and solvents:** Green oxidation reaction, photochemical reaction, microwave, ultrasound assisted reactions, green reagents and solvents.

Unit 4. **Industrial case studies:** Greener approach of acetic acid manufacture, leather manufacture, greener approach of dyeing, polyethylene echo friendly pesticides, paper and pulp industry, pharmaceutical industry. Case study: Ranitidine/omeprazole.

Unit 5. **Greenhouse effect and Global warming:** Impact of green house, effect on global climate, consequence of greenhouse effect.

Suggested Readings:

1. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
2. Rashmi Sanghi and M M Srivastava, Green chemistry: Environment Friendly Alternatives, Narosa Publishing House
3. Gurtu & Gurtu, Green Chemistry, Pragati Edition
4. Mike Lancaster, Green Chemistry: An introductory Text, RSC Publishing
5. Paul Anastas, John C.Warner, John Warner Joint; Green Chemistry: Theory & Practice New Ed Edition; Oxford University press, USA, 2000.

PH101 Engineering Physics

L-T-P-Cr: 3-1-0-4

Syllabus:

Unit 1. **Electrostatic and Electromagnetic theory:** The three electric vectors, to show that normal component of D and tangential component of E are continuous across the boundary between two dielectrics Continuity equation for charge (SAD .5.8), displacement current (SAD 9.4), Maxwell's Equation in free space, speed of plane electromagnetic waves traveling in vacuum, pointing vector, (SAD 9.5, 10.3-10.5, 10.7), EM waves propagation in dialectics and conductors**.**

Unit 2. **Optics:** Temporal coherence, Michelson's interferometer for measurement of coherence length of a source, line width spatial coherence, measurement of spatial coherence using Young's interferometer, Fraunhofer diffraction by single slit and grating.

Unit 3. **Polarisation:** Polarised light, production of plane polaroid technique (principal of action to be emphasised Brewster's law, Malus law, Double refraction, production of circular and elliptical lights, analysis of unpolalrised and polarized lights, Magneto-optics effect, photo-elastic effect, electro-optic effect.

Unit 4. **Lasers:** Lasers and Laser light, Einstein's A and B coefficients and the laser, population-inversion, Light amplification, Optical resonators, Characteristics of lasers, Ruby laser, How He-Ne Laser works.

Unit 5. **Special theory of Relativity:** Michelson – Morley's Expt., Postulates of special theory of relativity, consequences of special theory of relativity, Galilean transformation, Lorenz transformation, Length- contraction. Time Dilation, velocity addition, Mass change and Einstein's mass – energy relation (A.B & 1.1,1.2,1.4 & 1.7-1.9 and appendix to chapter-1)

Unit 6. **Quantum Physics:** Planck's theory of black body radiation (.B & 2.3 & 9.5 &9.6) Compton effect (.B & 2.7) wave particle duality, deBroglie waves, deBroglie wave velocity, wave and group velocity, Davission and Germar experiment Heisenberg uncertainty principle, application of the uncertainty principle, wave functions and wave equations, physical interpretation of wave function and their normalization,. Expectation values, Schrodinger equation time dependent form and steady state form in one dimension (Quantum mechanical operators) particle in a box.

Recommended Readings:

1. D. J. Griffith, Introduction to Electromagnetic Theory,
2. A. Ghatak, Optics,
3. A. Beiser, Prospective of Modern Physics,

PH102 Engineering Physics Lab

L-T-P-Cr: 0-0-3-1

Only six experiments re required to be done out of the following experiments:

1. To determine the Young's Modulus of elasticity by Bending of Beam Method,
2. To determine elastic constant by Searle's Apparatus,
3. To determine mechanical equivalent of heat by Joule's Calorimeter,
4. To determine internal resistance of a cell by Stretched Wire Potentiometer,
5. To compare e.m.f. of two cells by Rayleigh Potentiometer,
6. To determine the frequency of electrical maintained tuning fork by Meldies' Method,
7. to determine electronic charge by Millikon's Oil Drop Experiment,
8. To determine the wave length of laser light (Red light) using double slit interference,
9. To produce the properties of He/Ne Laser,
10. To measure band gap energy of semiconductors

PH103 Materials Science & Technology

(Syllabus till session 2014-15 for B. Tech All Branch)

L-T-P-Cr: 3-0-0-3

Objective: Materials Science is backbone of technology, which provides a good understanding of the basics of materials, in terms of their structural, electrical, magnetic, optical and mechanical properties. It constitutes an important area of study for the students of various engineering disciplines and helps to create ability to apply scientific knowledge to technology. To enrich the understanding of various types of materials and their applications in different fields of engineering and technology is the main objective of this course.

PREREQUISITES: Experimental and theoretical basic knowledge of physical and chemical sciences are prerequisites.

OUTCOMES: The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications.

Syllabus:

Unit 1. **Crystallography:** Space lattices, Crystal systems and Bravais lattices, Reciprocal lattice concept. Lattice Planes, Miller Indices, Study of crystal structure by diffraction methods, Bragg's condition for crystal diffraction. 5 Lecture

Unit 2. **Bonding and crystal imperfections:** Classification of Solids, Bonding in Solids, Classification of Imperfections, Point Defect or Imperfection, Line Imperfection, Dislocation, Surface Defect or Planar Defect, Volume Defect or Bulk Defect, Stoichiometry, Nonstoichiometry and defect structures. 5 Lecture

Unit 3. **Electron Theory of Solids:** Electrical Conduction, Classification of conducting Materials, Classical Free Electron or Drude – Lorentz Theory of metals, Expression for Electrical Conductivity and Drift Velocity, Thermal Conductivity, Wiedemann-Franz Law, Verification of Ohm's Law, Classical Free Electron Theory: Advantage and Drawbacks. 6 Lecture

Unit 4. **Band Theory of Solids:** Origin of Energy Gap, Kronig-Penney Model, Brillouin Zone, Explanation of Band Gap, Effective Mass of an Electron, Concept of Hole, High Resistivity

Materials. Solid solutions and two phase solids, Phase diagrams of Cu-Ni and other isomorphous alloy. 5 Lecture

Unit 5. **Magnetic and Dielectric properties of materials:** Magnetic parameters, Classification of Magnetic materials, Importance of Dipole moments in classification of magnetic materials, Origin of Ferromagnetism and hysteresis loop, Magnetic domains, Magnetostriction, Soft and Hard Magnetic Materials and their Applications. Magnetic anisotropy, Antiferro- & ferrimagnetism materials. Ferrites and its applications, Dielectrics: Types of polarization, Frequency and temperature dependence of polarization. Dielectric loss, dielectric breakdown, uses of dielectric materials (capacitor and transformer), ferroelectricity, piezoelectricity and their applications. 6 Lecture

Unit 6. **Semiconducting and Superconducting Materials:** Conductivity of semiconductors, intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, elemental and compound semiconductors, Direct and indirect band gap semiconductors, Hall effect, Variation of electrical conductivity with temperature, Variation of Fermi level with temperature. Superconductivity, General properties of superconducting materials, Types of superconductors, Thermodynamic properties of superconductors, London equations, BCS theory, applications of superconductors. (6 Lecture)

Unit 7. **Advanced ceramics and composites materials:** Their classification, structure, processing, properties and applications. (4 Lecture)

Unit 8. **Nanophase materials:** Basic principles of nanoscience and nanotechnology, Types of nanomaterials, Synthesis of Nanostructured Materials, Top-Down and Bottom-up Process, Nanotechnology and environment, Properties and possible applications to nanodevices (4 Lecture)

Suggested readings:

1. V. Raghavan, Materials Science and Engineering, Prentice-Hall of India Private Limited (2003).
2. W.F. Smith, Principles of Materials Science and Engineering, McGraw Hill, New York (1994).
3. W.D.Callister, An Introduction to Materials Science & Engineering, John Wiley & Sons (2007).
4. L.H. Van Vlack, Elements of Materials Science and Engineering, Addison Wisley, New York (1985).
5. D. W. Richerson, Modern Ceramic Engineering.

PH103A Material Science & Technology

(Revised Syllabus with effect from 2015-16 for B. Tech CSE, ECE, EE and IT)

L-T-P-Cr: 3-0-0-3

Pre-requisite:- Basic Knowledge of physics is required.

Expected Outcome: - Students will able to understand the basic structure of materials and their applications in various field of science and technology.

Syllabus:

GROUP - A

Unit 1. **Atomic bonding in solids and Crystallography:** Types of bonding, Classification of solids: Crystalline and amorphous solids, Space lattice and unit cell, Crystal systems, Primitive and Non-primitive lattices, Bravais lattices, Close-Packing of spheres, Miller Indices, Introduction to Point and Space groups, Reciprocal lattice concept, Structure by diffraction methods, Bragg's condition for crystal diffraction, Imperfections in Crystals: Point, Line, Surface and Volume defect.

Unit 2. **Phase diagram:** Basic concepts, Solubility limit, Unary and binary phase diagrams, Fe-C and Cu-Ni phase diagrams and other isomorphous alloys.

Unit 3. **Mechanical properties of Materials:** Concept of stress and strain, Elastic and plastic deformation, Hardness, Creep, Brittle fracture in ceramics and glasses, Toughening of ceramics and composites, Fatigue, Mechanical testing.

Unit 4. **Electrical properties of materials:** Electrical Conduction, Classification of conducting Materials, Energy bands, Temperature dependence of metallic conductivity, Semiconductor materials: Intrinsic, Extrinsic, Compound and amorphous semiconductors, Electrical resistivity and Hall effect measurements, Dielectrics: Types of polarization, Frequency and temperature dependence of polarization, Dielectric loss, dielectric breakdown, uses of dielectric materials, ferroelectricity, piezoelectricity and Applications.

GROUP - B

Unit 5. **Magnetic properties of materials:** Basic concepts, Classification of Magnetic materials: dia-, para-, ferro-, antiferro- and ferri-magnetism, Influence of temperature on magnetic behavior, Magnetic domains and hysteresis loop, Magnetostriction, Soft and Hard Magnetic Materials and their Applications. Magnetic anisotropy, Ferrites and its applications, Superconductivity, General properties of superconducting materials, Types of superconductors, Thermodynamic properties of superconductors, BCS theory and applications of supercoductors.

Unit 6. **Thermal and Optical properties of materials**: Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Refraction, Transmission, Reflection, Absorption, Colour, Luminescence, Photoconductivity, Lasers, Optical fiber, and applications.

Unit 7. **Ceramics, Composites and Polymeric materials:** (i) Classification, Structure, Processing, Properties and applications of ceramics and composites, (ii) Polymer: Polymerization, Structure, Feature of polymers, Thermosetting and thermoplastic polymer, Additives and processing of polymer.

Unit 8. **Nano materials**: Basic principles, Types of nanomaterials, Synthesis: Top-Down and Bottom-up Process, Nanotechnology and environment, Properties and possible applications to nano-devices.

Recommended books:

1. V. Raghavan, Materials Science and Engineering, Prentice-Hall of India Private Limited (2003).
2. W.F. Smith, Principles of Materials Science and Engineering, McGraw Hill, New York (1994).

3. W.D.Callister, An Introduction to Materials Science & Engineering, John Wiley & Sons (2007).
4. L.H. Van Vlack, Elements of Materials Science and Engineering, Addison Wisley, New York (1985).
5. J.F. Shackelford and M.K. Muralidhara, Introduction to Materials Science for engineers, Pearson Education (2007) .

PH104 Materials science & Technology (Civil Engg)

(Revised Syllabus with effect from 2015-16 for B. Tech Civil Engg)

L-T-P-Cr: 3-0-0-3

Pre requisite : No pre requisite subject is required.

Expected Outcome: - Students should have acquired sound knowledge of building material and their application in building construction.

Syllabus

Part A

Unit 1. **Mechanical properties of Materials:** Concept of stress and strain, Elastic and plastic deformation, Hardness, Creep, Brittle fracture in ceramics and glasses, Toughening of ceramics and composites, Fatigue, Mechanical testing. 6 Lectures

Unit 2. **Thermal and Optical properties of materials**: Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Refraction, Transmission, Reflection, Absorption, Colour, Luminescence, Photoconductivity, Lasers, Optical fiber, and applications. 5 Lectures

Unit 3. **Ceramics, Composites and Polymeric materials:** (i) Classification, Structure, Processing, Properties and applications of ceramics and composites, (ii) Polymer: Polymerization, Structure, Feature of polymers, Thermosetting and thermoplastic polymer, Additives and processing of polymer. 5 Lectures

Unit 4. **Nano materials**: Basic principles, Types of nanomaterials, Synthesis: Top-Down and Bottom-up Process, Nanotechnology and environment, Properties and possible applications to nano-devices. 5 Lectures

Part B

UNIT 5. (Introduction to Building Materials) **6** Lectures

1. Natural materials : Their properties , forms and availability , defects , strength, limitation and utility.
2. Clay and Clay products, Terracotta, Roof tiles
3. Bricks – Types and their classification, Methods of manufacturing, physical and chemical properties and tests.
4. Building stones – Types of Building stone, their properties and application.
5. Timber and Timber products – Different types of timber , seasoning and preservation, properties and application; processed timber.

UNIT 6. (Hybrid Building Materials) **5** Lectures

1. Cement : Types of cement, physical and chemical properties and tests.
2. Mortars – Definition, types of mortar (Cement and Lime), Ingredients.
3. Concrete: Ingredients, types of concrete, methods of mix proportioning, cast- in-situ concrete, Pre-cast, Ferro fibre and pre-stressed concrete.

4. Ceramic materials and products

Unit 7. (Ferrous and Nonferrous Building Materials) 5 Lectures

1. Ferrous Metals- pig iron, cast iron , mild steel, HYSD reinforcing rods, and stainless steel
2. Nonferrous Metals – Aluminium, copper , lead etc, their properties and applications.

Unit 8. (Miscellaneous Building Materials) **5** Lectures

1. Glass : Type of glass , ingredients and manufacturing of glass, properties of glass for building purposes and structural uses.
2. Paints , Varnishes and Distemper
3. Modern and Advanced Building Materials: - polymer materials, Fibre reinforced plastics, ready to use building materials, etc. .

Recommended books:

1. V. Raghavan, Materials Science and Engineering, Prentice-Hall of India Private Limited (2003).
2. W.F. Smith, Principles of Materials Science and Engineering, McGraw Hill, New York (1994).
3. W.D.Callister, An Introduction to Materials Science & Engineering, John Wiley & Sons (2007).
4. L.H. Van Vlack, Elements of Materials Science and Engineering, Addison Wisley, New York (1985).
5. J.F. Shackelford and M.K. Muralidhara, Introduction to Materials Science for engineers, Pearson Education (2007).
6. Civil Engineering Materials by N Jackson and R K Dhir, ELBS.
7. Civil Engineering Materialsby TTTI Chandigarh.
8. Text book of building construction by S P Bindra and Arora.
9. Materials and Methods in Architecture by S Kumar.
10. Building materials: S C Rangwala by Charotar Publishing House, Ananad, 1993.
11. Architectural Material Science by D Airapetob.
12. Construction material by Ghosh

PH109: Materials Science & Technology (Mech. Engg)

(Revised Syllabus with effect from 2015-16 for B. Tech Mech Engg)

L-T-P-Cr: 3-0-0-3

Part A

UNIT-1 **Atomic bonding in solids and Crystallography:** Types of bonding, Classification of solids: Crystalline and amorphous solids, Space lattice and unit cell, Crystal systems, Primitive and Non-primitive lattices, Bravais lattices, Close-Packing of spheres, Miller Indices, Introduction to Point and Space groups, Reciprocal lattice concept, Structure by diffraction methods, Bragg's condition for crystal diffraction, Imperfections in Crystals: Point, Line, Surface and Volume defect. 6 Lectures

UNIT-2 **Mechanical properties of Materials:** Concept of stress and strain, Elastic and plastic deformation, Hardness, Creep, Brittle fracture in ceramics and glasses, Toughening of ceramics and composites, Fatigue, Mechanical testing. 5 Lectures

UNIT-3 **Thermal and Optical properties of materials**: Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Refraction, Transmission, Reflection, Absorption, Colour, Luminescence, Photoconductivity, Lasers, Optical fiber, and applications. 5 Lectures

UNIT-4 **Nano materials**: Basic principles, Types of nanomaterials, Synthesis: Top-Down and Bottom-up Process, Nanotechnology and environment, Properties and possible applications to nano-devices. 5 Lectures

Part B

UNIT-5 Introduction, Solid Engineering Materials- their classification and characteristic properties, Atomic Structure and Interatomic Bonding; Crystallography: crystal systems, notations for lattice directions and planes, symmetry elements, common crystal structures, interstitial sites. 5 Lectures

UNIT-6 Defects in Materials: point, line and surface defects, strengthening mechanisms. Mechanical Properties: Fundamentals of plastic deformation of metals, deformation by slip and twin, plastic deformation in polycrystalline metals, concept of cold working, preferred orientation, tensile strength, stress-strain relation, hardness, impact, fatigue, creep, fracture; Annealing: cold worked structure, recovery, recrystallization and grain growth. 6 Lectures

UNIT-7 Solidification: nucleation and growth, structure of cast metals, rapid solidification processing; Concept of formation of alloys: Types of alloys, solid solutions, factors affecting solid solubility, order disorder transformation. Phase Diagrams: various binary phase diagrams, Fe-Fe_3C diagram, introduction to ternary phase diagrams; Introduction to Solid State Phase Transformations: diffusion, classification of phase transformations, martensitic and bainitic transformations, precipitation. 6 Lectures

UNIT-8 Introduction to Heat Treatment of Steels: TTT and CCT diagrams, basic heat treatments; annealing, normalizing, hardening and tempering; microstructural effects brought about by these processes and their influence on mechanical properties. Effect of common alloying elements in steel. 5 Lectures

Recommended books:

1. V. Raghavan, Materials Science and Engineering, Prentice-Hall of India Private Limited (2003).
2. W.F. Smith, Principles of Materials Science and Engineering, McGraw Hill, New York (1994).
3. W.D.Callister, An Introduction to Materials Science & Engineering, John Wiley & Sons (2007).
4. L.H. Van Vlack, Elements of Materials Science and Engineering, Addison Wisley, New York (1985).
5. J.F. Shackelford and M.K. Muralidhara, Introduction to Materials Science for engineers, Pearson Education (2007) .

Department of Humanities & Social Sciences

The primary objective kept in mind while preparing and recommending the course structure detailed in the successive paragraphs is as follows:

1. English literature is being offered to students having a fair knowledge of English and a study of literature will enhance their flair in written and verbal expression.
2. Remedial English is being offered to students weak in language who will benefit in their language skill since the syllabus is supported by the language Lab.
3. Communication skill development and technical writing is aimed at providing the students with language wherewithal which is an inescapable tool for the young technocrats to break the geographical boundaries and step into the global village.
4. Science, Society & Ethical values. Keeping in view the present day scenario an urgent need to introduce this subject as part of the class room curriculum was felt and hence included in the syllabus. The aim is to inculcate the right values during the period that a youngster is preparing to step into the professional world and still in the process of understanding the society and the relevance of science in the right perspective.
5. Sociology & Building economics for the students of architecture in the 5th semester aims at developing the understanding of the people who form the society and their sociological needs, the surroundings and the habitat, the geographical area and the economics involved in the architectural endeavours.

HS101 English Literature

L-T-P-Cr: 2-1-0-3

The primary objective of the English literature Course which is being offered to students having a fair knowledge of English and a study of literature will enhance their flair in written and verbal expression.

The recommended any one novels will be covered as described below: 28 Lectures

1. Oliver Twist – Charles Dickens

(a) Discussion of the Victorian age in English fiction and the role of Charles Dickens as a novelist during this period.
(b) Introduction to Charles Dickens – his life and works.
(c) Oliver Twist as a criticism of the industrial Age.
(d) Oliver Twist as an analysis of Victorian poverty and condition of children.
(e) Discussion of the Art of Plot and Characterization.

2. **Julius Caesar – William Shakespeare**

(a) Introduction to the author.
(b) A discussion of the socio political structure of the 20th century Europe up to the rise of Communism and World War 2.
(c) Animal Farm as a political satire.
(d) Satire and Fable.
(e) Animal Farm as a fusion of Political purpose and artistic vision of the author.

3. **Julius Caesar – William Shakespeare**

(a) Life of Shakespeare.

(b) Shakespeare as a Dramatist.
(c) Synopsis of the play.
(d) Justification of the title of the play.
(e) Theme of the play.
(f) Fate as the Hero of "Julius Caesar".
(g) Superstitions in Julius Caesar.
(h) Caesar as a Marlowean Hero.
(i) Characters: Julius Caesar, Mark Antony, Marcus Brutus, Cassio.
(j) Shakespeare's conception of tragedy.

4. **Macbeth – William Shakespeare**

(a) Introduction to William Shakespeare and Historical introduction to Elizabethan and Jacobean periods.
(b) The play as a tragedy.
(c) Definition of tragedy as in Aristotle and its application to Elizabethan tragedies.
(d) Analysis of its plot structure.
(e) Analysis of major characters such as Macbeth, Lady Macbeth and Banquo.
(f) The Elements of supernatural in the play Macbeth.
(g) The role of the Witches in the play.
(h) An analysis of figures of speech, poetic imagery and various dramatic conventions in the play.

Text book (Novel)

1. Oliver Twist – Charles Dickens
2. Animal farm – George Orwell
3. Julius Caesar – William Shakespeare
4. Macbeth – William Shakespeare

HS102 Communication skill development and Technical Writing

L-T-P-Cr: 0-1-3-2

The primary objective of Course which is being offered to students is for Communication skill development and technical writing. The course is aimed at providing the students with language wherewithal which is an inescapable tool for the young technocrats to break the geographical boundaries and step into the global village.

1. Communicative: What is Communication? 9 Lectures

Theory: Importance of Communication:

Process of Communication:

(i) Verbal
(ii) Non-verbal

Practical:

(a) How to face an interview
(b) Group Discussion
(c) How should the Interviewer Plan & conduct the Interview.
(d) Body Language & Gesture
(e) Eye Contact
(f) Appearance

2. Listening: Its importance & Barriers to listening 12 Lectures

Theory:

(a) Listening
(b) Developing Reading Skills
(c) Developing Conversational skills

English in Formal situations

(i) Interview
(ii) At the Bank
(iii) At the Airport
(iv) At the police station
(v) Customer Care
(vi) At the Embassy

English in informal Situations

(i) At a dinner party
(ii) Booking a room at a hotel
(iii) At a travel agency
(iv) At the hospital
(v) Ask for a opinion

3. Technical Writing 3 Lectures

Suggested Readings:

1. Sreevalsan, MC; Spoken English, Vikash Publishing House, New Delhi.
2. Communication Skills; Sanjay Kumar, Pushphate, Oxford.
3. English for Engineers & Technologists, Orient Blackswan, ELT.
4. Krishna Mohan & N P Singh Speaking English Effectively.
5. Krishna Mohan, Meera Banarjee, Developing Communication Skills.
6. Frank O' Connor, Phonetics, Pengiun.
7. Business Correspondence & Report Writing- Sharma & Krishna Mohan- Tata Mgraw.

Reference Books:

1. Sardanand K, Teaching, Listening & Speaking (With Audio CD), Orient Blackswan, Hyderabad.

HS103 Remedial English

L-T-P-Cr: 2-0-0-2

The primary objective of the Course detailed for Remedial English is being offered to students weak in language who will benefit in their language skill since the syllabus is supported by the language Lab.

1. Basic Grammar - Structural Pattern 6 Lectures

(a) Articles
(b) Verbs: Auxiliaries, Finite & Non Finites.
(c) Time and Tense
(d) Subject: Verb Agreement (concord).
(e) Active & Passive Voice.
(f) Narration

2. (i) Single word / verb substitution 6 Lectures

(ii) Editing

3. Common Error, Comparison 3 Lectures

4. Antonym, homonym, Sentence, Building (Vocabulary) 5 Lectures

5. Précis, Essay, Paragraph Writing & Comprehension 4 Lectures

6. Official Correspondence, Memorandum; Circular Letter 4 Lectures

Text Books:

1. English Grammar- N.D. Turton, ABC of Common Grammatical Error for learners & Teachers.
2. English Grammar- Dr. D. Thakur
3. English Grammar- Dr. K.K. Ramchandran etal; business Communication.
4. Technical English- Sharon j Gerson and Steven M Gerson
5. Angela Burt, Quick Solutions to common Error in English.
6. W. Foulsham, The Complete letter writer.
7. John East wood- Oxford guide to English Grammar.

Suggested Readings:

1. Communication in English for Technical Student- Orient Longman.
2. G. Nagroj, English Language Teaching.
3. N. Saraswati, English language Teaching; principles & practices.
4. English for Engineers- Orient Blackswan

HS104 Language Lab

L-T-P-Cr: 0-0-3-1

The primary objective of the Course detailed for Remedial English is being offered to students weak in language who will benefit in their language skill since the syllabus is supported by the language Lab.

(i) Phonetics: 10 Lectures

- (a) Sound of English (Vowels, short, Vowels, Long Vowels & consonants)
- (b) Stress, Rythm, Pitch & Intonation, Accent.

(ii) English in formal situation 4 Lectures

- (a) Greetings
- (b) Making a Telephone Call
- (c) Making apology
- (d) At college

(iii) English in formal situation 4 Lectures

- (a) At the Doctor's
- (b) Outside the class
- (c) Introducing self and other

HS105 Science Society and Ethical Values

L-T-P-Cr: 1-1-0-2

The primary objective of the Course detailed in the successive paragraphs for Science, Society & Ethical values is keeping in view the present day scenario an urgent need to introduce this subject as part of the class room curriculum was felt and hence included in the syllabus. The aim is to inculcate the right values during the period that a youngster is preparing to step into the professional world and still in the process of understanding the society and the relevance of science in the right perspective

Professional Ethics: Aim of Professionals, Responsibilities of Professionals, Right of Professionals, Impediments to responsibilities, Honesty, Integrity, Reliability, Risk, Safety and Liability, Global Issues.

Personal Ethics: Value of Self, Others and Society, Compliance with law, Social Norms.

Service to Community, Corruption, Indian and Western Culture, Simple living and high thinking, Science and Spirituality.

Suggested Readings:

1. Charles E. Harris et al, Engineering Ethics, Cengage, 2009
2. N. N. Das, Ethical Considerations.
3. R. Subramaniam, Professional Ethics Oxford University Press

HS106 Sociology and Building Economics

L-T-P-Cr: 3-0-0-3

1. Definition and use of sociology, its application in architecture 2 Lectures
2. Basic concept of sociology, society, groups, community, association, institution, culture, civilization and personality in terms of their characteristics and types. 5 Lectures
3. Social structure of India: caste and class and marriage and family, their characteristics. 5 Lectures
4. Rural and Urban Societies – their characteristics, features and problems, like crime, slum and poverty. . 4 Lectures
5. Social change – Biological, Technological and cultural factors of social change, social aspects of housing and neighbourhood in the context of changing society and growing population. . 4 Lectures
6. Elements of Economics – concept of utility, total utility and average utility, law of equi – marginal utility, concept of demand factors of governing demand for building. 4 Lectures
7. Production – concept of production, factors of production, land, labour, capital, entrepreneur and organization. Their characteristics, laws of diminishing returns, division of labour, efficiency of labour. . 5 Lectures
8. Distribution of National income – Rent, wages, interest and profits – inequalities in income distribution – causes and courses, role of demand supply in the determination of price and under perfect condition. . 5 Lectures

9. Money and Banking – Function of money – Inflation and Deflation, and their effects on building industry, functions of central and commercial bank. 5 Lectures

10. Concept of economic Planning, objectives of the five years plans with special reference of housing. . 3 Lectures

Text Books:

1. H.L. Ahuja – Modern Micro Economics Theory – S.Chand.
2. M.L. Jhingan – Advance Economics Theory – Konark Publication
3. Economics – Samuelson and Nordhous – Tata McGraw Hills

Reference Books:

1. Stonier & Hague – A textbook of Economic Theory – Pearson

HSS Elective courses (4th & 7th semester)

Course Code	Course Title	L	T	P	Credit
HS107	Industrial Economics and Financial Management	3	0	0	3
HS108	Innovation, Entrepreneurship & IPR	3	0	0	3
HS109	Organisational Behaviour and industrial psychology	3	0	0	3
HS110	History of science and technology	3	0	0	3
HS111	Economics and its impact on industrial technology	3	0	0	3
HS112	Foreign Language	3	0	0	3

The Elective course structure has been recommended keeping in mind the need of understanding the fundamentals of subjects which are indirectly but deeply related to the practitioner of science and technology.

The objective of each elective is as follows:

1. Industrial Economics and financial management. The impact of Economics including finance has to be well understood by the engineers since it has a deep impact on the decision making ability of an engineer and also in selecting the best possible alternative out of the ones available to him. The student must understand micro and macro-economic and their variants to understand the production and cost indicator like breakeven point, depreciation, inflation etc.

2. For any developing country, innovation, entrepreneurship and intellectual property rights hold the key to the entry in the league of developed countries. Equipped with the scientific knowledge and the right training, the engineer is an important building block of a nation.

3. Understanding of organisational behaviour and industrial psychology is a must for an engineer since it directly affects the industry in the larger sense. The functioning of an organisation right from the floor to the top management level has to be understood well from the OBIP perspective in order to make a positive contribution to the growth of the organisation.

4. Economics and its impact on science and technology have to be well understood by the engineers to ensure success of any technological venture.

5. To understand the growth process of any discipline one has to be conversant with the history of the subject which has been recorded. One is able to appreciate the various factors that have influenced and inspired the growth of science and technology. We reflect on giants like Newton, Einstein, Edison, Vishveshwarya, and JC Bose etal.

HS107 Industrial Economics and Financial Management

L-T-P-Cr: 3-0-0-3

1. Various Definition of Economics, Nature of Economics problem, relation between science, engineering, technology & economics 3 Lectures
2. Meaning of demand, law of demand, elasticity of demand, practical importance & applications of the concept of elasticity of demand. 5 Lectures
3. Meaning of production and factor of production – Land, Labour, Capital, Entrepreneur & organizations – their characteristics, law of variable proportion, return to scale. 5 Lectures
4. Cost Analysis-various concept of cost, cost function, short & long run cost, concept of revenue, break-even analysis. 6 Lectures
5. Meaning of market-type of market-perfect competition, Monopoly, Oligopoly, Monopolistic competition (Main feature of these market) Meaning of supply and law of supply; Role of demand & supply in price determination imperfect competition. 7 Lectures
6. Economy: 6 Lectures
    (a) Simple and compound interest, Annuities
    (b) Basic methods for making economy studies:
        (i) Present worth method
        (ii) Future worth method
        (iii) I.R.R. Method
    (c) Comparison of alternative:
        (i) Present worth method
        (ii) Future worth method
        (iii) I.R.R. method
7. National Income – Definition, Methods of calculation and deflation, concept of national income, gross national product, net national product, genuine progress index (GPI), exposure to econometric models. 4 Lectures
8. Financial management: Financial management, accounting concepts. Financial statement analysis. Financial investment analysis. Financial decisions. Managing components of working capital investment & financing decisions. 6 Lectures

Text Books:

1. Modern micro economic theory – H.L. Ahuja, S.Chand.
2. Advance economic theory – M.L. Jhingan, Konark publication.
3. Engineering economics – Sullivan, Wicks, Koelling – Pearsons.
4. Macroeconomics – M.L. Jhingan.
5. Financial management by Rajiv shrivastava and Anil Mishra – Oxford publication

Reference book:

1. Stonier & Hague – A text book of economic theory, Pearson.
2. Industrial organisation and engineering economics – Banga & sharma.

HS108 Innovation, Entrepreneurship & IPR

L-T-P-Cr: 3-0-0-3

Unit 1. **Innovation:** Basic concept 4 Lectures

Unit 2. **Entrepreneurship:** Definition of Entrepreneur, function of an entrepreneur, entrepreneurial motivation and barriers, classification of entrepreneurship, theory of entrepreneurship, concept of entrepreneurship, development of entrepreneurship. 7 Lectures

Unit 3. Creativity and Entrepreneurial plan, idea generation, project identification, feasibility analysis, economic, marketing, financial and technical, project planning, evaluation, monitoring and control segmentation, creative problem solving, innovation. 7 Lectures

Unit 4. The Nature of international entrepreneurship, international versus domestic entrepreneurship, stages of economic development. Institutional support for new ventures: Supporting organizations, incentives and facilities, financial institutions and micro, small and medium enterprises, Govt. policies for MSMEs. 7 Lectures

Unit 5. Family and non-family entrepreneur: Role of professionals, professionalism vs. family entrepreneurs, role of woman entrepreneur. Venture capital: Venture capital, nature and overview, venture capital process. 7 Lectures

Unit 6. **Intellectual Property Right (IPR)** 10 Lecture

i. Introduction to intellectual property, copyright, related rights, trademarks, patents, unfair competition, protecting new varieties plants.

ii. WIPO hand book/ notes

iii. Law relating to patents, trademarks, copyright design & geographical indication,

iv. Profiting from intellectual capital: extracting value from innovation

v. Intellectual property right, the WTO and developing countries: the TRIPS agreement and policy options.

Suggested Readings:

1. Cougher, C-Creativity and innovation (IPP, 1999)
2. Niha Jacob, creativity in organizations (wheeler, 1998)
3. Jonne&Ceserani – innovation & creativity (crest, 2001)
4. Holt – Entrepreneurship: New venture creation (Prentice hall, 1998)
5. Dollinger M J – Entrepreneurship (Prentice Hall, 1999)
6. Wadehra B.L. Law relating to patents, trademarks, copyright design & geographical indication, universal law pub. 2000.
7. Sullivan & Patrick H, Profiting from intellectual capital: extracting value from innovation, John wily, 1998.
8. Correa, Carlos M., Intellectual property right, the WTO and developing countries: the TRIPS agreement and policy options, Zed books, New york 2000.

HS109 Organizational Behaviour & Industrial Psychology

L-T-P-Cr: 3-0-0-3

1. Concept of organization & organizational behaviour. 4 Lectures

2. Personality: Meaning, concept, determinants, personality theories (psychoanalytic theory, trait theory and self-theory) 11 Lectures
   (a) Perception: Meaning, concept, process of perception, significance of perception.
   (b) Leaning: meaning, concept, nature, component of learning process.
   (c) Attitude: Meaning, concept, factors in attitude formation, method of finding employee's attitude.
   (d) Value: Meaning and types, value and attitude – similarity and difference.
   (e) Motivation: Meaning, theories of motivation (Maslow's theory & Herzberg's theory), Hawthorne experiment
3. Group & group dynamics: Concept, importance, classification of groups, reason for group formation, group cohesiveness.
4. Team work: Meaning, concept, types, creating an effective team. 3 Lectures
5. Communication: 8 Lectures
   (a) Concept, process, importance, barrier
   (b) Organizational conflict: Meaning, concept, types, stages of conflict, resolution of conflict.
   (c) Power & Politics: Nature and concept, ethics of power and politics, types of power.
   (d) Leadership: Concept, Qualities and functions of a leader, approaches to the analysis of leadership
6. Concept of Organization theory, Concept of Organization structure, form of Organizational Structure. 6 Lectures
7. Concept of Organizational culture. 2 Lectures
8. Organizational effectiveness 6 Lectures
   (a) Concept, approaches, criteria of effectiveness.
   (b) Organizational Change: Meaning, factors in organizational change, process of planned Change.
   (c) Organizational development: Concept, Need of organizational development, difference between organizations development & management development
9. Gender at the workplace: problems and solutions. 2 Lectures

Text Books:

1. Organizational Behaviour – Stephen P. Robbin & SeemaSanghi – Pearson.
2. Organizational Behaviour – L.M. Prasad, S. Chand & son.

Reference Books:

Organizational Behaviour – Managing people and organization, Gregory Moorhead, Biztantra

HS110 History of Science & Technology

L-T-P-Cr: 3-0-0-3

1. The History of science & technology introduction, beginning of science, technology & engineering, traveling through the ages. 5 Lectures
2. Science, Engineering & technology Major: Introduction, function, emerging field. 5 Lectures
3. Profile of Engineers, scientist & technologist. 5 Lectures
4. Statistical profile of science & engineering profession: Statistical, overview, college enrolment trends of science and engineering students, college majors of recent science & engineering

students. Job placement trends, diversity of profession distribution of scientist and engineers by type of employer. 6 Lectures

5. Succeeding in the classroom: Introduction, attitude, goal, key to effectiveness, test taking, learning style, accountability and overcoming challenges. 6 Lectures
6. Problem solving: Introduction, analytical and creative problem solving, analytical problem solving, personal problem solving styles, brainstorming strategies, critical thinking 6 Lectures
7. Biography of Isaac Newton, Einstein, Thomas Edison, Alfred Nobel, M. Visvesvaraya . 5 Lectures
8. Failure of science & technology. 4 Lectures

Text Books:

1. Engineering your future by William C. Oaks, Oxford university press.

HS111 Economics and its impact on industrial technology

2. **L-T-P-Cr:** 3-0-0-3

Syllabus Under Preparation

HS112 Foreign Language

1. **L-T-P-Cr:** 3-0-0-3

Syllabus Under Prepartion

xCE101 Engineering Mechanics

L-T-P-Cr: 3-1-0-4

Module -I

1. **Statics**: Force systems: Moment of a force about a point and about an axis; Equivalent forces and moment, Wrench. [**6 Lectures]**
2. **Equilibrium:** Free body diagram; equations of equilibrium; problems in two and three dimensions; Supports and reactions [**3 Lectures]**
3. Method of sections for evaluating internal forces in bodies; axial force, shear and bending moment diagrams: [**3 Lectures]**
4. Trusses and frames [**3 Lectures]**

Module –II

5. **Friction:** Laws of Coulomb friction, impending motion problems involving large and small contact surfaces [**3 Lectures]**
6. Principle of virtual work [**3 Lectures]**

Module - III

7. **Dynamics:** Kinematics and Kinetics of particles: Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables. [**4 Lectures]**
8. Kinematics and Kinetics of rigid bodies: Chasle's Theorem; General Plane motion; D' Alembert's Principal, Work & Energy and Impulse Momentum methods, Impact. [**6 Lectures]**

Module - IV

9. Simple Stress and Strain, Hook's Law [2 Lectures]
10. Analysis of stresses, Equilibrium Equations, Generalized Hook's Law, Elastic constants [3 Lectures]
11. Analysis of strains, Normal and Shear Strains, Volumetric Strain [3 Lectures]
12. Axially loaded members [3 Lectures]

Suggested Readings:

1. Shames, Engineering Mechanics Pearson's Education.
2. Beer, F.P. and Johnston, Mechanics for Engineers, Tata McGraw Hill, New Delhi
3. Meriam, Engineering Mechanics, Wiley Pub.
2. R .C. Hibbler, Engineering Mechanics,
3. Timoshenko and Gere, Mechanics of Solids, McGraw Hill Inc
4. E.P. Popov, Mechanics of Solids, Pearson Education pub.
5. Engineering Mechanics, Timoshenko, McGraw Hill Inc**.**

4CH104A Green Technologies (Environmental Science)

L-T-P-Cr: 3-0-0-3

Objective:

To impart knowledge and Awareness among the student about the Environmental Pollution, introduction about the various resources and sustainable development. Understanding about the ecology, biodiversity.

Theory:

1. Definition, scope and importance of Environmental Studies, Need for public awareness. **2 Lectures**

2. Environmental Pollution (water, air, noise etc): Definition, Causes, effects and control measures. **7 Lectures**
3. Solid waste management **2 Lectures**
4. Natural resources and associated problems. Renewable and Non-renewable energy resources**.** **2 Lectures**
5. Concept of an ecosystem: Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains and ecological pyramids. **4 Lectures**
6. Biodiversity and Its Conservation. **3 Lectures**
7. Social Issues and Environmental ethics **3 Lectures**
8. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, disaster management. **6 Lectures**
9. Wasteland reclamation. **2 Lectures**
10. Consumerism and waste products. **1 Lectures**
11. Acts related to Environment Protection, Issues involved in enforcement of environmental legislation. **3 Lectures**
12. Human Population and the Environment. **2 Lectures**
13. Field work equal to 5 Lecture hours. **5 Lectures**

Suggested Readings:

1. Introduction to Environmental Engineering and Science, G.M. Masters, Pearson Education.
2. R. Rajagopalan, Environmental Studies, Oxford IBH Pub, 2011.
3. Benny Joseph, Environmental Studies, McGraw Hill Pub, 2008.
4. ErachBharucha, Text Book for Environmental Studies, Pub., UGC, 2004.
5. Environmental Science by Botkin Keller, Eight edition Wiley publisher

End Semester Examination:

The end semester examination will be of a predetermined duration covering the entire syllabus covering both theoretical upon the instructor's discretion where all questions will need to be answered.

Expected Outcome:

The students would be able to understand how to stop the degradation of environment, and way of utilization of the resources so that environment may develop in sustainable way.

3CE105 Fluid Mechanics & Hydraulics (Core)

L-T-P-Cr: 3-1-0-4

Objective: To impart knowledge and skill of experimental fluid properties, basic and empirical equations of fluid mechanics pertaining to both statics and dynamics.

Theory:

1. **Introduction:** Fluid properties- density, viscosity, compressibility, ideal and real fluids.

2 Lecture

2. **Hydrostatics:** fluid force on plane and curved surfaces, manometry, buoyancy, uniformly accelerated motion. **4 Lectures**
3. **Kinematics of fluid flow:** Stream Lines, Pathlines, Streaklines; Eularian and Lagrangian Concepts; Irrotational motion; Stream and Potential Functions, Flow Nets and solution to Laplace equation. **5 Lectures**
4. **Dynamics of fluid flow:** Control Volume Concepts, Euler and Bernouli's theorem and various applications like pitot tube, venturimeter, orifice meter, notches and weirs etc; Impulse momentum theory and applications. **7 Lectures**
5. Introduction to NavierStoke's Equation, Flow of fluids in closed conduits, Laminar flow of viscous incompressible fluids, Darcy-Weisbach equation, Major & minor losses in pipes, Moody's diagram Hardy-Cross method for pipe networks. 6 Lectures
6. **Dimensional Analysis.** **1 Lectures**
7. **Forces on immersed bodies:** concepts of separation, drag force, circulation and lift force. Dimensional Analysis, Model Similitude: Theory and application. **5 Lectures**
8. **Introduction to Turbulent Flow** **5 Lectures**
9. **Concepts of boundary layer flow:** Introduction, boundary layer growth over a flat plate, Boundary layer thickness, laminar boundary layer, turbulent boundary layer, transition from laminar to turbulent flow. **7 Lectures**

Text Books:

1. A. K. Jain, Fluid Mechanics.
2. Modi& Seth, Fluid Mechanics.
3. Garde and Mazumadar, Fluid Mechanics, Nemchand Bros, Roorkee.

Reference Books:

1. V. L. Streeter E.B. and Wylie, Fluid Mechanics, McGraw Hill.
2. Fox & McDonald, Fluid Mechanics, John Wiley.
3. Munson, Fluid Mechanics, John Wiley.
4. F. M. White, Fluid Mechanics, McGraw Hill Int. edition.
5. R. L. Dougherty, J.B. Franzini, E.J. Finnermore: Fluid Mechanics with Engineering Application, McGraw Hill International Edition.
6. I.H. Shames, Fluid Mechanics, PHI.

Expected Outcome:

Students will be able to understand fluid properties and define and solve experimental problems in fluid mechanics using the basic and empirical equations of fluid mechanics

3CE106 Fluid Mechanics & Hydraulics Lab (Core)

L-T-P-Cr: 0-0-3-1

Objective: To impart knowledge and skill of fluid mechanics pertaining to both fluid statics and fluid dynamics on experimental setups.

Practical*:

1. Viscosity
2. Metacentric height
3. Orifice Meter
4. Notches
5. Reynolds number, Flow Visualization
6. Impact of jet
7. Bernoulli's Apparatus

* depending upon the availability of the instrument/ apparatus.

Reference Books/Text Books:

1. Sarbjit Singh, Experiments in Fluid Mechanics, Eastern Economy Edition, PHI.
2. R.V. Raikar, Laboratory manual on Hydraulics and Hydraulic Machines, PHI.
3. V. L. Streeter E.B. and Wylie, Fluid Mechanics, McGraw Hill.
4. Fox & McDonald, Fluid Mechanics, John Wiley.
5. Fluid Mechanics Experimental Laboratory Manual by K.R. Arora, Standard Publishers and Distributors, NaiSarak, Delhi-6.

Expected Outcome: Students should be able to set up and perform experiments in fluid mechanics based upon basic concepts and empirical equations.

3CE107 Mechanics of Solid

L-T-P-Cr: 3-1-0-4

Theory:

1. Shear Force & Bending Moment Diagrams, Bending, Shear & Torsion Analysis of Beams and Circular Shaft of Various Cross-Sectional Shapes, Combined Torsion and Bending Moment Problems. **8 Lectures**
2. Deflection of Beams using Singularity Function, Direct Integration Method, Moment-Area Methods, Deflection due to Shear; Introduction to energy methods, Unsymmetrical Bending, Shear Centre. **12 Lectures**
3. Analysis of Stress, Stress Invariants, Basic Equilibrium Equations, and Generalized Hook's Law & Constitutive Laws of Materials, Elastic Constants and their relations, Transformation of Stresses, Principal Stresses and Principle Planes, Mohr's Circle.

Analysis of Strain Deformation, Strain Displacement Relations, Compatibility Equations and Boundary conditions, Strain Rosettes, Transformation of Strains, Strain Energy, Theories of Elastic Failure. **12 Lectures**

4. Plastic Analysis: Plastic Hinges and Shape Factor, Uniqueness, Upper Bound and Lower Bound Theorems; Calculation of Collapse Load for Beams and Simple Portal Frames.

   Columns and Struts - Stability of Columns, Euler's formula, Eccentric Loading, End Conditions And Effective Length, Practical Design formulae. **12 Lectures**

Text Books:

1. A.P. Boresi and O.M. Sidebottom Advanced Mechanics of Materials, Wiley, Singapore.

2. S.P. Timoshenko-Strength of Materials Vol. 2, CBS Publishers Delhi.
3. Plastic Design of Structures.
4. S.M.A. Kazimi, Solid Mechanics, Tata McGraw Hill, New Delhi.
5. E.P. Popov, Mechanics of Solids, Pearson Education Pub.
6. Ryder, G.H., Strength of Materials, Macmillan Press Ltd.
7. Timoshinko and Gere, Mechanics of Solids.
8. S.H. Crandall, N.C.Dahl and T.V. Lardner, Mechanics of Solids: An Introduction, McGraw Hill International and Tokyo.

3CE108 Surveying

L-T-P-Cr: 3-1-0-4

Objective: To impart knowledge and skill of surveying theories and practices.

Theory:

1. **Introduction:** Importance of Surveying, Types of surveying, Principle of surveying, Scales (Plain & Diagonal), Plan & Map, Shrinkage of maps, Mapping concepts, Map projections, Total station uses and applications **2 Lectures**
2. **Chain Surveying**: Purpose, Chaining accessories (chains, Tape, arrows, pegs, ranging rods, offset rods, plumb bob etc.), ranging and its type, error due to incorrect chain, chaining on uneven ground, errors in chaining, tape corrections, survey stations and lines, well-conditioned triangle, Basic problems in chaining, Obstacle in chaining, Field book entry, standard conventional symbols for different objects **5 Lectures**
3. **Compass:** Introduction and Purpose, Definitions: True meridian and true bearing, magnetic meridian and magnetic bearing, Prismatic compass and surveyor's compass, Designation of magnetic bearing (WCB & QB), Magnetic Declination, Isogonic and Agonic lines, Local attraction and its adjustment 4 Lectures
4. **Plane Table Surveying**: Equipment and uses, Principle of surveying, Methods of Plane Tabling, Closing error and its adjustment, Two point problem and three point problem **3 Lectures**
5. **Levelling:** Objects and use of levelling, Equipment, Types of levelling, Adjustment of dumpy level, Methods of leveling, Level book and computation, Missing data, Curvature and refraction correction, Reciprocal leveling. Contouring: Definition, Methods of contour survey and Plotting of contour **6 Lectures**
6. **Theodolites and Theodolite traversing**: Scope, Types, Temporary adjustment of transit theodolite, Measurement of horizontal angles, Errors and its elimination, Methods of traversing, Calculation of latitude and departure, Balancing of traverse: Gale's traverse table, Bowditch's method, Transit method, Graphical method and Axis method **6 Lectures**
7. **Tacheometric survey:** Instruments used in tacheometry, principles of tacheometry, determination of tachometry constants, methods of tacheometry: stadia method and tangential method, field work in tacheometry **4 Lectures**
8. **Curve**: Simple curve – scope, Degree of curve, characteristics, offset form tangent, offset from chord produced, Rankin's method, obstacles. Compound

and reverse curve – Introduction of cases. Transition curve – Combined curve, super elevation, length of transition curve, characteristics, equations, shift, tangent length and curve length of combined curve, computation for setting out of combined curve. Vertical curve – scope, assumption of vertical curve, equations, computation for setting out curve, summit and valley curve.

12 Lectures

Scheme of Examination:

Class test I/Assignment	:	5Marks
Class test II/Assignment	:	5Marks
Mid Semester Examination	:	20Marks
End Semester Examination	:	70 Marks

Text Books:

1. Surveying and Levelling by N.N.Basak, TMH Publication
2. Surveying by B.C. Punamia, A.K. Jain and A.K. Jain, Vol. 1, Laxmi Publications (P) Ltd., New Delhi
3. Textbook of Surveying by C.Venkatramaiah,University Press

Reference Books:

1. Surveying and levelling by T.P.Kanetkar and S. Kulkarni, Vol-I
2. Surveying by K.R. Arora, Standard Book House, Delhi
3. S.K.Duggal, Surveying, Vol-I, TMH Publications, New Delhi
4. A.M.Chandra,Higher Surveying, New age international Publications, Delhi.

Expected Outcome:

The students would be able to understand about chain surveying, compass traversing, leveling, theodolite and tachometric survey, plane tabling, total station and curves.

3CE109 Surveying Lab

L-T-P: 0-0-3 **Credits: 1**

Objective: The Surveying Laboratory enables students to understand the basic principles of surveying by conducting field exercises using surveying equipment.

Practical:

1. Chain Surveying
2. Compass Surveying
3. Leveling (Longitudinal Profile and Cross-sectional Profile)
4. Plane Table Survey
5. Theodolite Traversing
6. Layout of Building
7. Tachometry Survey
8. Total Station Survey
9. Layout of curves(simple circular curve/transition curve)

Scheme of Examination:

Class performance	:	15Marks

Lab Record : 15Marks
Internal Via-Voce : 10Marks
External Viva-Voce : 60 Marks

Text Books:

1. Surveying by B.C. Punamia, A.K. Jain and A.K. Jain, Vol. 1, Laxmi Publications (P) Ltd., New Delhi.
2. Surveying and Levelling by N.N.Basak, TMH Publication

Expected Outcome: The students would be able to handle surveying instruments and obtain an expertise that how conducts the survey work in the field.

4CE110 Design of Concrete Structures

L-T-P-Cr: 3-1-0-3

Theory:

1 Design principles, working stress method ,ultimate load method and limit state design method ,design load consideration as per Indian codes ,Design of singly reinforced, doubly reinforced & T-Beams ,Design for flexure ,shear, Bond and Torsion. **12 Lectures**

2 Design of one and two- way slabs,

3 Design of Axial, Uniaxial and Biaxial columns. **10 Lectures**

4 Isolated and combined footings staircase and design of retaining walls. Detailing considerations, bond anchorage, shear and curtailments**.** **10 Lectures**

5 Design of buildings frames for seismic loads, using approximate method of analysis and ductile detailing **10 Lectures**

Text Books:

1. N. Subramanian- Design of reinforced concrete structures, Oxford University press.
2. IS -456-2000 Code of Practise for plain and reinforced concrete.
3. P.Dayaratnam: Design of reinforced concrete structures, Oxford-IBM publications, NewDelhi.
4. S.N.Sinha :Reinforced concrete Design ,Tata Mcgraw hill New Delhi
5. IS – 102622-2009 Code of practise for mixing proportioning.
6. IS-456-2000 Code of practise for plain and reinforced concrete.

4CE111 Cement Concrete Lab.

L-T-P-Cr: 0-0-3-1

Practical:

1. Laboratory testing of cement –soundness test, consistency test, initial and final setting time compressive strength test, specific gravity
2. Laboratory testing of sand –sieve analysis, specific gravity
3. Laboratory testing of course aggregate –sieve analysis, specific gravity
4. Test of Bricks –Water absorption, Compressive strength , efflorescence
5. ix proportioning calculations for different working conditions
6. Mix proportioning calculations for different grades

7. Workability test: Slump and Compaction factor test with & without admixture
8. Compressive strength test for cubes

Text Books/IS-Codes:

1. IS-10262-2009 Code of Practice for Mix Proportioning
2. IS-456-2000 Code of Practice for Plain and Reinforced Concrete.

4CE112 Geotechnical Engineering –I

L-T-P-Cr:3-1-0-4

Prerequisite: A Pass grade or having attended at least 75% of the classes conducted or at least 60 % attendance and a minimum of 40% marks in the course (s) Earth Sciences / Earth & Climate Science.

Objective: To impart knowledge and skill for soil identification, classification other physical

Properties of soils, viz seepage, stress distribution, compaction and consolidation.

Theory:

1. Introduction, Origin and Classification of soils, Soil weight volume relationships, Index properties of soil, Soil Structures and Clay Minerals. **9 Lectures**
2. Effective stress principle, Surface Tension and Capillarity, Permeability of soils, Darcy's law, tests for determination of permeability, engineering use of permeability. **4 Lectures**
3. Seepage analysis, flow nets, flow through dams, filter design criteria **4 Lectures**
4. Effective stress concept in soils, Shear Strength of Soil, Engineering use of shear strength, Direct and triaxial shear tests, Mohr-Coulomb strength criterion, drained, consolidated undrained and undrained tests, strength of loose and dense sands, NC and OC soils, dilation, pore pressure and Skempton's pore pressure coefficients. 8 **Lectures**
5. Compressibility and consolidation 8 **Lectures**
6. Vertical stress below applied load in soils (Boussinesq, Westergaard, and graphical solutions), one and two-dimensional cases. Lectures
7. Compaction characteristics, water content - dry unit weight relationships, OMC, max. Dry unit weight, field compaction control. 4 Lectures
8. Soil Stabilization 1 Lecture

Text Books:

1. A Text Book of Soil Mechanics and Foundation Engineering - V.N.S. Murthy, Saikripa Technical Consultants, Bangalore.
2. Geotechnical Engineering - S. K. Gulatiet. al., TMH Publishing Co. Ltd, New Delhi.
3. Basic and Applied Soil Mechanics - GopalRanjan and A. S. R. Rao, Wiley Eastern Ltd, New Delhi.
4. Soil Mechanics and Foundation Engineering - K. R. Arora, Standard Pub. and Dist., Delhi.

Reference Books:

1. Soil Mechanics in Engineering Practice - Terzaghi and Peck, John Wiley and Sons Inc

New York.

2. Soil Mechanics- Lamb and Whitman, Wiley Eastern Pvt. Ltd, New Delhi.
3. Fundamentals of Soil Mechanics - Taylor, John Wiley and Sons Inc New York.

End Semester Examination (3 Hrs.):

The duration of the Examination will be 3 hrs. The questions will be comprehensive, i.e. from the entire unit, may have subsections with theory and numerical with approximately 50% weightage and may / may not have choices. Minimum five questions will have to be answered.

Expected Outcome:

The students would be able to identify, classify and determine physical properties of different types of soils.

4CE113 Geotechnical Engineering – I Lab

L-T-P-Cr: 0-0-3-1

Prerequisite:

A Pass grade or having attended at least 75% of the classes conducted or at least 60 % attendance and a minimum of 40% marks in the course(s) Earth Sciences/Earth & Climate Science.

Objective:

To impart knowledge and skill for soil identification, classification other physical Properties of soils, viz seepage, stress distribution, compaction and consolidation.

Practical:

1. Specific Gravity of Soils.
2. Field Density of soils.
3. Particle size distribution of soils by sieving.
4. Particle size distribution of soils by hydrometer method.
5. Determination of Atterberg's limits.
6. Permeability of soils using falling head method.
7. Permeability of soils using constant head method.
8. Consolidation Characteristics of soils.
9. Proctor's Compaction Test.
10. Direct Shear Test.
11. Unconfined Shear Test.
12. Tri-axial Shear Test.
13. Vane Shear Test.
14. Differential Swelling Test.

Books And Laboratory Mannuals:

1. Soil Mechanics in Engineering Practice - Terzaghi and Peck, John Wiley and Sons Inc New York.
2. Soil Mechanics- Lamb and Whitman, Wiley Eastern Pvt. Ltd, New Delhi.
3. Fundamentals of Soil Mechanics - Taylor, John Wiley and Sons Inc New York.
4. Experiments in Soil Mechanics by Jain and ----, Nem Chand publication Civil lines Roorkee.

Expected Outcome:

The students would be able to identify, classify and determine physical & engineering properties of different types of soils.

4CE114 Environmental Engineering – I

L-T-P-Cr: 3-1-0-4

Objective:

Students should be imparted upon knowledge of Environmental Engineering using basic principles of Fluid mechanics, Biological and Chemical Science to develop basic and empirical equations for Environmental Engineering Applications.

Theory:

1. Sources of Water: Ground and Surface sources **2 Lectures**
2. Water Quality: Physical, chemical and biological parameters; Examination of physical, chemical and biological characteristics of water. **5 Lectures**
3. Water Quantity/Demand: Design period; population forecast, variation of quantity of water demand. **3 Lectures**
4. Intakes structures for surface water source. **2 Lectures**
5. Water Purification: Philosophy of treatment. Unit operations and introduction to physical, chemical and biological processes. Plain sedimentation, Coagulation and flocculation, Filtration: Slow and Rapid sand filters, Disinfection, Softening, Introduction of adsorption and Reverse Osmosis and other treatment methods. **15 Lectures**
6. Water Storage, pumping and Transportation of water; Water distribution systems and analysis; Appurtenances of water transport and distribution systems, hardy-cross method of analysis. **9 Lectures**
7. Introduction to air and noise pollution. **6 Lectures**

Reference Books/ Text Books:

1. Environmental Engineering by Peavy H.S, Rowe D.R. and Tchobanoglous G, Tata McGraw Hills, New Delhi.
2. Environmental Engineering (Vol I), Water Supply Engineering, S.K. Garg, Khanna Publishers, New Delhi.
3. G.M. Fair, J.C. Geyer, D.A. Okan, Elements of Water Supply and Wastewater Disposal, John Wiley and Sons Inc.
4. Terence, J. McGhee Water Supply and Sewerage, McGraw Hill Book Co.
5. M.J. Hammer, Water and Waste Water Technology, John Wiley and Sons, New York.
6. CPHEEO: Manual on water supply and treatment, Ministry of Urban Development.

End Semester Examination: The end semester examination will be of a predetermined duration covering the entire syllabus covering both theoretical and (or) numerical exercises upon the instructor's discretion where all questions will need to be answered

Expected Outcome:

Students will be able to understand and develop basic and empirical equations for Environmental Engineering Applications.

5CE116 Design of Steel Structures

L-T-P-Cr: 3-1-0-4

Theory:

1. Introduction to Design Philosphies: Working stress method, limit state method, LRFD method of Design Loads and Load Combinations, Introduction to Steel sections and Steel structures. **4 Lectures**
2. Design of structural fasteners: rivets, bolts and welds, Simple connections, bracket connections. **5 Lectures**
3. Design of tension members, lug angles. **5 Lectures**
4. Design of compression members, laced and battened columns and column splices. **7 Lectures**
5. Design of column bases & footing. **5 Lectures**
6. Design of flexural members: rolled sections, built-up sections. **5 Lectures**
7. Design of members subjected to axial load and bending moment. **5 Lectures**
8. Design of Roof Trusses**.** **6 Lectures**

Text Books:

1. S.K. Duggal, Limit State Design of Steel Structures 2nd Edition. Tata McGraw Hill, New Delhi.
2. S.S. Bhavikatti, Design of Steel Structures 3RD Edition. Tata McGraw Hill, New Delhi.
3. N. Subramanian, Design of Steel Structures 2nd Edition. Oxford University Press India.
4. Sairam, Design of Steel Structures 2nd Edition. Pearson.

5CE117 Design of Steel Structures - Lab

L-T-P-Cr: 0-0-3-1

Practical/ Sessional:

1. Detailing of simple and bracket connections
2. Detailing of tension members, lug angles
3. Detailing of compression members laced and battened columns.
4. Detailing of column bases & footing
5. Detailing of flexure members: Beams - rolled sections, built-up sections
6. Detailing of Roof Trusses

Text Books:

1. S.K. Duggal, Limit State Design of Steel Structures 2nd Edition. Tata McGraw Hill, New Delhi.
2. S.S. Bhavikatti, Design of Steel Structures 3RD Edition. Tata McGraw Hill, New Delhi.

3. N. Subramanian, Design of Steel Structures 2nd Edition. Oxford University Press India.
4. Sairam, Design of Steel Structures 2nd Edition. Pearson.

5CE118 Geotechnical Engineering - II

Prerequisite: A Pass grade or having attended at least 75% of the classes conducted or at least 60 % attendance and a minimum of 40% marks in the course Geotechnical Engineering–I (CE114).

Objective: To impart knowledge and skill for engineering properties of soils, bearing capacity, shallow foundation and deep foundation (pile foundation only).

Theory:

1. Earth pressure theories & Retaining Walls: Analytical and Graphical Methods. **6 Lectures**
2. Stability of slopes, limit equilibrium methods, methods of slices, simplified Bishop's method, and friction circle method, factors of safety, stability under conditions of submergence , drawdown and steady seepage, location of critical arc, stability number, chart. **8 Lectures**
3. Explorations, geophysical investigations. Characterization of ground, site investigations, methods of drilling, sampling. **6 Lectures**
4. Bearing capacity and In -situ tests: SPT and plate load tests, estimation of ultimate bearing capacity based on in - situ tests. Bearing capacity, general, local and punching shear failures, correction for size, shape, depth, water table, compressibility, ultimate and allowable stresses, Effect of groundwater level. **8 Lectures**
5. Design of footings and rafts. Foundations subjected to eccentric loads and moments, Footings on slopes, Contact pressure distributions, Sub grade modulus. **8 Lectures**
6. Pile foundation; driving stresses, load tests, pile groups, pile caps. Settlement of foundation **6 Lectures**

Text Books:

1. A Text Book of Soil Mechanics and Foundation Engineering - V.N.S. Murthy, Saikripa Technical Consultants, Bangalore. Revised and enlarged 4th edition, 1993.
2. Basic and Applied Soil Mechanics - GopalRanjan and A. S. R. Rao, Wiley Eastern Ltd, New Delhi.
3. Soil Mechanics and Foundation Engineering - K. R. Arora, Standard Pub. and Dist., Delhi.,1992.

Reference Books:

1. Soil Mechanics in Engineering Practice - Terzaghi and Peck, John Wiley and Sons IncNewyork, 1967.
2. Soil Mechanics- Lamb and Whitman, Wiley Eastern Pvt. Ltd, New Delhi, 1969.
3. Fundamentals of Soil Mechanics - Taylor, John Wiley and Sons IncNewyork, 1948.
4. Foundation Engineering- R. B. Peck, W. E. Hanson and T. H. Thournburn, John Wiley, New York.
5. Foundation Analysis and Design- J. E. Bowles, McGraw Hill Book co. New York.

End Semester Examination (3 Hrs.):

The duration of the Examination will be 3 hrs. The questions will be comprehensive, i.e. from the entire unit, may have subsections with theory and numerical with approximately 50% weight age and may / may not have choices. Minimum five questions will have to be answered.

Expected Outcome:

The students would be able to determine the shear strength and earth pressure and analyse and design the problems related with stability of slopes, bearing capacity, proportioning of shallow and pile foundations.

5CE119 Material Testing Lab

L-T-P-Cr: 0-0-3-1

Practical/ Sessional:

1. To find out the total energy required to break a specimen of particular dimension and material.
2. To find hardness number of the specimen (i) cast Iron ii) Mild Steel (iii) Copper (iv) Brass.
3. To determine the modules of rigidity of the material supplied and to establish the relationship between the torque applied and the angle of twist causing this torque.
4. To find the tensile strength, compressive strength and bending strength of the supplied specimen
5. To determine the behavior of the material under tension and to find out

Text Books:

1. Moondra, H. S., and Gupta R., Laboratory Manual for Civil Engineering, CBS Publication, 2013

5CE121 Transportation Engineering - I

L-T-P-Cr: 3-1-0-4

Objective:

To introduce the elements related to highway engineering. The subject knowledge of traffic engineering, geometric design and pavement design shall be imparted along with highway material and construction.

Theory:

1. **Introduction:** Importance of transportation, Different modes of transportation, Characteristics of road transport, historical development of roads, Scope of Highway Engineering, Classification of roads and road patterns, recently launched highway projects in India. **3 Lectures**
2. **Traffic Engineering:** Introduction, Traffic characteristics, Traffic studies, Traffic flow characteristics, traffic control devices. **6 Lectures**
3. **Highway Geometric Design:** Introduction, Highway cross-section elements, sight distances, Design of horizontal Alignment, Design of vertical alignment, IRC Specifications. **12 Lectures**
4. **Highway Materials:** Subgrade soil, stone aggregates, binding materials (bitumen, emulsion tar and cut back), Introduction to modified binders, Geosynthetics and SUPERPAVE. **6 Lectures**
5. **Design of Highway Pavements:** Flexible pavement and their design, IRC: 37-2012 method of design, Rigid pavement and their design, IRC: 58-2011 method of design. **8 Lectures**

6. **Highway construction:** Earthwork, construction of various layers of the pavements. **4 Lectures**
7. Highway maintenance, Pavement evaluation, Highway drainage. **3 Lectures**

Scheme of Examination:

Class test I/Assignment	:	5Marks
Class test II/Assignment	:	5Marks
Mid Semester Examination	:	20Marks
End Semester Examination	:	70 Marks

Text Books:

1. Khanna, S. K. and Justo, C. E. G., Highway Engineering, Nemchand Bros., Roorkee
2. Kadiyali, L. R., Principle and Design of pavements, Khanna Publishers, New Delhi
3. Kumar SrinivasaR.,Textbook of Highway Engineering, University Press

Reference Books:

1. Wright, P. H., Highway Engineering, John Wiley and Sons, New York.
2. Hay, W. W., Introduction to Transportation Engineering. John Wiley and Sons, New York.
3. Papacostas, C. S., Fundamentals of Transportation Engineering, Prentice Hall of India, New Delhi.
4. Huang, Y. H., Pavement analysis and Design. Prentice Hall, Englewood Cliffs, New Jersey.

Expected Outcome:

The students would have ability for design of highways including pavement. They have awareness of highway materials, construction materials, maintenance and elements traffic engineering.

5CE122 Transportation Engineering - I Lab

L-T-P-Cr: 0-0-3-1

Objective: To conduct the major test on road aggregates & bitumen, and minor test in field.

Practical:

1. Tests on Road Aggregates
    a. Aggregate Crushing Value Test
    b. Los Angeles Abrasion Test
    c. Aggregate Impact Test
    d. Specific Gravity and Water absorption Test
    e. Shape Test (Elongation and Flakiness)
    f. Stripping value of road aggregate
2. Tests on Bitumen
    a. Penetration test
    b. Softening point test

c. Specific gravity test

d. Viscosity test

e. Ductility test

3. Field test: Traffic survey, Axle load survey, Pavement Condition survey

Scheme of Examination:

Class performance	:	15Marks
Lab Record	:	15Marks
Internal Via-Voce	:	10Marks
External Viva-Voce	:	60 Marks

Text Books:

1. Khanna, S. K. and Justo, C. E. G., Highway Material Testing, Nemchand Bros., Roorkee
2. Latest relevant IS and IRC Codes

Expected Outcome: The students would be aware about the physical test performed on the aggregate and bitumen generally conducted in the practice. Also exposure has been given about the field test like traffic survey (volume, density & speed), axle load determination and pavement condition evaluation.

6CE125 Hydrology and Open Channel Flow

L-T-P-Cr: 3-1-0-4

Prerequisite:A Pass grade or having obtained at least 75% of the classes conducted or a least 60% attendance and a minimum of 40% marks in the course (s) Fluid Mechanicsand Hydraulics (CE105).

Objective: To impart knowledge and skills for all the hydrological and meteorological processes- precipitation, evaporation, infiltration, and runoff. It will also impart knowledge for the types of flow in the open channel.

Theory:

1. Introduction, hydrologic cycle and their processes and water budget equation, Drainage basin, Catchment Characteristics. **1 Lectures**
2. Precipitation Gauges and data: Types of precipitation, measurement and processing of rainfall, Depth-Area-Duration and intensity-duration frequency relations, Probable maximum precipitation. **4 Lectures**
3. Abstractions from precipitation: Evaporation and factors affecting evaporation; measurement, and estimation; Evapotranspiration and factors affecting, measurement and estimation; Infiltration process, measurement and estimation, Infiltration Indices. **6 Lectures**
4. Stream flow measurements: measurement of stage, velocity and discharge; Stage-discharge relationship. **2 Lectures**
5. Runoff and Hydrographs: Runoff and its characteristics, Rainfall-Runoff correlations, Flow duration curve, Flow-Mass curve, Hydrograph, Factors

affecting hydrograph, Unit hydrograph, its analysis, S-curve hydrograph, Synthetic and instantaneous unit hydrographs. **7 Lectures**

6. Introduction to Groundwater flow: Forms of subsurface flow, aquifer properties and Darcy's laws and basics Flow equations. **2 Lectures**
7. Basic concepts of Open Channel flow: Open Channels and their properties; Specific Energy, Critical flow, channel transitions. **4 Lectures**
8. Uniform flow: Theoretical uniform flow equations including Chezy, Darcy-Weishbach and Mannings formula and computations; hydraulically efficient channel sections. **5 Lectures**
9. Gradually varied flow: Differential Equation; flow profile classification and computation methods stand. **5 Lectures**
10. Rapidly varied flow: Hydraulic jump; Momentum equation; classification; characteristics and elements; Use of jump as an energy dissipater. **4 Lectures**
11. Introduction to Unsteady Flow. **2 Lectures**

Text Books:

1. Engineering Hydrology by K. Subramanya,Tata McGraw-Hill Pub., New Delhi.
2. Hydrology by H.M. Raghunath, New Age Publication, New Delhi.
3. Engineering Hydrology by CSP Ojha, R Berndtsson and P K Bhunia, Oxford Univ New Delhi.
4. Flow in Open Channels by K.Subramanya, Tata McGraw Hill Pub. Co. Ltd., New Delhi.
5. Flow in Open Channels by K.G. Rangaraju, Tata McGraw Hill Pub. Co. Ltd., New Delhi.
6. Flow through Open Channel by Rajesh Srivastava, Oxford Publication.

Reference Books:

1. Applied Hydrology by V.T. Chow, McGraw Hill International, New York.
2. D.K. Todd, Groundwater Hydrology, John Wiley and Sons.
3. Open Channel Hydraulics by V.T. Chow, McGraw Hill International.
4. Open Channel Flow by M HanifChaudhary, PHI
5. Open Channel Hydraulics by R.H. French, McGraw Hill Book Co., New York.

End Semester Examination (3 Hrs.):

The duration of the examination will be 3 hours. The questions will be comprehensive, i.e. from the entire unit, may have subsections with theory and numerical exercises based upon the instructors discretion.

Expected Outcome:

The student will be able to assess different hydrological processes e.g. precipitation, evaporation, infiltration, runoff and ground water. They will also be able to analyse the flow types in open channel.

6CE126 Hydrology and Open Channel Flow Lab

L-T-P-Cr: 0-0-3-1

Prerequisite: A Pass grade or having obtained at least 75% of the classes conducted or at least 60% attendance and a minimum of 40% marks in the course Fluid Mechanics and Hydraulics (CE 105).

Objective: To impart knowledge and skills to measure/ estimate all the hydrological and meteorological processes- precipitation, evaporation, infiltration, and runoff. It will

also impart knowledge for the types of flow and related computations in the open channel.

Practical:

1. Measurement of rainfall using raingauges,
2. Measurement of evaporation using evaporimeter,
3. Measurement of infiltration using double ring infiltrometer,
4. Study of measurement of River Discharge at gauging site,
5. Study of hydraulic jump and hump in Laboratory flume,
6. Measurement of sun shine hours,
7. Measurement of relative humidity,
8. Measurement of wind speed and direction.

Depending upon the availability of the instrument/ apparatus.

Books and Laboratory Manuals:

1. Engineering Hydrology by K. Subramanya,Tata McGraw-Hill Pub., New Delhi.
2. Flow in Open Channels by K.Subramanya, Tata McGraw Hill Pub. Co. Ltd., New Delhi.
3. Hydrology by H.M. Raghunath, New Age Publication, New Delhi.

Expected Outcome:

The student would be able to measure and analyse rainfall, evaporation, infiltration and stream flow.

6CE127 Transportation Engineering - II

L-T-P-Cr: 3-1-0-4

Objective:

To introduce the elements related to railway engineering and airport engineering. The knowledge of rails, rail joints, geometric design railway tracks, points and crossings. The knowledge of airport elements, design of airport pavements and geometric design of runways and taxiways.

Theory:

Railway Engineering

1. Railway Engineering: Role of railways in transportation system, railways and highways comparisons; classification of Indian railways, railway zones in India, railway gauges, creep, coning of wheels and traction resistance **5 Lectures**
2. Permanent ways: Rail & rail joints (welding of rails, LWR, SWR, CWR), Sleepers, Ballast, Formation and its drainage, track fitting and fastening, Stresses in railway tracks. **6 Lectures**
3. Geometric design of railway track: Alignment and grades, cross section and its elements (at filling & cutting), grade compensation, cant and cant deficiency, negative cant and widening of gauges on curves, curves used for railway track (horizontal and vertical curves), level crossing. **8 Lectures**
4. Points and crossing, Stations and yards, Signals and Interlocking system. **6 Lectures**
5. Railway System in the Urban Area: Surface railways, Elevated railways, Underground railway **4 Lectures**

Airport Engineering

6. Airport Overview: Air transportation in India, Classification of airports, Airport terminology, Outline of technical planning process, Terminal building, Visual Aids, Orientation of Runway. **6 Lectures**

7. Geometric design of Runway &Taxiway, Structural design of airport pavement.

7 Lectures

Scheme of Examination:

Class test I/Assignment	:	5Marks
Class test II/Assignment	:	5Marks
Mid Semester Examination	:	20Marks
End Semester Examination	:	70 Marks

Text Books:

1. Sexena, S.C. Arora, S. P., A text Book of Railway Engineering, DhanpatRai& Sons, New Delhi.
2. Agarwal, M. M. & Satish Chandra, Railway Engineering, Oxford University Press, New Delhi.
3. Khanna and Arora, Airport planning and design, DhanpatRai& Sons, New Delhi.
4. Rangwala S.C., Airport Engineering, Charotar publishing house

Reference Books:

1. Mundary, J.S. Railway Track Engineering, Tata McGraw Hill, New Delhi.
2. Hay, W. W., Railroad Engineering, John Wiley and Sons, New York
3. SaxenaS.C.,Airport Engineering(Planning and Design),CBS Publications & Distributors, New Delhi
4. Horonjeff .R and Francis X.McKelvey, Mc Grow Hill, New York

Expected Outcome:

The students should be able to carry out railway track design, signal design, should have awareness of railway track materials and construction. The students should be able to plan and design the airport elements.

6CE128 Environmental Engineering - II

L-T-P-Cr: 3-1-0 -4

Objective:

Students should impart upon knowledge of Environmental Engineering using basic principles of Fluid mechanics, Biological and Chemical Science to develop basic and empirical equations for Environmental Engineering Applications.

Theory:

1. Generation and collection of wastewater, sanitary, storm and combined sewerage systems, Quantities of sanitary wastes and storm water.

5 Lectures

2. Physical Chemical and Biological characteristics of wastewater, Primary, secondary and tertiary treatment of wastewater; Wastewater disposal standards. 4 Lectures

3. Basics of microbiology. Biological wastewater treatment systems: BOD Kinetics, Kinetics and Design of Aerobic processes - activated sludge process and its modifications. Trickling filter, RBC, Oxidation Ponds and Aerated lagoons. 10 Lectures
4. Anaerobic Processes- Anaerobic digester, UASB reactor, Septic tanks, Imhoff tank, Sludge handling, Disposal of effluent and sludge. 9 Lectures
5. Design problems on sewerage, wastewater treatment units and sludge digestion. 10 Lectures
6. Introduction to Municipal Solid Waste Management. 4 Lectures

Reference Books/ Text Books:

1. Waste Water Engineering: Treatment and Reuse, Metcalf & Eddy, T.M.H. Publication.
2. Environmental Engineering by Peavy H.S, Rowe D.R. and Tchobanoglous G, Tata McGraw Hills, New Delhi.
3. Environmental Engineering (Vol II), S.K. Garg, Khanna Publishers, New Delhi.
4. G.M. Fair, J.C. Geyer, D.A. Okan, Elements of Water Supply and Wastewater Disposal, John Wiley and Sons Inc.
5. Terence, J. McGhee Water Supply and Sewerage, McGraw Hill Book Co.
6. M.J. Hammer, Water and Waste Water Technology, John Wiley and Sons, New York.
7. CPHEEO: Manual on water supply and treatment, Ministry of Urban Development.

End Semester Examination:

The end semester examination will be of a predetermined duration covering the entire syllabus covering both theoretical and (or) numerical exercises upon the instructor's discretion where all questions will need to be answered.

Expected Outcome:

Students will be able to understand and develop basic and empirical equations for Environmental Engineering Applications.

6CE129 Environmental Engineering – II Lab

L-T-P-Cr: 0-0-3 -1

(Detailed Syllabus under Preparation)

List of Electives

Prog	S. No.	Sem	Course Code	Course Title	L	T	P	Credit		
CEUG	1	EL	CE141	Design of Dams	3	0	0	3		
CEUG	2	EL	CE142	Pre-stressed Concrete Design	3	0	0	3		
CEUG	3	EL	CE143	Water and Land Management	3	0	0	3		
CEUG	4	EL	CE145	Advanced Design of Steel Structures	2	0	2	3		
CEUG	5	EL	CE146	Advanced Soil Mechanics	3	0	0	3		
CEUG	6	EL	CE147	Air Pollution Engineering	3	0	0	3		
CEUG	7	EL	CE148	Computer Aided Design	3	0	0	3		
CEUG	8	EL	CE149	Environmental Impact Assessments	3	0	0	3		
CEUG	9	EL	CE150	Land Drainage	3	0	0	3		
CEUG	10	EL	CE151	River Hydraulics and Sediment Transport	3	0	0	3		
CEUG	11	EL	CE152	Traffic engineering	3	0	0	3		
CEUG	12	EL	CE153	Water Power Engineering	3	0	0	3		
CEUG	13	EL	CE155	Advanced Foundation Engineering	3	0	0	3		
CEUG	14	EL	CE156	Advanced Structural Analysis	3	0	0	3		
CEUG	15	EL	CE157	Advanced surveying	3	0	0	3		
CEUG	16	EL	CE158	Airport Planning and design	3	0	0	3		
CEUG	17	EL	CE159	Finite Element Method	3	0	0	3		
CEUG	18	EL	CE160	Floods and Droughts	3	0	0	3		
CEUG	19	EL	CE161	Irrigation Engineering and Design of Hydraulic Structure	3	0	0	3		
CEUG	20	EL	CE162	Mechanics of Composite Materials	3	0	0	3		
CEUG	21	EL	CE163	Solid Waste Management	3	0	0	3		
CEUG	22	EL	CE164	Transportation Systems and Planning	3	0	0	3		
CEUG	23	EL	CE168	Bridge Engineering	3	0	0	3		
CEUG	24	EL	CE169	Design of Plate and Shell Structures	3	0	0	3		
CEUG	25	EL	CE170	Disaster Management and Mitigation	3	0	0	3		
CEUG	26	EL	CE171	Ground Water Engineering	3	0	0	3		
CEUG	27	EL	CE172	Industrial Waste Treatment	3	0	0	3		
CEUG	28	EL	CE173	Rock Mechanics	3	0	0	3		
CEUG	29	EL	CE174	Soil Dynamics	3	0	0	3		
CEUG	30	EL	CE175	Structural Dynamics & Earthquake Resistant Design	3	0	0	3		
CEUG	31	EL	CE176	System Engineering						
CEUG	32	EL	CE177	Water Resources Planning and Management						
CEUG	33	EL	HS107	Engineering Economics	3	0	0	3		
CEUG	34	EL	CE178	Civil Engineering Drawing Using Auto CAD/STAAD	3	0	0	3		

CEUG	35	EL	CE179	Design of advanced concrete structures	3	0	0	3		
CEUG	36	EL	CE180	Advanced Steel Structures	3	0	0	3		
CEUG	37	EL	CE181	Theory of Plates and Shells	3	0	0	3		
CEUG	38	EL	CE182	Engineering Optimization	3	0	0	3		
CEUG	39	EL	CE183	Structural Analysis	3	0	0	3		
CEUG	40	EL	CE184	Building Science	3	0	0	3		
CEUG	41	EL	CE185	Civil Engineering Drawing Using Auto CAD	3	0	0	3		

5CE141 Design of Dams

L-T-P: 3-0-0-3

Theory:

1. Gravity dams, Arch dams, and Buttress dams. Application of analogy techniques; **11 Lectures**
2. Earthen Dams and Earth-Rock fill dams, Seepage analysis and Stability analysis **10 Lectures**
3. Dam ancillary works; Spillways; Classification, design consideration; Contraction joints, treatment of foundations and outlets, **10 Lectures**
4. Design of hydropower installation and intake structures. **11 Lectures**

Text Books:

1. Bharat Singh: Fundamentals of Irrigation Engineering, Nemchand Bros., Roorkee, Uttrakhand.
2. Punamia, B. C., Pande Lal B. B. Irrigation and Water Power Engineering, Laxmi Publication Pvt. Ltd., New Delhi, 1969.
3. Garg S. K., Water Resourse Engineering, Khanna Publication, Nai Sarak, Delhi 1973.

Reference Books:

1. R. K. Linsley and J. L. H. Paulhus, Water Resource Engineering, McGraw Hill Book Co. New York.

5CE142 Pre-stressed Concrete Design

L-T-P: 3-0-0-3

Objective:

The objective of the course is to make the students learn basics and design of pre-stressed concrete and to make them aware of the codal provisions of pre-stressed concrete design.

Theory:

1. Introduction, difference between RCC and pre-stress concrete, pre tensioning and post tensioning. **6 Lectures**
2. Analysis of pre-stress: assumptions, direct and bending stress analysis, eccentric and concentric tendons concept of load balancing, stresses in tendons, mechanism of bond in pre-stressed concrete, transmission length, stresses in end blocks, pressure line **8 Lectures**
3. Losses in pre-stress concrete: pre-tensioning and post tensioning **6 Lectures**
4. IS code provisions in design **6 Lectures**
5. Design of beams; symmetrical, unsymmetrical, Design for shear **8 Lectures**
6. Ultimate strength in flexure **6 Lectures**

7. Pre-stressing of Circular pipes **6 Lectures**

Texts/Books:

1. Pre-stressed Concrete by Krishna Raju, McGraw Hill Publ.
2. Pre-stressed Concrete Design and Construction by F. Leonhardt W Ernst and Sohen, Berlin
3. Design of Pre-stressed Concrete Structures by TY Lin and H Burns Wiley and Sons New York
4. Pre-stressed Concrete by Y. Guyan, CR Books London

5CE143 Water and Land Management

L-T-P-Cr: 3-0-0-3

Theory:

1. Problem of irrigation system in India, Soil and Land Irrigation classification, Basic concept of diagnostic analysis. **3 Lectures**
2. Soil water plant relationship, Evapotranspiration, crop coefficient, effective rainfall, crop water requirements, and irrigation efficiencies. **8 Lectures**
3. Irrigation scheduling, Stressed irrigation, drought and water management policy during drought. **4 Lectures**
4. Micro level planning for any canal/tube well system, Evaluation of check planning and design. **3 Lectures**
5. Water application methods: Border irrigation, basin irrigation, furrow irrigation sprinkler and drip irrigation. **3 Lectures**
6. Operation and maintenance of irrigation system: rotational water distribution system-arabandi, Evaluation of irrigation project's performance and improvement. **5 Lectures**
7. Design of an on farm drainage system; surface drains, sub-surface drains, mole drain and bio-drains; outfall condition, salinity and alkalinity control, operation and maintenance of a drainage system. **6 Lectures**
8. Evaluation and status of land development in irrigation commands, Norms of land levelling, methods of land levelling, plane method or centroid method, contour adjustment method. **5 Lectures**
9. Irrigation behavior and decision making, Attitudes and their influence on irrigation management, night irrigation, participatory irrigation management, irrigation organizations. **5 Lectures**

Text Books:

1. Irrigation Theory and Practical – A. M. Michael, Vikas, Pub., New Delhi.
2. FAO Irrigation and Drainage Paper no. 24 & 58, Rome, Italy.
3. Irrigation Engineering- G. L. Aswa, Wiley Eastern, New Delhi.
4. Irrigation Engineering – S. K. Mazumdar, Tata McGraw Hill Pub., New Delhi.

Reference Books:

1. Diagnostic Analysis of Minor irrigation scheme, Publication no. 11 W ALMI, Aurangabad (Maharashtra), 1885.
2. Application of soil survey in irrigation Water Management, Publication no 21, W ALMI, Aurangabad (Maharashtra), 1885.
3. Irrigation – Gravity Method and Efficiencies, Publication no 15, W ALMI, Aurangabad (Maharashtra), 1885.

6CE145 Advanced Design of Steel Structures

L-T-P-Cr: 3-0-0-3

Objective:

The objective of the course is to make the students learn design of advanced steel structural members and to make them aware of the codal provisions of steel design.

Theory:

1. Design of seat connection , stiffened and unstiffened seat connection **6 Lectures**
2. Design of plate girders **8 Lectures**
3. Design of gantry girders **6 Lectures**
4. Design of Industrial building **8 Lectures**
5. Design of pressed steel water tanks **7 Lectures**
6. Design of steel bridges: foot bridge **7 Lectures**

Text Books:

1. S. K .Duggal, "Design of Steel Structures", Tata McGraw Hill Publishing Co.Pvt. Ltd. 3rd Edition, (2008).
2. N Subramanaim,"Design of Steel Structures: Theory and Practice", Oxford University Press, (2010).

References:

1. Edwin H. Gaylord, "Design of Steel Structures", Tata McGraw Hill Publishing Co.Pvt.Ltd.3rd Edition, (2010).
2. Jack C. McCormac, "Structural Steel Design", Prentice Hall, (2008).

6CE146 Advanced Soil Mechanics

L-T-P: 3 - 0 – 0-3

Prerequisite:

A Pass grade or having attended at least 75% of the classes conducted or at least 60 % attendance and a minimum of 40% marks in the course (s) Geotechnical Engineering –II, CE 118.

Objective:

To impart advanced knowledge and skill for soil identification, classification other physical properties of soils, viz. seepage, stress distribution, compaction and consolidation.

Theory:

1. Soil Structures & Mineralogy: Soil texture, Solid particles in soil, Atomic & molecular bond, Inter-particle forces in a soil mass, Single grained structure, Honey -comb structures. Flocculent &dispersed structures, Structure of connected soil, Clay minerals. **6 Lectures**
2. Soil Water: Modes of occurrence of water in soils- Absorbed water, Double layer, Capillary water. **2Lectures**
3. Stress condition in soil - Effective & neutral pressures. **6 Lectures**
4. Capillary permeability test. Drainage & Dewatering Ditches & sumps, Well point system, Shallow well system, Deep well drainage, Electrosmosis method, Protective filters. **6 Lectures**

5. Shear Strength Use of Stress path in triaxial test- Undrained& drained tests for Normally Consolidated & Over Consolidated clay samples. 7-**Lectures**
6. Skempton's pore-pressure parameters, Choice of shear parameters. Stability of open cut - braced open cut. Bishop's rigorous method, Limit equilibrium approach.

7 Lectures

7. Bulk Head & Cofferdams: Classification - cantilever sheet pile wall in cohesionless and in cohesive soils Arching in soils, Classes of underground conduits, loads on positive projecting and negative projecting conduits.

8 **Lectures**

Text Books:

1. Geotechnical Engineering - S. K. Gulatiet. al., TMH Publishing Co. Ltd, New Delhi.
2. Basic and Applied Soil Mechanics - GopalRanjan and A. S. R. Rao, Wiley Eastern Ltd, New Delhi.
3. Lambe T. W. and Whitman, R.V. (1979), Soil Mechanics, John Wiley & Sons Inc.

Reference Books:

1. Soil Mechanics in Engineering Practice - Terzaghi and Peck, John Wiley and Sons Inc., New York.
2. Soil Mechanics- Lamb and Whitman, Wiley Eastern Pvt. Ltd, New Delhi.
3. Fundamentals of Soil Mechanics - Taylor, John Wiley and Sons Inc New York.

End Semester Examination (3 Hrs.):

The duration of the Examination will be 3 hrs. The questions will be comprehensive, i.e. from the entire unit, may have subsections with theory and numerical with approximately 50% weightage and may / may not have choices. Minimum five questions will have to be answered

Expected Outcome:

The students would be able to identify, classify and determine physical properties of different types of soils.

6CE147 Air Pollution Engineering

L-T-P-Cr: 3-0-0-3

Objective:

To impart knowledge and skill for pollutants identification, classification other properties of pollutants, control of the air pollution

Theory:

1. Air pollutants, Sources, classification. **3 Lectures**
2. Combustion Processes and pollutant emission, **4 Lectures**
3. Effects on Health, vegetation, materials and atmosphere **4 Lectures**
4. Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance etc. **8 Lectures**
5. Atmospheric diffusion of pollutants and their analysis, Transport, transformation and deposition of air contaminants on a global scale. **8 Lectures**
6. Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards. **5 Lectures**

7. Control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods.

10 Lectures

Text Books:

1. Air Pollution, Rao & Rao, TMH.
2. Air Pollution Control Engineering, Rao, TMH

Reference Books:

1. Environmental Engineering, Peavy, Rowe and Tchobanogous, McGraw-Hill International edition

End Semester Examination (3 Hrs.):

The duration of the Examination will be 3 hrs. The questions will be comprehensive, i.e. from the entire unit, may have subsections with both theoretical and (or) numerical exercises.

Expected Outcome:

The students would be able to identify, classify and determine properties of different types of pollutants and also able to know the control measure of the pollution.

6CE148 Computer Aided Design

L-T-P-Cr: 3-0-0-3

Theory:

1. Engineering design principles, interactive design using work station, and software tools. **10 Lectures**
2. Computer graphics, Introduction to GKS, Star base Libraries. **10 Lectures**
3. Computer aided design and drafting, data base management system, simulation and optimization. **12 Lectures**
4. Applications in Civil Engineering, structural design. **10 Lectures**

Books:

1. Holland, L., Chappell, E., Mastering AutoCAD Civil 3D 2014, John Wiley & Sons Publication, 2013.
2. Chappell, E., AutoCAD Civil 3D 2015 Essentials, John Wiley & Sons Publication, 2014.

6CE149 Environmental Impact Assessment

L-T-P-Cr: 3-0-0-3

Objective:

To impart knowledge for the various techniques/ procedure for assessing the Impacts of the various developmental activities on the environment.

Theory:

1. National Environmental Policy Act and its Implementation: Introduction to EIA, Contents of an impact statement, Role of Environmental protection agency, Technical and procedural aspects of Environmental Impact assessment. **5 lecturers**
2. Frame work for Environmental Assessment: Environmental Assessment Process, Basic to the process. **5 lecturers**
3. Prediction and Assessment of Impacts on the Environment: Air, Water, Noise, Biological Cultural, Socioeconomic. **10 Lectures**

4. Methodology of Impact Analysis: Purpose of Environment assessment method, Matrix method, Overlays, Checklist method. Application of mathematical models. **8 Lectures**
5. Public participation in Environmental Decision making **2 Lectures**
6. Environmental Clearance Procedure in India **4 lecturers**
7. Environmental Management Plan **5 lecturers**
8. EIA monitoring and auditing **3 lecturers**

Text/ Reference Books:

1. Environmental Impact Assessment, by Larry W Canter, Tata McGraw Hill Inc
2. Environmental Engineering, by Gerard Kiely, Tata McGraw Hill Education Private Ltd, New Delhi

End Semester Examination (3 Hrs.):

The duration of the Examination will be 3 hrs. The questions will be comprehensive, i.e. from the entire unit, may have subsections both theoretical and (or) numerical exercises.

Expected Outcome:

The students would be able to quantify the impacts of the various developmental projects on the Environment and also be able to suggest the mitigation measures.

6CE150 Land Drainage

L-T-P: 3-0-0 3

1. INTRODUCTION: Form and nature of occurrence of water on soils- Soil moisture characteristic - Darcy's Law and Richard's equation – Soil Water movement above water table. **3 Lectures**
2. AGRICULTURAL DRAINAGE: Needs for drainage - Drainage and crop production – Drainage to control water logging and salinity. **2 Lectures**
3. DRAINAGE SYSTEM: Components of Drainage system – Field drainage system Surface drainage system, Subsurface drainage system and Compound drainage system **3 Lectures**
4. DRAINAGE INVESTIGATION: Water table – Dissolved salts in ground water – Hydraulic conductivity – Drainage co-efficient – Flow at the junction of two drains. **10 Lectures**
5. SURFACE DRAINS: Hydraulic design of surface drains and its related structures – construction and maintenance of surface drains. **4 Lectures**
6. SUBSURFACE DRAINS: Types – Design and Depth of subsurface drains esign of spacing subsurface drains. For steady state condition For unsteady state condition – Diameter of pipe drains – Grade of pipe drains – Design of envelope – Construction and maintenance – Economics of subsurface drains. **12 Lectures**
7. SOIL SALINTY: Definitions – Saline, alkaline and saline – alkali soils – Drainage for salinity control – Land reclamation techniques for salt affected soils. **8 Lectures**

Text Books:

1. Drainage Manual 'US Department of the Interior, Bureau of reclamation, 1st Edition, 1978, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.

2. Drainage Principles and application, International Institute Land Reclamation and Improvement, Waganingen, The Netherland, publication No. 16, 1994 9th Revised Edition.
3. Drainage Engineering, J. N. Luthin, John Wiley & sons, New York, USA, 1966.

Reference Books:

1. Diagnosis and Improvement of saline and alkali soil, Agricultural Hand Book No. 60, US Department of Agricultural, Feb, 1954.
2. Hand book of Drainage of irrigated area in India, LBII/WAPCOS (India) Ltd., Technical Report no.5, New Delhi, March 1988.
3. Hand Book of Irrigation Technology, Vol. II, Hermah J. Finkel, CRC press, Inc. Boca Raton, Florida.

6CE151 River Hydraulics and Sediment Transport

L-T-P-Cr: 3-0-0-4

Theory:

1. River morphology, types and stages of river, Flow instability. **7 Lectures**
2. Phenomenon of floods, Flood Analysis and Flood Control **7 Lectures**
3. Soil Erosion **7 Lectures**
4. River training works, groynes and spurs, embankments, cut-offs and river control structures. **7 Lectures**
5. Sediment transport principle, mechanics of aggradation and degradation of riverbeds and bank erosion. Bed load, suspended load and total load, **7Lectures**
6. River measurement gauge discharge and sediment **7 Lectures**

Texts/Reference Books:

1. R.J. Garde and K.G. Rangaraju, Mechanics of Sediment Transport and Alluvium Stream Problems,Wiley Eastern Ltd., New Delhi.
2. D.V. Joglekar, Manual of River Behaviors, Control and Training, CBIP Pub. No. 60, 1971.
3. G.L. Aswa, Irrigation Engg, New Agro Int. (P) Ltd. Pub., New Delhi.
4. M.S. Peterson, River Engg., PHI, New Delhi.

6CE152 Traffic Engineering

L-T-P-Cr:3-0-0-3

Objective: To introduce the elements related to traffic engineering. The knowledge of traffic surveys, fundamentals of traffic flow elements, traffic operations and controls, traffic regulations, traffic safety.

Theory:

1. Introduction, Traffic Survey: speed, Journey and Delay Surveys, Vehicle Volume counts, O-D survey, Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis, Statistical Methods of Traffic Engineering. 12 Lectures
2. Fundamentals of traffic flow: Traffic flow elements, gap and gap acceptance, highway capacity analysis. 8 Lectures
3. Traffic operation and Controls: Traffic signs, Road marking, Traffic signals and its design 6 Lectures

4. Traffic Regulations: Regulation of traffic, Design of Controlled and uncontrolled intersections, at grade and grade separated intersections 8 Lectures
5. Traffic Safety: Road accidents, Causes and Prevention, Road safety audit Street Lighting and Traffic management, Traffic calming techniques, Detection of crash prone road locations 8 Lectures

Scheme of Examination:

Class test I/Assignment	:	5Marks
Class test II/Assignment	:	5Marks
Mid Semester Examination	:	20Marks
End Semester Examination	:	70 Marks

Text Books:

1. Kadiyali, L. R., Traffic engineering and transport planning',6th edition, Khanna publishers
2. Khanna, S. K. and Justo, C. e. G., Highway Engineering, Nemchand Bros., Roorkee
3. Khisty C.J &Lall B. K., Transportation Engineering, Prentice Hall of India

Reference Books:

1. Papacostas, C. S., Fundamentals of Transportation Engineering, Prentice Hall of India, New Delhi.
2. Flaherty C.A., Transport planning and traffic engineering', Butterworth-Heineman
3. McShane, William R and Roess, RogarP,'Traffic Engineering', Printice Hall

Expected Outcome:

The students should be able to design traffic facilities and conduct traffic surveys, should understands elements of traffic flow, should be able to determine the capacity, level of service and safety performance of highways, design intersection controls and be aware of road signs.

6CE153 Water Power Engineering

L-T-P: 3-0-0-3

Theory:

1. Comparison of hydro-power and thermal power, combined power system and grids. 8 Lectures
2. Assessment of available hydropower, necessity of storage and pondage, flow duration curve and power duration curve and their uses 9 Lectures
3. Types of hydropower plant, design of power house structures: intakes, conveyance system, foreway, surge tanks power house, tail race. 15 Lectures
4. Types of turbines and their selection, power duration curve and their uses, water hammer analysis. 10 Lectures

Text Book/Reference Books:

1. M. M. Dandekar and K. N. Sharma, Water Power Engg., Vikas Publication House, New Delhi.
2. R. S. Varshney, Hydropower Structures, Nem Chand and Bros., Roorkee.

7CE156 Advanced Structural Analysis

L-T-P-Cr: 3-0-0-3

Theory:

1. Matrix method in skeletal structural analysis **14 Lectures**
2. Force and displacement methods including analysis using substructures. **14 Lectures**
3. Non-linear and elastoplastic analysis. **14 Lectures**

References:

1. Pandit, G. S., and Gupta S. P., Structural Analysis 'A Matrix Approach', Mc Graw Hill, London, April 2008.
2. Weaver and Gere, Matrix Analysis of Frame Structure, CBS, 2004
3. Muthukrishnan Sathyaamoorthy, "Nonlinear Analysis of Structure, CBS, 1997.
4. Borkowski, A., Analysis of Skeletal Structural System in the Elastic and Elastic-Plastic Range, Elsevier Science Ltd, 1988.

7CE155 Advanced Foundation Engineering

L-T-P-Cr: 3-0-0-3

Prerequisite:

A Pass grade or having attended at least 75% of the classes conducted or at least 60 % attendance and a minimum of 40% marks in the course (s) Geotechnical Engineering –II, CE 118.

Objective: To impart advanced knowledge and skill for of different types of foundations.

Theory:

1. Types of foundation; criteria for choosing a foundation based on in-situ soil condition; overview of different laboratory tests conducted on soil; interpretation of data; criteria for foundation design. **3 Lectures**
2. Shallow foundation; Terzaghi's theory for bearing capacity analysis for shallow foundation; Meyerhof's theory for bearing capacity analysis for shallow foundation; difference between Terzaghi's and Meyerhof's theory; Skempton's bearing capacity equation; IS 6403-1981 method for bearing capacity determination (as suggested by Vesic); effect of water table on bearing capacity; bearing capacity of eccentrically loaded footing, bearing capacity from SPT (N) values; bearing capacity determination from plate load test; design examples. **9 Lectures**
3. Mat/Raft footing; Buoyancy raft foundation; Design examples. **4 Lectures**
4. Deep foundation; Static and dynamic formulae for determination of pile load capacity; skin friction in sand and clay; design of pile group; negative skin friction; under reamed piles; pile load test; batter piles; pile subjected to horizontal loads; Reese and Matlock theory; anchor piles and determination of pull out resistance; design examples. **12 Lectures**
5. Deep open cuts; coffer dams; Well foundations; Terzaghi's method; IRC method; **7 Lectures**
6. Soil structure interaction; interaction problems based on the theory of subgrade reaction such as beams, footing; use of finite difference and finite element method in determination of specific problems related to foundation engineering, use of FEM for calculation of

bearing capacity of soil. **7 Lectures**

Text Books:

1. Analytical and computer methods in Foundation, J.E., Bowles, McGraw-Hill Book Co., New York.
2. Numerical Methods in Geotechnical Engineering, Eds., C.S. Desai and J.T. Christian, McGraw-Hill Book Co., New York.
3. Soil Mechanics and Foundation Engineering (Geotechnical Engineering) by K. R. Arora. Standard Publishers and Distributors.
4. Introduction to soil mechanics and foundation engineering by Prof. V. N. S. Murthy, UBS publishers.
5. Programming the finite element method by I. M. Smith and G. V. Griffiths. (4th ed), Wiley International.

Reference Books:

1. Soil Mechanics by T. William Lambe and Robert V. Whitman.
2. Soil Mechanics in Engineering Practice by Karl Terzaghi, John Wiley & Sons (1996).
3. Pile Design and Construction Practices by M. J. Tomlinson and John Woodward.

Expected Outcome:

The students would be able to design different types of foundations subjected to given loading conditions.

7CE157 Advanced Surveying

L-T-P-Cr: 3-0-0-3

Prerequisite: Surveying course should be studied**.**

Objective: To impart knowledge and skill of advanced surveying techniques and tools

Theory:

1. **Astronomical Survey**: Terms, Spherical triangle, spherical trigonometry, Time, sidereal time, apparent time, mean solar time, equation of time, universal time, standard time, conversion of time, determination of time, determination of azimuth, Latitude, Longitude **8 Lectures**
2. **Triangulation**: Triangulation figure or systems, System of framework, Station marks, signals and towers, Base line measurement, Measurements of angles, Field check in Triangulation, Trilateration **8 Lectures**
3. **Theory of Errors and Triangulation Adjustments**: Definitions, Laws of weight, Laws of accidental errors, Principle of least squares, Distribution of error to the field measurement, Normal Equation, Triangulation adjustments, Adjustment of a Geodetic Quadrilateral **6 Lectures**
4. **Trigonometrically leveling:** Correction for curvature and Refraction, Axis Signal Correction, Difference of elevation of two stations by single observation, Difference of elevation of two stations by reciprocal observations, Determination of coefficient of refraction **4 Lectures**

5. **Hydrographic Surveying**: Scope, methods of sounding, locating of sounding, three-point problem, and shoreline survey. **4 Lectures**
6. **Remote Sensing(RS)**:Introduction, Remote sensing in India, Electromagnetic energy(EME) and spectrum, Interaction of EME with matters, Sensor systems and platforms, Data acquisition and interpretation **6 Lectures**
7. **GIS and GPS:**GIS &GPS overview, Subsystems of GIS, Data for GIS(Vector $ Raster),GPS Surveying techniques and accuracy, Uses and applications of GPS

6 Lectures

Scheme of Examination:

Class test I/Assignment	:	5Marks
Class test II/Assignment	:	5Marks
Mid Semester Examination	:	20Marks
End Semester Examination	:	70 Marks

Text Books:

1. B.C. Punmia, A.K. Jain and A.K. Jain, Surveying, Vol. II and III, Laxmi Publications (P) Ltd., New Delhi
2. S.K. Duggal, Surveying, Vol-II, TMH Publications, New Delhi
3. Textbook of Surveying by C. Venkatramaiah, University Press

Reference Books:

1. K.R. Arora, Surveying, Vol. II and III, Standard Book House, Delhi.
2. R. Subramanian, Surveying and Levelling, Oxford University Press, New Delhi
3. A. M. Chandra, Higher Surveying, New age international Publications, Delhi

Expected Outcome:

The students would be able to understand about astronomical survey, triangulation, geodetic leveling, and hydrographic survey, remote sensing, GIS and GPS.

7CE158 Airport Planning and Design

L-T-P: 3-0-0 **Credits: 3**

Objective: To introduce the elements related to airport planning and design. The subject knowledge of airport configurations, geometric design, design of terminal area, structural design of airfield pavements, airport lighting and markings and air traffic control.

Theory:

1. Aircraft characteristics related to airport design; Airport configuration - Runway configurations, Relation of terminal area to runways, Runway orientation, Wind rose diagram **9 Lectures**
2. Geometric design of the airfield : ICAO and FAA design standards, Runways, Taxiways, Holding aprons and aprons **9 Lectures**
3. Planning and design of the terminal area : Apron-gate system, Size and number of gates, Aircraft parking configurations, Passenger terminal system **8 Lectures**

4. Structural design of airfield pavements **6 Lectures**
5. Airport lighting and marking **4 Lectures**
6. Air traffic control; Airport planning and air travel demand forecasting **6 Lectures**

Scheme of Examination:

Class test I/Assignment	:	5Marks
Class test II/Assignment	:	5Marks
Mid Semester Examination	:	20Marks
End Semester Examination	:	70 Marks

Text Books:

1. Khanna and Arora, Airport planning and design, Dhanpat Rai & Sons, New Delhi
2. Rangwala S.C., Airport Engineering, Charotar publishing house, Anand

Reference Books:

1. Rao, G.V, Airport Planning and Design, TMH
2. Horonjeff .R and Francis X. McKelvey, Mc Grow Hill, New York
3. Saxena S. C., Airport Engineering(Planning and Design), CBS Publications & Distributors, New Delhi

Expected Outcome:

The students should be able to plan and design the airports.

7CE159 Finite Element Methods

L-T-P: 3-0-0-3

Theory:

1. Module 1: Introduction to Finite Element Analysis, Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis. **4 Lectures**
2. Module 2: Finite Element Formulation Techniques, Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions **4 Lectures**
3. Module 3: Element Properties, Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration: One Dimensional Numerical Integration: Two and Three Dimensional **9 Lectures**
4. Module 4: Analysis of Frame Structures Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame. **6 Lectures**
5. Module 5: FEM for Two and Three Dimensional Solids Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Non linearity and Static Condensation, Ax symmetric Element, Finite Element Formulation of Ax symmetric Element, Finite Element Formulation of Ax symmetric Element, Finite Element Formulation for 3 Dimensional Elements **8 Lectures**

6. Module 6: FEM for Plates and Shells, Introduction to Plate Bending Problems, Finite Element Analysis of Thin Plate, Finite Element Analysis of Thick Plate, Finite Element Analysis of Skew Plate, Introduction to Finite Strip Method **5 Lectures**
7. Module 7: Additional Applications of FEM, Finite Elements for Elastic Stability, Finite Elements in Civil Engineering, Dynamic Analysis. **3 Lectures**

References:

1. S. Krishnamoorty, Finite Element Analysis, Tata Mc Graw-Hill
2. David V. Hutton, Fundamentals of Finite Element Analysis, Mc GrawHill
1. Maity, Computer Analysis of Framed Structures, I. K. International Pvt. Ltd. New Delhi
2. Erik G. Thompson, Introduction to the Finite Element Method: Theory, Programming and Applications, John Wiley
3. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis-Theory and Application, New York, McGraw-Hill
4. Irving H. Shames, CliveL. Dym, Energy and Finite Element Methods in Structural Mechanics; New Age International
5. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India, New Delhi, India
6. M. Mukhopadhyay, Matrix, Finite Element, Computer and Structural Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India
7. C. Zienkiewicz and Y. K. Cheung, The Finite Element Method in Structural and Soild Mechanics, Mc Graw Hill, London
8. E. Ceruzzi, A History of Modern Computing, The MIT Press, Cambridge, MA, 1998.
9. D. Cook, Concepts and Applications of Finite Element Analysis, Wiley
10. S. Rao, Finite Element Analysis, Elsevier Butterworth-Heinemann
11. W. Weaver Jr. and J. M. Gere, Matrix Analysis of Framed Structure, CBS Publishers & Distributors, New Delhi, India

7CE160 Floods and Droughts

L-T-P-Cr: 3-0-0-3

Theory:

1. FLOODS: Introduction, Rational Method, Empirical Formulae, Unit Hydrograph Method, Flood Frequency Studies, Gumbel's Method, Log Pearson Type III Distribution, Partial Duration Series, Regional Flood Frequency Analysis, Limitation of Frequency Studies, Design Flood, Design Strom **2 Lectures**

2. FLOOD ROUTING: Introduction, Basic Equation, Hydrologic Storage Routing, Attenuation, Hydrologic Channel Routing, Hydraulic Method of Flood Routing, Routing in Conceptual Hydrograph Development, Clark's Method of IUH, Flood Control, Flood Forecasting, Flood Control in India with Special Reference to Bihar **15 Lectures**

3. FLOOD MANAGEMENT TECHNIQUES: Introduction Flood Control and Management, Catchment Area Treatment, Structural Measures, Non-structural Measures **5 Lectures**

4. DROUGHTS: Climatic Regions: Arid Region, Semi-Arid Region, Humid Region; Drought: Drought and Rainfall, Drought and Classification, Drought, Rainfall and Temperature; Effect of Draught: Effects on Ground Water, Effects on Water Quality, Effects on Socio Economic

Status; Drought Control: Supply Oriented Drought Control Measures, Demand Oriented, Drought, Control Measures

Text Books:

1. Engineering Hydrology by Muteraja
2. Engineering Hydrology by Subramanim
3. Watershed Hydrology by R. Suresh, Standrad

7CE161 Irrigation Engineering and Hydraulic Structures

L-T-P- Cr: 3-0-0-3

Prerequisite:

A Pass grade or having obtained at least 75% of the classes conducted or at least 60% attendance and a minimum of 40% marks in the course (s) Engineering Hydrology and open Channel flow (CE 126).

Objective:

To impart knowledge and skills in basic principles and design of irrigation and Hydraulic Structure.

Theory:

1. Irrigation Principles and Practices: Introduction, Necessity, Advantages and disadvantages of irrigation, Types of irrigation, Methods of water distribution in the farms, Quality of irrigation water. **4 Lectures**
2. Water Requirements of Crops: Soil-Plant-Water relation, Crop period, base period, Duty and Delta and their relationship, Crop seasons, optimum use of irrigation water, Irrigation efficiencies, Different methods of estimation of consumptive use, Crop Coefficients. **5 Lectures**
3. Irrigation scheduling: Irrigation scheduling for both irrigated dry and wet crops, irrigation scheduling in command areas. **3 Lectures**
4. Canals: Classification of Canals, Canals alignments, Distribution system for canal irrigation, Regime theories: Kennedy's silt theory and design of channels on its basis, Lacey's silt theory and Design of channels on its basis. **5 Lectures**
5. Canal Head works: Selection of site for storage and diversion head-works, Weir and barrages, types and layout of diversion head-works and their components, Theories of seepage and Design of weirs and barrages on permeable foundations. **10 Lectures**
6. Canal Falls and Outlets: Types of falls and design of vertical drop fall: Types of Canals outlets or modules. **4 Lectures**
7. Cross Drainage Works: Types of C-D works, Aqueducts, Siphon Aqueducts, Super passages, Siphon super passages, level crossing. **5 Lectures**
8. Introduction to Dams: Gravity dams, earth and rock-fill dams. **6 Lectures**

Text Books:

1. Irrigation Engineering and Hydraulic Structures by S K Garg, Khanna Publication, Delhi.
2. Fundamentals of Irrigation Engineering by Bharat Singh: Nemchand Bros., Roorkee.
3. Irrigation Water Resources and Water Power Engineering by P.N. Modi, Standard Book House, New Delhi.

4. Irrigation, Water Power and Water Resources Engineering by K. R. Arora, Nem Chand Brothers, Delhi.
5. Irrigation Engineering by B. C. Punima, Laxmi Publication, Delhi.

Reference Books:

1. Water Resources Engineering, by R.K. Linsley and J.L.H. Paulhus, McGraw Hill Book Co., New Delhi
2. Hydroelectric Handbook by W.P. Creager and J.D. Justin, John Wiley, New York.

End Semester Examination (3 Hrs.):

The duration of the examination will be 3 hrs. The questions will be comprehensive, i.e. from the entire unit, may have subsections with theory and numerical with approximately 50% weight age and may / may not have choices. Minimum five questions will have to be answered.

Expected Outcome:

The students will be able to know the principles of irrigation, its type and different methods of irrigation. They will be imparted the knowledge of the hydraulics structures.

7CE162 Mechanics of Composite Materials

L-T-P-Cr: 3-0-0-3

Objective:

The objective of the course is that the students should have good appreciation of this new emerging material and its application potential in Civil Engineering.

Theory:

1. Introduction to Composites **3 Lectures**
2. Basic constituent materials in Composites **4 Lectures**
3. Behaviors of a Lamina. **4 Lectures**
4. Laminated Composites: **6 Lectures**
5. Strength and Failure theories **4 Lectures**
6. Design Concepts **5 Lectures**
7. Manufacturing Processes **6 Lectures**
8. Creating Special Topics, Engineering Applications, Civil Engineering Applications **10 Lectures**

Texts/References

1. Autar K. Kaw, Mechanics of Composite Materials, CRC Press, 2005.
2. Robert M. Jones, Mechanics of Composite Materials, CRC Press; 2nd Revised edition (16 November 1998)

7CE163 Solid Waste Management

L-T-P-Cr: 3-0-0-3

Objective:

To impart knowledge and skill for solid waste identification, classification and Components of solid waste, and their management.

Theory:

1. Solid wastes-Sources, nature and characteristics, and Quantities, Rates of generation and factors affecting them. **7 Lectures**
2. Potential of diseases, nuisances and other problems due to solid wastes. **2 Lectures**

3. Changing nature of solid wastes and its impact on solid waste management.

3 Lectures

4. Solid wastes management- Generation, on-site storage, collection, separation, processing and disposal, On-site storage methods-containers, their type, size and location.

8 Lectures

5. Collection systems-Vehicles, routing, route balancing and transfer stations.

7 Lectures

6. Processing methods, recovery and reuse of materials and energy. **5 Lectures**
7. Disposal methods such as sanitary landfill biological digestion etc. **4 Lectures**
8. Industrial and Hazardous solid waste management, Urban solid waste management and its modeling. **6 Lectures**

Text Books:

1. Tchobanoglous, George; Theisen, Hilary; Vigil, Samuel "Integrated Solid Waste Management: Engineering Principles and Management Issues" 2nd Edition, TMH
2. Michael D. LaGrega, Philip L. Buckingham, Jeffery C. Evans, HAZARDOUS WASTE MANAGEMENT Second Edition, TMH
3. McBean, Rovers & Farquhar "Solid Waste Landfill Engineering and Design" Prentice Hall

Reference Books:

1. Mackenzie L. Davis, and David A. "INTRODUCTION TO ENVIRONMENTAL ENGINEERING" Fourth Edition, TMH

End Semester Examination:

The duration of the Examination will be 3 hrs. The questions will be comprehensive, i.e. from the entire unit, may have subsections with both theoretical and (or) numerical exercises.

Expected Outcome:

The students would be able to classify and manage the different types of solid waste and also able to minimizing the solid waste production.

7CE164 Transportation Systems and Planning

L-T-P-Cr: 3-0-0-3

Objective: To introduce the planning process and travel demand analysis.

Theory:

1. **Transportation planning process and concepts:** Role of transportation, Transportation problems, Urban travel characteristics, Concept of travel demand, Demand function, Demand estimation **8 Lectures**
2. **Trip Generation Analysis:** Zoning, types and sources of data, expansion factors, Accuracy checks, Trip generation models (Zonal models, Household models, Category analysis, Trip attraction of work centers) **9 Lectures**
3. **Trip Distribution Analysis**: Trip distribution models, Growth factor models, Gravity models, Opportunity models **8 Lectures**

4. **Model Split Analysis:** Model split models, Mode choice behavior, Competing models, Mode split curves, Probabilistic models **8 Lectures**
5. **Traffic Assignment:** Route split analysis, Elements of transportation networks, Nodes and links, Minimum path trees, All-or-nothing assignment, Multiple assignment, Capacity restraint **9 Lectures**

Scheme of Examination:

Class test I/Assignment	:	5Marks
Class test II/Assignment	:	5Marks
Mid Semester Examination	:	20Marks
End Semester Examination	:	70 Marks

Text Books:

1. Kadiyali, L. R.,'Traffic engineering and transport planning',6th edition,Khanna publishers
2. Khisty C.J &LallB.K.,Transportation Engineering, Prentice Hall of India
3. Papacostas, C. S., Fundamentals of Transportation Engineering, Prentice Hall of India, New Delhi

Reference Books:

1. PrakashRao and Sundaram, Regional Development Planning in India, Vikas Publishing House.
2. B.G. Hutchinson, Introduction to Urban Transportation Systems Planning, McGraw Hill.
3. Vukan R. Vuchic, Urban Public Transportation Systems and Technology, Prentice Hall Inc., N.J.
4. G.E. Gray and L.A. Hoel, Public Transportation Planning Operations and Management, Prentice Hall Inc.

Expected Outcome:

The students will be able to forecast travel demand and analyze the trip route distribution, modal split and traffic assignment.

8CE168 Bridge Engineering

L-T-P-Cr: 3-0-0-3

Objective:

The objective of the course is to make the students learn basics and design of bridges and to make them aware of the codal provisions of bridges design.

Theory:

1. Brief historical review, Different types of Bridges and span range, Bridge codes. **8 Lectures**
2. Bridge super structures ,Reinforced concrete slab bridge decks, Tee beam and slab deck, box culverts **10 Lectures**
3. Load distribution in different girders – Courbon's method, Morice-Little method. **8 Lectures**
4. Box girder bridges - finite element and finite strip analyses, finite difference analysis of deck slab, **8 Lectures**
5. Grillage analysis. Cable stayed and suspension bridges; Bridge construction; Bridge

maintenance. **8 Lectures**

Texts/Reference Books:

1. Bridge Engineering, Victor et. al., TMH.
2. Pre stressed Concrete Bridges by N Krishna Raju CBS Pub
3. Design and Construction of Highway Bridges by K S Rakshit, Central Publication

8CE169 Design of Plate and Shell Structures

L-T-P-Cr: 3-0-0-3

Objective:

The objective of the course is to make the students learn basics of design of plate and shell structures

Theory:

1. Pure bending of plates; Symmetric bending of circular plates; Small deflection of laterally loaded plates; Rectangular plates with various edge conditions; Continuous rectangular plates: **8 Lectures**
2. Plates of various shapes: Shells as space enclosure, geometry, classification, principal and Gauss curvature; General theory of thin elastic shells; **8 Lectures**
3. Shallow and high rise shells; Circular long and short cylindrical, shells, beam-arch approximation for long shells; **8 Lectures**
4. Shells of double curvature, surfaces of revolution and translation; Circular, elliptic and hyperbolic paraboloids, conoids and funicular shells - membrane and approximate bending theories: **8 Lectures**
5. Closed form and numerical methods of analysis of synclastic and anticlastic shells. **10 Lectures**

Texts/References:

1. G. S. Ramaswami, Design and Construction of Concrete Shell Roofs, CBS Publishers, New Delhi, 2004.
2. M. L. Gambhir, Stability Analysis and Design of Structure, Springer, 2009.
3. S. P. Timoshenko and W. W. Krieger, Theory of Plates and Shells, McGraw Hill, 2nd Ed, 1964.
4. R. Szilard, Theory and Analysis of Plates - Classical and Numerical Methods, John Wiley and Sons, 2004.
5. A. Zingoni, Shell Structures in Civil and Mechanical Engineering, Thomas Telford, 1997.
6. S. P. Timoshenko and J. M. Gere, Theory of Elastic Stability, Dover Publications, 2nd Ed, 2009.
7. A. Chajes, Principles of Structural Stability Theory, Pearson Education Limited, 1993.

8CE170 Disaster Management and Mitigation

L-T-P-Cr: 3-0–0-3

Objective:

The objective of the course is to make the students learn basics of disaster management and mitigation.

Theory:

1. Disasters: Natures and Extent of Disasters, Natural Calamities (such as Earthquake, Floods, Drought, Volcanoes, Forest, Coastal Hazards, Landslides, Cyclones etc.). Manmade Disasters: such as Chemical and Industrial Hazards, Nuclear Hazards, Fire Hazards etc **5 Lectures**
2. Disaster Management: Disaster Response, Rehabilitation, Reconstruction and Recovery, Legal Aspects, Rescue Operations, Emerging Trends in Disaster Mitigation, Role of Information Technology, Community Based Disaster Preparedness Plan, National Disaster Preparedness Plan **5 Lectures**
3. Strategies for Earthquake Protection and Mitigation: Creating a Safety Culture, Construction Control Building Code Upgrading, Education and Enforcement, Targeting Weak Buildings, Education and Training for Engineers and other Professions, Public Awareness, Micro Zoning and Land -use Planning Emergency Planning, Self - Protection in an Earthquake. **8 Lectures**
4. Flood and Mitigation: Mitigation Measures, Preparedness, Readiness, Emergency Response and Rehabilitation, Flood Damages, Institutional Arrangement, Collaboration and Coordination **8 Lectures**
5. Droughts and Mitigation: Mitigation and Adaptation Measures, Drought Damages, Drought Management, Institutional Arrangement, Collaboration and Coordination **5 Lectures**
6. Risk Management: Framework of Risk Management, Risk Decision - Making Principles Risk Assessment Methods, Prevention, Preparedness and Mitigation, Tools Strategies and Organization Arrangements **5 Lectures**
7. Emergency Management Programme: Administrative and Organization, Hazard Analysis, Training of Personnel, Information Management system, Emergency Facilities - Trauma and Stress Management, Rumors and Panic Management, Public Awareness Creation, Preparation and Execution of the Emergency Management Programme, Needs Assessment and Immediate Response, Suppliers and Logistics, Health, Flood and Nutrition, Water, Sanitation and Environmental Services, Social Services and Education, Field Level Management **6 Lectures**

Text Books:

1. Joseph Gustin, Disaster & Recovery Planning: A guide for facility managers, 4th Edition Fairmont Press, 2002.

8CE171 Groundwater Engineering

L-T-P-Cr: 3-0-0-3

Objective: Students will be imparted upon knowledge of the formation of the aquifer and its properties, flow through porous media and its applications in Civil Engineering.

Theory:

1. **Introduction:** Ground water development in India, Soil moisture, Classification of subsurface water. **4 Lectures**
2. **Characteristics of fluid and the Medium**, Specific yield, Porosity, Storage co-efficient, Permeability, Compressibility, Aquifers, Classification of aquifer. **5 Lectures**
3. **Darcy's law**, Range of validity of Darcy's law, Co-efficient of permeability, Determination of permeability. **4 Lectures**
4. **General Hydrodynamics:** Equations for the flow of Fluids through Porous media. The Equation of continuity, Equations of motion, Dupuit's equations for unconfined seepage flow, Plane free surface flow with horizontal impervious base without infiltration, Plane free surface flow with horizontal impervious boundary with infiltration and evaporation, Confined and semi-confined flow. **10 Lectures**
5. **Unconfined flow** towards well with uniform infiltration from the ground surface, Confined radial flow towards the well, Discharge as a function of drawdown, well efficiency, Radius of influence, Lowering of ground water table, Unsteady confined flow, well losses. **8 Lectures**
6. Design and construction of different types of wells. **4 Lectures**
7. **Geophysical Investigations:** Surface geophysical techniques, Electrical resistivity, Seismic refraction and reflection, other methods. **4 Lectures**
8. **Ground Water Quality:** Ground Water sampling, potable water standards of WHO& BIS. **3 Lectures**

Text Books:

1. M.H. Raghunath, Groundwater Hydrology, New Age Publication, New Delhi.
2. Charles Fitts, Groundwater Science, Academic Press.
3. V.C. Agarwal, Groundwater Hydrology, PHI.

Reference Books:

1. Todd, David Keith (2007), Ground Water Hydrology, Wiley India Edition, New Delhi-110002.
2. Charles Fitts, Groundwater Science, Academic Press.
3. Bear, J., Hydraulics of Groundwater, McGraw Hill, New York.
4. Freeze and Cherry, Groundwater Hydrology.

Expected Outcome:

Students will be able to understand and use basic equations of flow through porous media and its applications.

8CE172 Industrial Waste Treatment

L-T-P: 3-0-0 **Credits: 3**

Objective:

To impart knowledge for the various techniques employed for characterisation and quantification of waste/wastewater generated by various industrial activities, and safe disposal of treated waste/wastewater employing appropriate treatment methods in to the environment.

Theory:

1. Industrial wastewaters, nature and effects, water pollution and problem pollutants **3 Lectures**
2. Stream sanitation, de-oxygenation and self-purification in streams **2 Lectures**
3. Sources and characteristics of industrial wastewaters, sampling and analysis **2 Lectures**
4. In-plant waste control and water reuse **3 Lectures**
5. Different methods of treatment, aeration, sedimentation, floatation and coagulation, aerobic and anaerobic digestion **8 Lectures**
6. Ion exchange, reverse osmosis, adsorption, combined biological, physical and chemical process **6 Lectures**
7. Application of treatment methods to some selected industries **12 Lectures**
8. Introduction to ISO: 14,000, Life cycle analysis etc. **6 Lectures**

Text Books:

1. Waste Water Engineering: Treatment and Reuse, Metcalf & Eddy, T.M.H. Publication. Environmental Engineering by Peavy H.S, Rowe D.R. and Tchobanoglous G, Tata McGraw Hills, New Delhi.

Reference Books:

1. G.M. Fair, J.C. Geyer, D.A. Okan, Elements of Water Supply and Wastewater Disposal, John Wiley and Sons Inc.
2. Terence, J. McGhee Water Supply and Sewerage, McGraw Hill Book Co.
3. M.J. Hammer, Water and Waste Water Technology, John Wiley and Sons, New York.
4. CPHEEO: Manual on Sewerage and Sewage Treatment, Ministry of Works and Housing, New Delhi.

End Semester Examination: The duration of the Examination will be 3 hrs. The questions will be comprehensive, i.e. from the Entire unit, may have subsections with both theoretical and (or) numerical exercises.

Expected Outcome: The students would be able to characterize and quantify of wastewater generated from the various industry, able to design the various process for the treatment of the Industrial wastewater.

8CE173 Rock Mechanics

L-T-P-Cr: 3-0-0-3

Theory:

1. Introduction to rock mechanics, engineering classification of rocks,
2. Engineering properties of intact rocks, Determination of in-situ properties; shear strength, deformation,
3. Application to rock slopes, rock blasting,
4. Ground improvement techniques in rocks
5. Bearing Capacity of Rocks

Text Books:

1. Jaegar and Cook, Foundation of Rock Masses
2. Goodman, Introduction to Rock Mechanics, Wiley international

8CE174 Soil Dynamics

L-T-P: 3-0-0-3

Theory:

1. Principles of dynamics and vibrations, Single degree and multi degree of freedom system – free and forced vibrations. **10 Lectures**
2. Dampening and Soil spring constants, Introduction to vibration of continuous system – wave propagation in soil media. **8 Lectures**
3. Laboratory and In-situ determination of dynamic properties. **6 Lectures**
4. Introduction to machine foundations and its practical considerations for construction IS code of Practice. **8 Lectures**
5. Soil Liquefaction. **10 Lectures**

Text Books:

1. Srinivasulu and Vidyanathan, Handbook of Machine Foundations, TMH, New Delhi.

8CE175 Structural Dynamics & Earthquake Resistant Design

L-T-P-Cr: 3-0-0-3

Objective:

The objective of the course is that the students should have good concepts of dynamics of structures

Theory:

1. SDOF systems: Equations of Motion, Free vibration, damping, forced vibrations under Harmonic, impulse and general loadings **6 Lectures**
2. Response spectrum Generalized SDOF systems: Rigid body distributed mass and stiffness systems; MDOF Systems: Dynamic properties, modal damping, classical damping, modal superposition methods. **7 Lectures**
3. Numerical methods in dynamics: Eigen value analysis, direct integration scheme: Continuous systems: Equations of motion. **5 Lectures**
4. Hamilton's principle, Lagrangian formulation, Free and force vibration scheme, Wave propagation. **8 Lectures**

5. Introduction to Random vibration: Random variables, Random process, moment and characteristic function, **8 Lectures**
6. Spectral analysis, response to random excitation; Application of structural dynamics in the design of block and frame foundation. **5 Lectures**
7. Introduction of Earthquake Engineering and Design of Earthquake Resistance Structures as per IS Codes **5 Lectures**

Texts/References

1. R.W. Clough and J. Penzien, Dynamics of Structures, Second edition, McGraw Hill
2. International edition, 1993.
3. Mario Paz, Structural dynamics, CBS Publishers 1987.
4. Anil K. Chopra, Dynamics of structures: Theory and applications to earthquake
5. Engineering, PHI Ltd., 1997.
6. K. Rao, Vibration analysis and foundation dynamics, Wheeler, 1998.
7. E. Siniu and R. H. Scanlan, Wind effects on structures: fundamentals and applications to Design, John Wiley and Sons, 1997.

8CE176 System Engineering

L-T-P-Cr: 3-0-3

Objective: At the end of the module the reader will be able to

1. Understand the need and origin of the optimization methods.
2. Get a broader picture of the various applications of optimization methods used in engineering.
3. Define and optimization problem and its various components.
4. Formulate optimization problems as mathematical problems.
5. Classify optimization problems to suitably choose the method needed to solve the particular type of problem.
6. Briefly learn about classical and advanced techniques in optimizations.

Theory:

1. Introduction to the course and its importance towards Civil Engineering Optimization methods: - Introduction, mathematical principles in optimization. Modelling with linear programming, Problem formulation, Transportation and assignment problem, manpower planning problems, etc. **10 Lectures**
2. Solution techniques for LPP: graphical approach to problem solving, transition from graphical to algebraic solution, simplex and dual simplex method, primal dual, generalized simplex method, Introduction to civil engineering case studies. **12 Lectures**
3. Classical optimization Techniques: Introduction single variable optimization, multi, variable optimization with no constraints, multivariable optimization with equality and inequality constraints. Direct method of constrained optimization. **12 Lectures**
4. Introduction to nonlinear programming algorithms, Lagrange Multipliers, Kuhn Tucker Conditions. **8 Lectures**

Text Books:

1. S.S .Rao , Optimization Theory And Application
2. H. A. Taha , Operations Research An Introduction

8CE177 Water Resources Planning and Management

L-T-P-Cr: 3-0-0-3

Prerequisite: A Pass grade or having obtained at least 75% attendance and minimum of 50% marks in Hydrology and Irrigation Engineering.

Objective: This course provides a firm foundation in water excess management concepts, storm water control and economics in water resources, linear programming for water resources, integrated water resources management and planning.

Theory:

1. **Flood Control-** Introduction to floods, Floodplain management, Flood control alternatives, Flood damage and net benefit estimation, Flood estimation and forecasting. **7 Lectures**
2. **Drought Management-** Types of drought, Drought management options, Drought severity, Economic aspects of water shortage. **5 Lectures**
3. **Water Quality-**Water pollution, Basic parameters of water, Inorganic and organic chemicals, Water quality management. **6 Lectures**
4. **Engineering Economy in Water Resources -** Benefit-cost analysis, Evaluation of alternatives, Price elasticity of water demand, Demand models. **8 Lectures**
5. **Linear Programming and its Application in Water Resources -** Introduction to linear programming, Linear programming model, Assumptions of linear programming, Simplex method for linear programming. **8 Lectures**
6. **Water Resources Planning -** Levels of planning, Phases and objectives, Data requirements, Project formulation and evaluation, Environmental considerations, Multi-purpose projects. River Basin Planning, Integrated Water, Resources Management. **8 Lectures**

Text Books:

1. Linsley, R.K., Franzini. J.B., Freygerg, D.L., and Tchnbanoglous G. (1992): Water Resources Engineering, McGraw Hill Book Co.
2. Mays, L.W. (2005): Water Resources Engineering, John Wiley & Sons, Inc.

Reference Books:

1. Hillier F.S. and Lieberman G.J. (2001): Introduction to Operation Research, McGraw Hill Book Co.
2. Cech T.V. (2009): Principles of Water Resources: History, Development, Management and Policy, 3rd edition, John Wiley and sons inc.
3. Stephenson D. (2003): Water Resources Management, Swets and Zeitlinger B.V. Lisse, the Netherlands.
4. Chandrakumar G. and Mukundan N. (2006): Water Resources Management: Thrust and Challenges, Sarup and sons.
5. Jain, S.K. and Singh, V.P., Water Resources, Oxford Publications.

Expected Outcome:

Students will be able to understand the processes in water resources and to impart the knowledge of planning and managements of water resources.

CE 178 Civil Engineering Drawing Using Auto CAD

L-T-P: 3-0-0 **Credits: 3**

Prerequisite:

Students should have a sound knowledge of basics of structural analysis.

Objective:

The objective of the course is to make the students learn basics of Civil Engineering Drawing Using Auto CAD

Theory:

1. **Introduction to Auto-Cad**: Loading and configuring AUTO CAD Starting a new drawing, setting units, limits command, o-snap, snap, grid, ortho, cords, etc. **3 Lectures**
2. **Data Entrie**s, Absolute coordinates, Relative and polar coordinates **3 Lectures**
3. **Study of entity drawing commands**: line, spline, pline, circle, arc, ellipse, donut, polygon, chamfer, offset, fillet, etc. **4 Lectures**
4. **Study of utility commands:** explode, layer, undo, redo, oops, save, quit, color, line type, etc. **6 Lectures**
5. **Study of editing commands**: erase, move, copy, array, rotate, mirror, break, extend, trim, stretch, change, etc. **6 Lectures**
6. **Study of hatching commands**: hatch, bhatch, hatch edit **3 Lectures**
7. **Study of dimensioning commands:** linear commands, angular commands, diameter dimensioning, radius dimensioning **3 Lectures**
8. **Creating texts and defining block attributes:** all commands related to text and characters **6 Lectures**
9. **Isometric drawing:** isometric projection, ISO- AXIS, etc. **4 Lectures**
10. **Civil Engineering drawing practice through sessional** **4 Lectures**

Texts/References

1. NighatYasmin, Introduction to AutoCAD 2014 for Civil Engineering Applications, Schroff Development Corp, 2013
2. Sham Tickoo, Anurag, AUTOCAD 2013 FOR ENGINEERS AND DESIGNERS, Dreamtech Press, 2012
3. Donnie Gladfelter, AutoCAD 2014 and AutoCAD LT 2014 , Wiley, 2013
4. Brian C. Benton, George Omura, Mastering AutoCAD and AutoCAD LT - 2014 , Wiley, 2013
5. Ellen Finkelstein,AutoCAD 2012 &AutoCAD Lt 2012 , Wiley India Pvt Ltd, 2011

Expected Outcome:

It is expected that the students will gain sound concept of Civil Engineering Drawing.

CE 179 Advanced Steel Structures

L-T-P: 3-0-0 **Credits: 3**

Prerequisite:

Students should have a sound knowledge of Structural Analysis.

Objective: The objective of the course is to make the students learn design of advanced steel structural members and to make them aware of the codal provisions of steel design.

Theory:

1. Design of seat connection , stiffened and unstiffened seat connection **6 lecture**
2. Design of plate girders **8 Lectures**
3. Design of gantry girders **6 lectures**
4. Design of Industrial building **8 lecture**
5. Design of pressed steel water tanks **7 lectures**
6. Design of steel bridges: foot bridge **7 lectures**

Text Books:

1. S. K .Duggal, “Design of Steel Structures”, Tata McGraw Hill Publishing Co.Pvt. Ltd. 3rd Edition, (2008).
2. N Subramanaim,”Design of Steel Structures: Theory and Practice”, Oxford University Press, (2010).

References:

1. Edwin H. Gaylord, “Design of Steel Structures”, Tata McGraw Hill Publishing Co.Pvt.Ltd. 3rd Edition, (2010).
2. Jack C. McCormac, “Structural Steel Design”, Prentice Hall, (2008).

Expected Outcome:

It is expected that the students will gain sound concept of advanced steel structural behaviour and design.

CE 181 Theory of Plate and Shell Structures

L-T-P: 3-0-0 **Credits: 3**

Prerequisite:

Students should have a sound knowledge of basics of structural analysis.

Objective:

The objective of the course is to make the students learn basics of design of plate and shell structures

Theory:

1. Pure bending of plates; Symmetric bending of circular plates; Small deflection of laterally loaded plates; Rectangular plates with various edge conditions; Continuous rectangular plates: **8 Lectures**
2. Plates of various shapes:Shells as space enclosure, geometry, classification, principal and Gauss curvature; General theory of thin elastic shells; **8 Lectures**
3. Shallow and high rise shells; Circular long and short cylindrical,shells, beam-arch approximation for long shells; **8 Lectures**
4. Shells of double curvature, surfaces of revolution and translation; Circular, elliptic and hyperbolic paraboloids, conoids and funicular shells - membrane and approximate bending theories: **8 Lectures**
5. Closed form and numerical methods of analysis of synclastic and anticlastic shells. **10 Lectures**

Texts/References:

1. G. S. Ramaswami, Design and Construction of Concrete Shell Roofs, CBS Publishers, New Delhi, 2004.
2. M. L. Gambhir, Stability Analysis and Design of Structure, Springer, 2009.
3. S. P. Timoshenko and W. W. Krieger, Theory of Plates and Shells, McGraw Hill, 2nd Ed, 1964.
4. R. Szilard, Theory and Analysis of Plates - Classical and Numerical Methods, John Wiley and Sons, 2004.
5. A. Zingoni, Shell Structures in Civil and Mechanical Engineering, Thomas Telford, 1997.
6. S. P. Timoshenko and J. M. Gere, Theory of Elastic Stability, Dover Publications, 2nd Ed, 2009.
7. A. Chajes, Principles of Structural Stability Theory, Pearson Education Limited, 1993.

Expected Outcome:

It is expected that the students will gain sound concept of design of plate and shell structures

CE 182 Engineering Optimization

L-T-P: 3-0-0 **Credits: 3**

Detailed Course Outline

Prerequisite: Students should have done basic course in engineering mathematics.

Objective: To provide basic knowledge to find optimal solution for particular type of problem.

1. MODULE – I

Introduction to the course and its importance towards Civil Engineering Optimization methods: - Introduction, mathematical principles in optimization. Modelling with linear programming, Problem formulation, Transportation and assignment problem, manpower planning problems, etc. **10 Lectures**

2. MODULE – II

Solution techniques for LPP: graphical approach to problem solving, transition from graphical to algebraic solution, simplex and dual simplex method, primal dual, generalized simplex method, Introduction to civil engineering case studies. **12 Lectures**

3. MODULE – III

Classical optimization Techniques: Introduction single variable optimization, multi, variable optimization with no constraints, multivariable optimization with equality and inequality constraints. Direct method of constrained optimization. **12 Lectures**

4. MODULE – IV

Introduction to nonlinear programming algorithms, Lagrange Multipliers, Kuhn Tucker Conditions, Genetic Algorithms. **8 Lectures**

Text Books:

1. S.S.Rao ; Optimization Theory And Application
2. H.A.Taha ; Operations Research An Introduction

Expected Outcome: The students should be able to find optimal solution for particular type of problem.

CE 183 Structural Analysis

L-T-P: 3-1-0 **Credits: 4**

Detailed Course Outline

Prerequisite: Students should have done basic course in mechanics of solid/strength of materials.

Objective: To provide basics to solve problems in structures.

1. MODULE-I

Basic Introductory Concepts: Structural Systems, Elements, Joints, Stability, equilibrium, Compatibility, Indeterminacy, Types of Loading.Methods of analysis: Displacement Analysis of Statically Determinate Beams and Trusses Unit Load and energy methods, Moment Area and Conjugate Beam Methods. **10 Lectures**

2. MODULE-II

Influence Lines for Beams and Trusses under moving loads Mueller Breslau's Principle with applications and Energy theorems.Analysis of two and three hinged arches. **10 Lectures**

3. MODULE-III

Analysis of statically and kinematically indeterminate structure by Energy methods, Clapeyron's theorem; slope-deflection method, moment distribution method and Kani's method. **10 Lectures**

4. MODULE-IV

Analysis of statically Indeterminate Structures by the Direct Stiffness Method, Flexibility methods and approximate methods. **12 Lectures**

Text Books:

1. Design of steel Structures- S.K. Duggal, Tata McGraw Hill, New Delhi.
2. Basic Structural Analysis - C.S. Reddy, Tata McGraw Hill, New Delhi.
3. Elementary Structural Analysis - Norris, Wilbur and Utku, McGraw Hill.
4. Intermediate Structural Analysis - C.K. Wang, McGraw-Hill.
5. Theory of Structures - Volumes 1 and 2, S P Gupta and G S Pandit, Tata McGraw Hill.
6. Structural Analysis - L.S. Negi& R.S. Jangid, Tata McGraw Hill.
7. Theory of Structures- B.C. Punima, Laxmi Publications.

CE184 Building Science

L-T-P-Cr: 3-0-0-3

Theory:

1. Building construction: overview of building process; Introduction to Building Laws and IS Codes, Different types of loads in Buildings, Load Combinations, IS Code provisions for Loads in Buildings. **7 Lectures**
2. Foundations-shallow foundations (simple calculations). **3 Lectures**
3. Superstructure - load bearing masonry, arches, lintels, scaffolding, formwork; Floors and roofs - flat and pitched roofs, centring, floor finishes; Staircases and other elements of construction; Doors andwindows; Building services - vertical transportation, plumbing, electrical; Ventilation and Air-conditioning, Energy efficiency, Fire Protection, Acoustics and Sound Insulation, Damp Proofing, Termite Proofing, Carpentry and Joinery. **10 Lectures**
4. Concrete - concrete making materials, properties and types of cement, properties of concrete in fresh and hardened state, durability, special concrete. **7 Lectures**
5. Building Stones: Varieties of Indian Stones, Quarrying blasting, Dressings of stones, Characteristics of good building stones, Slate, Marble, Artificial stones, Stone preservation. Bricks and brick masonry: Manufacture, Properties, classification and specifications, Brick masonry and principles of design of masonry structures. **9 Lectures**
6. Timber, Steel - properties, and types: Miscellaneous materials: Polymers and plastics, composites and smart materials. **6 Lectures**

Text Books:

1. Neville, A.M. & Brooks, J.J., Concrete Technology, Pearson Education.
2. Jackson, N. &Dhir, R.K., Civil Engineering Materials. ELBS.
3. S. C. Rangwala, —Building Construction, Charotar Publishing House, Anand, 1993.

4. TTTI Chandigarh, Civil Engineering materials

Reference Books:

1. R. Chudley, Construction Technology - Volumes 1 and 2, 2nd Edition, Longman, UK
2. W. B. McKay, Building Construction - Volumes 1, 2, 3, and 4, 5th Edition, Orient Longman, UK, 1993.
3. Michael S. Mamlouk and John P. Zaniewski, Materials for Civil and Construction Engineers, Addison Wesley Longman Inc., USA.
4. A. V. Srinivasan and D. M. McFarland, Smart Structures: Analysis and Design, Cambridge University Press, UK, 2001.

CE185 Civil Engineering Drawing Using Auto CAD

L-T-P: 3-0-0-3

Objective:

The objective of the course is to make the students learn basics of Civil Engineering Drawing Using Auto CAD

Theory:

1. Introduction to Auto-Cad: Loading and configuring AUTO CAD Starting a new drawing, setting units, limits command, o-snap, snap, grid, ortho, cords, etc. **3 Lectures**
2. Data Entries, Absolute coordinates, Relative and polar coordinates **3 Lectures**
3. Study of entity drawing commands: line, spline, pline, circle, arc, ellipse, donut, polygon, chamfer, offset, fillet, etc. **4 Lectures**
4. Study of utility commands: explode, layer, undo, redo, oops, save, quit, color, line type, etc. **6 Lectures**
5. Study of editing commands: erase, move, copy, array, rotate, mirror, break, extend, trim, stretch, change, etc. **6 Lectures**
6. Study of hatching commands: hatch, bhatch, hatch edit **3 Lectures**
7. Study of dimensioning commands: linear commands, angular commands, diameter dimensioning, radius dimensioning. **3 Lectures**
8. Creating texts and defining block attributes: all commands related to text and characters **6 Lectures**
9. Isometric drawing: isometric projection, ISO- AXIS, etc. **4 Lectures**
10. Civil Engineering drawing practice through sessional **4 Lectures**

Texts/References

1. NighatYasmin, Introduction to AutoCAD 2014 for Civil Engineering Applications, Schroff Development Corp, 2013
2. Sham Tickoo, Anurag, AUTOCAD 2013 FOR ENGINEERS AND DESIGNERS, Dreamtech Press, 2012
3. Donnie Gladfelter, AutoCAD 2014 and AutoCAD LT 2014 , Wiley, 2013
4. Brian C. Benton, George Omura, Mastering AutoCAD and AutoCAD LT - 2014 , Wiley, 2013
5. Ellen Finkelstein,AutoCAD 2012 &AutoCAD Lt 2012 , Wiley India Pvt Ltd, 2011

Department of Computer Science & Engineering

CS101 Introduction to Computing

L-T-P-Cr: 2-1-0-3

Syllabus:

Unit 1. **Introduction to Programming, Algorithms and Flow Chart:** Generation of programming languages, steps involved in Problem Solving, Algorithm, Flow chat, Pseudo code

1 Lecture

Unit 2. **Basics of C:** A Simple C program, Header files, data types and sizes, Constants, variables, token, identifiers, Operators: arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators; expressions, L-value, r-value, type conversions, conditional expressions, precedence and order of evaluation, data type conversion, mixed- mode operation, Managing Input and Output operation (formatted and unformatted) **3 Lectures**

Unit 3. **Control Statements:** Conditional control statement—if, if-else, nested-if, switch; Go-to-statement; Looping—while, do-while, for, nested for; jumps in loops—break and continue statement **4 Lectures**

Unit 4. **Arrays:** Definition, one-dimensional arrays—declaration and initialization, two—dimensional arrays, multidimensional arrays, dynamic arrays **3 Lectures**

Strings: Introduction, Declaring and initializing strings, reading and writing strings, String Handling Function, Implementation of string functions, Arithmetic operation on strings, comparison of Strings. **3 Lectures**

Unit 5. **Functions:** Function definition, arguments and parameters, categories of function, scope and extent, Storage classes, static and register variables, parameter passing mechanism, Inline function, nesting of function, recursion, passing arrays to function, passing strings to function, variable length argument list. **4 Lectures**

Unit 6. **Pointers:** Understanding memory address, declaring and initializing pointer variables, void pointer, null pointer, accessing a variable through pointer, array and pointer, pointer and string, pointer as function arguments, Pointer arithmetic, pointers to pointer, function returning pointer , pointers and structure, Dynamic memory allocation (Malloc , Calloc, releasing the used space, Realloc), Memory leak and memory corruption. **9 Lectures**

Unit 7. **User defined data:** Structure- defining, declaring, initializing; accessing structure members, processing of structure , array of structures, structures within structure, structure and function, type definition; Union—definition, declaration, accessing union members , initializing union Types: **4 Lectures**

Unit 8. **Pre-processor:** Introduction, macro substitution, File Inclusion, Compiler control Directives **1 Lectures**

Unit 9. **Files:** Introduction, file declaration, opening and closing a file, working with text and binary files, I/O operations on file, error handling, random access to files **4 Lectures**

Unit 10.**Graphics programming:** Introduction, Command line argument, function used in graphics, drawing shapes, designing using graphics. **3 Lectures**

Suggested Readings:

1. Pradip Dey and Manas Ghosh, Programming in C, Oxford
2. Ashok kamthane, Programming in C, Pearson Education,
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
3. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
4. Practical C Programming (3rd Edition) by Steve Oualline, O'reilly Press
5. C: The Complete Reference by Herbert Schildt, TMH

CS103 Data Structures and Algorithms

L – T – P: 3-1-0-4

Objectives: To provide theoretical concept of classical data structures.

Pre-requisites: CS 101 (Basic Computation and Principles of C/C++)

Outcome: Ideally this course should act as a primer/pre-requisite for CS 119 (Design and Analysis of Algorithms). On completion of this course, students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in C or in their known language, how their drawbacks can be overcome and what the applications are and where they can be used. Students should be able to learn about the data structures/ methods/algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/ method/algorithm in a program to enhance the efficiency (i.e. reduce the run-time) or for better memory utilization, based on the priority of the implementation. Detailed time analysis of the graph algorithms and sorting methods are expected to be covered in CS 119 but it is expected that the students will be able to understand at least the efficiency aspects of the graph and sorting algorithms covered in this course. The students should be able to convert an inefficient program into an efficient one using the knowledge gathered from this course

UNIT I: **Lectures: 9**

Introduction: Why we need data structure? , Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type, Algorithms and programs, basic idea of pseudo-code, Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Array: Different representations – row major, column major, Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List: Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

UNIT II: Linear Data Structure **Lectures: 8**

Stack and Queue: Stack and its implementations (using array, using linked list), applications. Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications.

Recursion: Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.

UNIT III: Nonlinear Data structures **Lectures: 15**

Trees: Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree, Binary search tree- operations (creation, insertion, deletion, searching).

Height balanced binary tree – AVL tree (insertion, deletion with examples only).

B- Trees – operations (insertion, deletion with examples only).

Graphs: Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree cut vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected

component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list.

Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in

DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications.

Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).

UNIT IV. Sorting, Searching and Hashing **Lectures: 10**

Sorting Algorithms: Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort.

Searching: Sequential search, binary search, interpolation search.

Hashing: Hashing functions, collision resolution techniques

Text Book:

1. CLASSIC DATA STRUCTURES, DEBASIS SAMANTA, PHI
2. Micheal T Goodrich and Roberto Tamassin : "Data Structures and Algorithms in Java (John Willey and Sons , Inc 1991)
3. Data Structures using C, 2nd edition by A. K. Sharma, Pearson

CS105 Object Oriented Methodology

L – T – P-Cr:3 – 1 – 0-4

Objectives: To provide theoretical and practical concept of object oriented programming.
Pre-requisites: Programming in C language.
Expected Outcomes: After going through these subject students will learn the introduction to object oriented programming, how classes and objects can be defined, declared and used in C++, different types of inheritance, function and operator overloading, polymorphism and virtual functions, different types of templates, exception handling, file operations and etc.

UNIT I **Lectures: 12**

Introduction to C++: Object Oriented Technology, Advantages of OOP, Input-output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derives data types, The *void* data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings.

Control Statements: Conditional Expressions, Loop Statements, Nested Control Structures, Breaking Control Structures.

Functions and Program Structures: Defining a Function, Function Prototypes, Parts of Function, User-defined Functions, Structure of the C++ Program, Nested Function, Scope rules, Storage Class Specifiers, Recursive Functions.

UNIT II **Lectures: 10**

Classes and Objects: Introduction, Structures and Classes, Declaration of a class, member Functions, Class Objects, Array of class Objects, Pointers and Classes, Unions and Classes, Nested Class, Pictorial representation in the form of Object Modeling Techniques (OMT) class and object notation diagram.

Special Member Functions: Introduction, Constructors, Destructors, Inline Member Functions, Static Class Members, Friend Functions, Dynamic Memory Allocations, *This* Pointer.

UNIT III **Lectures: 12**

Inheritance: Single Inheritance, Array of Class Objects and Single Inheritance, Multiple Inheritance, Container Classes, Member Access Control, Pictorial representation in the form of Object Modeling Techniques (OMT) of Inheritance.

Overloading Functions and Operators: Function Overloading, Operator Overloading, Overloading of Binary and Unary Operators.

Polymorphism and Virtual Functions: Polymorphism, Early Binding, Polymorphism with Pointers, Virtual Functions, Late Binding, Abstract Base Classes, Constructors and Destructors under Inheritance

UNIT IV **Lectures: 8**

Templates, Namespace and Exception Handling: Function Template, Class Template, Overloading of Function Template, Exception Handling, Namespace.

Data File Operations: Opening and Closing of Files, Reading and Writing a Character from a File, Binary File Operations, Classes and File Operations.

Text Books:

1. Programming with C++, 3/e by Ravichandran, Tata McGraw Hill.
2. Thinking in C++, Volume 1 & 2 by Bruce Eckel, Chuck Allison, Pearson Education
3. Object-Oriented Programming with C++ by A. K. Sharma, Pearson
4. Mastering C++, 1/e by Venugopal, Tata McGraw Hill

Reference Books:

1. The C++ Programming language 3/e by Bjarne Stroustrup, Pearson Education
2. C++ How to Program, 4e, by Deitel, Pearson Education
3. Big C++ by Cay Horstmann, Wiley India.
4. C++ Primer, 3e by Stanley B. Lippman, Josee Lajoie, Pearson Education.
5. C++ and Object Oriented Programming Paradigm, 2e by Debasish Jana, PHI
6. C ++ Programming Black Book by Steven Holzner, Dreamtech Press

CS106 Programming Lab

L-T-P-Cr: 0 – 0 – 3-1

List of Programs based on subjects Data Structures & Algorithms and Object Oriented Methodology

1. Program to insert, delete, search and sort in an array.
2. Program to implement singly linked list using linked list and Doubly Linked List.
3. Program to convert the given Infix Expression to its Postfix Format.
4. Program using arrays for implementing circular queue data structure.
5. Program to implement insertion, deletion and searching in binary tree.
6. Program to implement Tree Traversals and Program to implement Binary Search Tree (BST).
7. Program to implement the Priority Queue using Heaps and program using Hashing Technique.
8. Implement a program using Hashing Technique.
9. Program to solve the knapsack problem using backtracking algorithm.
10. Program to implement traveling sales man problem.

11. Two numbers are entered through the keyboard. Write a program to find the value of one number raised to the power of another.
12. Write a program to enter the numbers till the user wants and at the end it should display the count of positive, negative and zeros entered.
13. Write a program to print Fibonacci series of n terms where n is input by user: 0 1 1 2 3 5 8 13 24.....
14. Write a program to calculate the sum of following series where n is input by user:
    1 + 1/2 + 1/3 + 1/4 + 1/5 +…… 1/n
15. Compute the natural logarithm of 2, by adding up to n terms in the series 1 - 1/2 + 1/3 - 1/4 + 1/5 -... 1/n where n is a positive integer and input by user.
16. Write a program to print out all Armstrong numbers between 1 and 500. If sum of cubes of each digit of the number is equal to the number itself, then the number is called an Armstrong number. For example, 153 = (1 * 1 * 1) + (5 * 5 * 5) + (3 * 3 * 3)
17. Define a class student with the following specification

    Private members of class student

admno	integer
sname	20 character
eng, math, science	float
total	float
ctotal()	a function to calculate eng + math + science with float return type

    Public member function of class student

Takedata()	Function to accept values for admno, sname, eng, science
Invoke ctotal()	to calculate total
Showdata()	Function to display all the data members on the screen

18. Define a class batsman with the following specifications:

    Private members:

bcode	4 digits code number
bname	20 characters
innings, notout, run	integer type
batavg	it is calculated according to the formula **batavg =runs/(innings-notout)**
calcavg()	Function to compute batavg

    Public members:

readdata()	Function to accept value from bcode, name, innings, notout
invoke the function	calcavg()
displaydata()	Function to display the data members on the screen.

19. Define a class in C++ with following description:

    Private Members

    A data member Flight number of type integer

    A data member Destination of type string

    A data member Distance of type float

    A data member Fuel of type float

    A member function CALFUEL() to calculate the value of Fuel as per the following criteria

Distance	Fuel
<=1000	500
more than 1000 and <=2000	1100
more than 2000	2200

Public Members

A function FEEDINFO() to allow user to enter values for Flight Number, Destination, Distance

Call function CALFUEL() to calculate the quantity of Fuel

A function SHOWINFO() to allow user to view the content of all the data members.

20. Write a program to implement default & parameterized constructor.
21. Write a program to find the area of square, triangle, circle and rectangle using function overloading.
22. Write a program to implement pointer to object.
23. Write a program to implement pointer to class.
24. Write a program to show how to inherit private data of base class through private inheritance.
25. Introduction on DFD level 1, 2.
26. Introduction on Base diagram for Library System.
27. Introduction on E-R diagram for student admission.
28. Introduction on Class Diagram for Banking System.
29. Estimate the effort and cost required to build the software. Use any estimation technique.

Detailed instructions for Laboratory Manual to follow for further guidance. The details will be uploaded in the website from time to time)

CS107 Computer Organization & Architecture

L-T-P-Cr: 3-1-0-4

Objectives - The goal of the Computer Architecture course is to learn a micro programmed control, memory hierarchy etc. This includes the design and simulation of an instruction set, the implementation of a processor and its evaluation.

Prerequisites – Brief knowledge of in the following topics: Logic Circuit Design, Sequential Circuits, Fundamental programming skills

Outcome- After taking this course, students will be able to HDL Design, Verilog

UNIT I **Lectures: 12**

Introduction: Computer Arithmetic, Instruction sets, Introduction to computer organization, CPU Design.

Micro programmed Control: Control Memory, Address sequencing, Micro programming, sequencing and execution of microinstructions

UNIT II **Lectures: 16**

Memory system: Hierarchical memory structure, Cache memories, Set Associative memory, Virtual Memory, Paging, Segmentation, Input-Output Interface, Asynchronous Data Transfer, Programmed I/O, Interrupts, Direct Memory Access, ARM Cortex-A8 and Intel Core i7 Memory Hierarchies

Input-Output Organization: Basic Input/Output Structure of Computers, serial and parallel communications, Asynchronous Data Communication, Programmed I/O, Interrupt Driven I/O, Interrupt Controller, DMA, Device Drivers, Buses, Bus Arbitration.

UNIT III **Lectures: 10**

Introduction to Parallel Processing: Evolution of computer systems (RISC vs. CISC), Parallelism in uniprocessor systems, Architectural classification schemes.

Principles of Pipelining and Vector processing: Pipeline strategy, Pipeline performance, Controls and Data paths, Overlapped parallelism, Principles of designing pipelined processors, Vector processing requirements, ARM Cortex-A8 and Intel Core i7 Pipelines4

UNIT IV **Lectures: 9**

Structures & Algorithms for Array Processors: SIMD, MIMD, Array processors, SIMD Interconnection networks.

Text Books:

1. Computer Organization and Design. by Patterson & Hennessy .
2. Computer Architecture and parallel processing by Kai Hwang, Briggs, McGraw Hill
3. Computer Architecture by Carter, Tata McGraw Hill.
4. Computer System Organization & Architecture by John D. Carpinelli, Pearson Education.

CS109 Database Management Systems

L-T-P:3-1-0-4

Objectives: To design the well-defined and normalized database.

Outcomes: After going through this subject students will learn different types of database models, how to design the database, conversion from design to actual implementation of database, how to normalized the database, how the queries are processed and optimized using different optimization techniques, Transaction processing, management of concurrent transactions and etc.

UNIT I **Lectures: 10**

Introduction: Purpose of database systems, View of data, data models, & interface, database language, transaction management, storage management, database administrator, database users, overall system structure, Classification of Database Management System, Three- Schema Architecture.

Data Modeling: Entity- Relationship Model, Basic concepts, design issues, mapping constraints, keys, E-R diagram, weak entity sets, extended E-R features, design of an E-R database schema, reduction of an E-R schema to tables.

UNIT II **Lectures: 10**

Relational Model: Structure of relational databases, relational algebra, tuple relational calculus, domain relational calculus, extended relational-algebra operations, modification of the database and view, SQL and Other.

Relational Languages: Background, basic structure, set operations, aggregate functions, null values, nested sub-queries, derived database, joined relations, DOL embedded SQL and other SL features, query-by-example.

UNIT III **Lectures: 10**

Integrity Constraints: Domain constraints, referential integrity, assertions, triggers and functional dependencies.

Relational Database Design: Pitfalls in relational database design, decomposition, normalization using functional, multi-valued and join dependencies, domain key normal form and alternative approaches to database design.

UNIT IV **Lectures: 12**

Query Processing: Overview, catalog information for cost estimation, measures of query cost, selection operation, sorting, join operation, other operations, evaluation of expressions, Translating SQL query into Relational Algebra, transformation of relational expressions, Query Optimization.

Transactions: Transaction concept, transaction state, System log, Commit point, Desirable Properties of a Transaction, concurrent executions, serializability, recoverability, implementation of isolation, transaction definition in SQL, Testing for serializability.

Text Books:

1. Fundamental of Database Systems, by Elmasri, Navathe, Somayajulu, and Gupta, Pearson Education.
2. Database System Concepts, 3rd edition, by A.Silberschatz, H. F. Korth, & S. Sudhatshan, McGraw Hill,

Reference Books:

1. Database management System, by Rajesh Narang, PHI
2. Introduction to Database Management system by ISRD Group, Tata McGraw Hill.
3. An Introduction to database system by C.J. Date, A. Kanana, S. Swamynathan, Pearson Education

CS110 Database Management Systems Lab

L – T – P: 0 – 0 – 3-1

List of Programs

1. Overview of RDBMS and Oracle: Primary introduction to DBA, Creating user, Getting connected, Granting privileges.
2. Introduction to SQL: Basic DML, DDL, DTL commands& etc.
3. Table: Constraint definition, creating table.
4. Table handling: Alter, Drop Table, Insert Records& etc.
5. Record handling: Update, Delete, Select, Grouping, Ordering, & Logical, Arithmetic, Comparison operators.
6. SQL Functions: Date, Numeric, Character, Aggregate &etc.
7. Set Operations: Union, Union All, Intersection, Minus.
8. Join Concept: Simple, Equi, Self, Outer.
9. Synonym Introduction: Creating object type, Aliasing and Sequence: alter, drop Sequence.
10. Introduction to View: create, update, drop and Index: Introduction, creation.
11. Introduction to PL/SQL: Advantages, Support, Execution PL/SQL: Character set and data types.
12. PL/SQL Blocks : Attribute, Control Structure and Composite data types : Record, Table (count, delete, exists, first, last, next, prior)
13. Database Triggers: Definition, syntax, types, enabling and disabling triggers.
14. Sub programs : Definition, Features, Cursors and Procedures : Definition, creation, parameter

15. Function: Definitions and implementations.

CS111 Formal Languages & Automata Theory

L – T – P: 3 – 1 – 0 Credit: 4

Objectives: To provide theoretical concept of computation.

Outcomes: After going through this subject students will learn different type of finite state machines and its' applications in computer science, different type of grammars related to programming languages and their applications, Properties of regular languages, the machine part(PDA) of Context-Free Grammar, Properties of Context-Free languages, the machine part (TM) of recursively enumerable languages and it's application etc.

UNIT I **Lectures: 9**

Introduction to Automata: Study and Central concepts of automata theory, An informal picture of finite automata, deterministic and non-deterministic finite automata, application of finite automata, finite automata with epsilon transitions

Regular Expression and Languages: Regular expression, finite automata and regular expressions, applications of regular expressions, algebraic laws of regular expressions.

UNIT II **Lectures: 10**

Properties of Regular Language: Proving languages not to be regular, closure properties of regular languages, equivalence and minimization of automata.

Context-free Grammars and Languages: Parse trees, Applications of context free grammars, Ambiguity in grammars and languages.

UNIT III **Lectures: 11**

Pushdown Automata: Pushdown automation (PDA), the language of PDA, equivalence of PDA's and CFG's, deterministic pushdown automata.

Properties of Context-Free Languages: Normal forms of context free grammars, pumping lemma for context free languages, closure properties of context free languages.

UNIT IV **Lectures: 12**

Introduction to Turing Machine: The Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, restricted Turing Machines, Turing machines and Computers, Undecidable Problem about Turing Machine, Post's Correspondence Problem.

Intractable Problem: The Classes *P* & *NP,* NP-Complete Problem, Example of *P& NP* Problem.

Text Books:

1. Introduction to Automata Theory, Languages, and Computation, 2e, by John E. Hopcroft, Rajeev Motwani, and Jeffery D. Ullman, Pearson Education
2. Theory of Computer Science (Automata, Languages and Computation*)*, 2e, K. L. P. Mishra and N. Chandrasekharan, PHI

4CS112 UNIX Admin & Shell Programming Lab

L – T – P:-0-0- 3-1

List of Programs

1. Execution of various file/directory handling commands.
2. Execution of various system administrative commands.
3. Use vi editor to create a file called myfile.txt which contains some text.
4. Create three directories names letters, reports, and assignments under your home directory.
5. Write a SED command that deletes the first character in each line in a file.
6. Check the default permission of this directory. Is it 700?
7. Change the permissions to allow users in your group only to copy this file to their own directories.
8. Pipe your /etc/password file to AWK, and print out the home directory of each user.
9. Write a shell program which accepts the name of a file from the standard input and then performs the following test on it.
10. Write a shell program to perform a simulated cp command. Proceed this program using positional parameter and the usage will be on the form of copy <s.file><target file> and ensure that parameters are properly used.
    - File Existence
    - File Readable and Writable
11. Write a shell program to convert all lowercase letters in a file to uppercase letter.
12. Write a shell program for file contains records ith each record containing name and city, name of state and name of country. How would you sort this file with country as the primary key and state the secondary sort key.
13. Simple shell script for basic arithmetic and logical calculations.
14. Shell scripts to check various attributes of files and directories.
15. Shell scripts to perform various operations on given strings.
16. Shell scripts to explore system variables such as PATH, HOME etc.
17. Shell scripts to check and list attributes of processes.
18. Write AWK script that uses all of its features.
19. Use SED instruction to process/etc/password file.
20. Write a shell script to display list of users currently logged in.
21. Write a shell script to delete all the temporary files.
22. Write a shell script to search an element from an array using binary searching.

CS113 Compiler Design

L-T-P-Cr: 3 – 0 – 0-3

Objectives – The Objectives of this course is to explore the principles, algorithms, and data structures involved in the design and construction of compilers. Topics include context-free grammars, lexical analysis, parsing techniques, symbol tables, error recovery, code generation, and code optimization.

Prerequisites – Brief knowledge of programming languages, data structure, and algorithm design

Outcome- After completion of this course each student will implement a compiler for a small programming language.

UNIT I **Lectures: 12**

Introduction to Compilers: Compilers and translators, the phases of a compiler, Compiler writing tools, The Lexical and Syntactic structure of a language, operators, Assignment statements and parameter translation.

Lexical Analysis: The role of the lexical analyzer, Specification of tokens, lexical analysis tool.

Syntax Analysis: Role of Parser, CFG, Top-down parsing, bottom-up parser, Operator-precedence parsing, LR Parsers, The Canonical Collection of LR (0) items, Constructing SLR, Canonical LR, and LALR parsing tables, Use of ambiguous grammars in LR parsing, An automatic parser generator, Implementation of LR parsing tables, and constructing LALR sets of items.

UNIT II **Lectures: 10**

Syntax Directed Translation: Syntax tree, Bottom-up evolution of S-attributed definitions, L-attributed definition, top-down translation, Bottom-up evaluation of inherited attributed, Recursive evaluators.

Type Checking: Static vs. Dynamic Checking, Type expression, Type Checking, Type Equivalence, Type Conversion.

Symbol Tables: Structure of Symbol Table, Simple Symbol Table (Linear Table, Ordered List, Tree, Hash Table), Scoped Symbol Table (Nested Lexical Scoping, One Table per Scope, One Table for all Scopes).

UNIT III **Lectures: 8**

Intermediate Code Generation: Intermediate Language, Intermediate representation Technique, Three-address code, quadruples and triples, Translation of assignment statements, Boolean expressions, Control Flow, Case Statement, and Function Call.

Code Generation: Factors affecting code generation, Basic Block, Code generation for tree, Register Allocation and assignment, DAG representation, Code generation using dynamic programming, code-generator generators.

UNIT IV **Lectures: 12**

Error Detection and Recovery: Errors, Lexical- Phase errors, Syntactic- Phase errors, Semantic errors.

Code Optimization: Need for optimization, Optimization of Basic Blocks, Loops in flow graph, Optimizing transformation (Compile time evaluation, common sub-expression elimination, Variable Propagation, Code Movement Optimization, Strength Reduction, Dead code optimization, Loop Optimization), Local Optimization, Global Optimization, Computing Global data flow equation, Setting up data flow Equations, Iterative Data Flow Analysis.

Text Books:

1. Compilers: Principles, Techniques, and Tools by Alfered V. Aho, Ravi Sethi, Jeffery D. Ullman, Pearson Education.
2. Compiler Design by Santanu Chattopadhyay, PHI

Reference Book:

1. Modern Compiler Design by Dick Grune, E. Bal, Ceriel J.H. Jacobs, and Koen G. Langendoen, Wiley Dreamtech

CS114 Compiler Design Lab

L–T–P:0–0–3-1

List of Programs

1. Write a lex Program to identify a simple and a compound statement.
2. Write a program to check whether string belongs to a grammar or not.
3. Write a lex Program to count the number of keywords and identifiers in a sentence.
4. Write a lex program to convert an octal number to decimal number.
5. Write a YACC Program to check whether given string a^nb^n is accepted by the grammar.
6. Write a YACC program to check the validity of an arithmetic expression.
7. Write a YACC Program to identify an input for the grammar a^nb (n>=10).
8. Write a Program to create an recursive descent parser for a particular grammar.
9. Write an ANTLr grammar to accept the pascal statement READ (Value) and print a parse tree for the same.
10. Write an ANTLr grammar to perform basic arithmetic operation in a calculator
11. Write an ANTLr grammar to accept a block of PASCAL statements between begin and end and print the parse tree for the same.
12. Write an ANTLr grammar to decide whether given sentence is simple or compound.
13. Write a program to find first and follow of a user given numbers.
14. Write a program to simulate LL1 parsing algorithm.
15. Write a program is to calculate leading for all the non –terminal of given grammar.

CS115 Operating Systems

L-T-P-Cr: 3-1-0-4

Objectives: To give in-depth concept of any general Operating System.

Outcomes: Students should be able to use his knowledge to develop/design any new Operating System.

UNIT I **Lectures: 14**

Introduction: Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel.

Processes*:* Concept of processes, process scheduling, operations on processes, inter-process communication, Communication in Client-Server Systems, overview & benefits of threads.

Process scheduling: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms.

UNIT II **Lectures: 10**

Process Synchronization*:* background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.

Deadlocks*:* system model, deadlock characterization, methods for handling deadlocks, deadlockprevention, deadlock avoidance, deadlock detection, recovery from deadlock.

UNIT III **Lectures: 10**

Memory Management*:* background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation.

Virtual Memory*:* background, demand paging, page replacement, page replacement algorithms, allocation of frames, thrashing.

UNIT IV **Lectures: 8**

File Systems*:* File concept, access methods, directory structure

Disk Management*:* disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN)

Text Books:

1. Operating System Principles by Silberschatz A. and Peterson J. L., Wiley
2. Operating Systems by Dhamdhere, TMH

Reference Book:

1. Operating Systems by Deitel, Deitel & Choffnes.
2. Operating Systems by Stalling, Pearson

CS116 Operating Systems Lab

L-T-P: 0-0-3-1

List of Programs

1. Programs Using Unix System Calls(fork, exec, getpid, exit, wait, close, stat, opendir, readdir)
2. Simulation of UNIX commands using C.
3. Implement the following CPU Scheduling Algorithms.
   i) FCFS iii) Shortest Job First
4. Implement the following CPU Scheduling Algorithms.
   i) Round Robin iii) priority based
5. Implement an Inter-Process communication using shared memory, pipes or message queues.
6. Implement Producer-Consumer Problem Using Semaphores (using UNIX system calls).
7. Implement first fit, best fit and worst fit storage allocation algorithms for memory management.
8. Implement memory allocation using paged memory management scheme.

9. Implement any file allocation technique (Linked, Indexed or Contiguous).
10. Implement a program for memory management using segmentation.
11. Implement a program for bankers' algorithm.
12. Write a program for FIFO page allocation algorithm.
13. Write a program for LRU page replacement algorithm.

5CS117 Graph Theory & Combinatorics

L–T–P-Cr: 3–1–0-4

Objectives: To impart detailed knowledge of one special data structure of computer science known as Graph.
Outcome-Upon successful completion of this course Students will be prepared to undertake advanced study in graph theory aimed toward original resear ch and a Ph.D. Students will be able to follow applications of graph theory in computer science

Graphs--- paths, cycles, walk; Trees and their characterization, diameter, center, degree sequences and realizability, Eulerian trails, Hamiltonian cycles---sufficient conditions, connectivity—cut points, bridges, block, Whitney's theorem, Planarity, colourability, Coverings and independence, digraphs, tournaments, orientability, Matrix representation of graphs, External problems. Permutation, Combination of multisets, Pegionhole principle, Formal power series, and recurrence relation, Stirling numbers, Mobius inversion, Posets, Sperner's lemma, Dilworth's theorem, Systems of distinct representatives, Principle of inclusion-exclusion.

Text Books:

1. Graph Theory & its application by Narsingh Deo, TMH

6CS119 Computer Networks

L-T-P-Cr: 3-1-0-4

Objectives: To give comprehensive knowledge of TCP/IP layers. To provide good understanding of Internet and networking design aspects.
Prerequisite: The course does not assume prior knowledge of networking.
Outcomes: Students should be able to use his knowledge to develop/design at LAN.

UNIT I **Lectures: 11**

Introduction: Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); Networks: distributed processing, network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN, WAN etc.); Internet: brief history, internet today; Internet and related softwares NETSCAPE and MOSAIC. Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Application layer: DNS; SMTP, SNMP, FTP, HTTP & WWW

UNIT II **Lectures: 8**

Transport layer: Process to process delivery; Port numbers, service models, UDP. Intro to reliability; TCP; Flow control vs. congestion control. Congestion collapse. Window-based and rate-based congestion control. Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets; Congestion control model, packet scheduling and buffer management, FIFO, FQ, RED. Congestion control taxonomy, fairness and effectiveness. Intro to TCP congestion control. Additive-increase/multiplicative decrease. Fairness and Efficiency. Quality of service: techniques to improve QoS. More TCP. Slow start. Fast retransmit. Fast recovery. Connection establishment, TCP, TCP state diagram,

UNIT III **Lectures: 13**

Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; The best effort service model., Addressing : Internet address, classful address, subnetting; Routing : techniques, static vs. dynamic routing , routing table for classful address; Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols.

Medium access sub layer: Point to point protocol, LCP, NCP, FDDI, token bus, token ring; Reservation, polling, concentration; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA; Traditional Ethernet, fast Ethernet;

UNIT IV **Lectures: 10**

Data link layer: Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;

Physical level Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & non-guided); TDM, FDM, WDM; Circuit switching: time division & space division switch, TDM bus; Telephone network;

Text Book:

1. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education

References Books:

1. S. Keshav, An engineering approach to computer networking: ATM networks, the internet, and the telephone network, Addison-Wesley, 1997.
2. L. L. Peterson and B. S. Davie, Computer networks: a systems approach, 3rd Edition, Morgan Kaufmann Publishers, 2001.

Tutorial: Practical local area network design and implementation

6CS120 Computer Networks Lab

L–T–P: 0-0-3-1

List of Programs

1. To implement date and time display from local host to server using TCP.
2. To write a client-server application for chat using TCP.
3. To implementation of echo client server using TCP/IP.
4. Design TCP iterative Client and Server application to reverse the given input sentence.
5. To write a program to develop a DNS client server to resolve the given hostname.
6. Write a Program to create an integer variable using Shared Memory concept and increment the variable simultaneously by two processes. Use Semaphores to avoid Race conditions.

7. To implement programs using raw sockets (like packet capturing and filtering) algorithm.
8. To implement the program using RMI
9. Program to perform sliding window.
10. To get the MAC or Physical address of the system using Address Resolution Protocol.
11. To simulate the Implementing Routing Protocols using border gateway protocol (BGP).
12. To simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to the path.
13. Design TCP Client and Server application to transfer file.
14. Design using Poll Client Server application to multiplex TCP and UDP requests for converting a given text into upper case.
15. Design a RPC application to add and subtract a given pair of integers.

CS121 Software Engineering

L–T–P: 3–1–0-4

Objectives: To design the software based on functional oriented and object technology.
Outcomes: After going through this subject students will learn different types of Software life cycle models, software requirements analysis and specification, design of software, object modeling techniques, design of user interface and how to do coding and testing of software and etc.

UNIT I **Lectures: 10**

Introduction: S/W Engineering Discipline-Evolution and Impact, Program vs S/W Product, Emergence of S/W Engineering.
Software Life Cycle Models: Waterfall, Prototyping, Evolutionary, Spiral models and their comparisons.
Software Project Management: Project Manager responsibilities, Project Planning, Project Size estimation Metrics, Project estimation Techniques, COCOMO, Staffing Level Estimation, Scheduling, Organization & Team Structures, Staffing, Risk Management, S/W Configuration Management.

UNIT II **Lectures: 11**

Requirements Analysis and Specification: Requirement Gathering and Analysis, SRS, Formal System Development Techniques, Axiomatic and Algebraic Specification.
Software Design: Overview, Cohesion and Coupling, S/W Design Approaches, Object-Oriented vs. Function-Oriented Design.
Function-Oriented S/W Design: SA/SD Methodology, Structured Analysis, DFDs, Structured Design, Detailed Design, Design Preview.

UNIT III **Lecture: 11**

Object Modelling Using UML: Overview, UML, UML Diagrams, Use Case Model, Class Diagrams etc.

Object-Oriented Software Development: Design Patterns, Object-Oriented analysis and Design Process, OOD Goodness Criteria.

User Interface Design: Characteristics, Basic Concepts, Types, Components Based GUI Development, User Interface Design Methodology.

UNIT IV **Lectures: 10**

Coding and Testing: Coding, Code Review, Testing, Unit Testing, Black Box Testing, White-Box Testing, Debugging, Program Analysis Tools, Integration Testing, System Testing, General Issues.

Software Reliability and Quality Management: S/W Reliability, Statistical Testing, S/W Quality, S/W Quality Management System, ISO 9000, SEI CMM, Personal Software Process, Six Sigma.

Software Maintenance: Characteristics, S/W Reverse Engineering, S/W Maintenance Process Models, Estimation of Maintenance Cost.

Text Books:

1. Fundamentals of Software Engineering by Rajib Mall, PHI
2. Software engineering by James F. Peters, Wiley
3. Software engineering A Practitioner's Approach by Pressman , MGH

Reference Books:

1. Software Project Management From Concept to Deployment by Kieron Conway, dreamtech Press
2. Software engineering, by Sommerville, Pearson education
3. Software engineering, by Jawadekar, TMH

CS122 Software Engineering Lab

L – T – P: 0 – 0 – 3 Credit: 1

List of Programs

1. Draw a Base diagram for Library System.
2. Draw a Context diagram for Registration System.
3. Draw a DFD level 1, 2 and 3 for Student Admission System.
4. To design and implement class diagram for ATM system.
5. To design and implement Sequence diagram for ATM System.
6. Draw an E-R diagram for student admission.
7. Write function requirements of Lab Management System.
8. Illustrate and draw use Case Diagram.
9. Describe the design process in software development.
10. Draw and explain Waterfall model.
11. Explain Testing process of a system.
12. Explain System Requirement Specification (SRS).
13. Write a synopsis for the course structure and teachers in CSE Dept.
14. Explain Testing process of a system.
15. Study of Any Testing Tool (like WinRunner).

CS123 Design & Analysis of Algorithms

L–T–P:3–1–0-4

Objectives: To develop the design and analyzing capabilities among the students

Outcome: After learning this subject students will learn how to find out the time complexities of any algorithm, notations used for specifying the time complexity, how one algorithm can be represented

in different ways for reducing it's time complexity, different approaches (Greedy, Dynamic Prog., Divide-and-Conquer etc.) for solving the same real life problem or various different real life problems, Concept of NP Completeness etc.

UNIT I **Lectures: 9**

Introduction: Algorithm, performance evaluation of algorithms, space & time complexity, notion of optimality, Master's Theorem.

Divide and Conquer: General Concept**,**Finding the maximum and minimum, Quick Sort, Merge Sort, Binary Search, Strassen's matrix multiplication.

UNIT II **Lectures: 15**

Greedy Algorithm: General Concept, Knapsack Problem (Fractional Knapsack), Job Sequencing with Deadline, Huffman's Codes, Minimum Cost Spanning Tree- Kruskal's Algorithm, Prim's Algorithm, Single Source Shortest Path-Dijkstra's Algorithm.

Dynamic Programming: General Concept, Matrix-Chain Multiplication, Knapsack Problem DP solution, Activity selection problem DP solution, Single Source Shortest Path- Bellman Ford Algorithm, All pairs shortest paths, Traveling salesman problem.

UNIT III **Lectures: 8**

BackTracking: Basic idea, 8-Queens problem, Graph Coloring, Hamiltonian Cycles.

Branch-And-Bound: Basic idea, LC search, the 15-puzzle problem, LC Branch-and-Bound, 0/1 Knapsack Problem

UNIT IV **Lectures: 10**

Graph Algorithms: Breadth First Search (BFS), Depth First Search (DFS), Strongly Connected Components, BiConnected Components and DFS, Euler Tour, Minimum Spanning Tree- Kruskal's Algorithm, Prim's Algorithm.

Introduction to NP-Completeness: Basic concepts on NP- hard and NP-Complete Problems, Discussion on one NP- hard graph problem- CDP.

Text Books:

1. Introduction to Algorithm, 2e, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, PHI
2. Beginning Algorithms by Simen Harris, James Ross, Wiley India.
3. Fundamentals of Computer Algorithms by E.Horowitz and S. Sahni, Galgotia,

CS151 Wireless Networks

L-T-P: 3-0-0-3

Objectives: Make the student familiar with the working technologies and advancement in wireless communications

Prerequisite: Computer Network

Outcome: The student should know the protocol stack of network in wireless domain**.**

UNIT I **Lectures: 9**

Introduction: Why wireless, IEEE 802.11.

802.11 MAC Fundamentals: Challenges for MAC, Access mode, Contention based access using DCF, Fragmentation and reassembly, Frame format, 802.11 graming in detail (DS bits, BSSID, RTS, CTS, control frame, management frame), Contation based data service, Frame processing and bridging, 802.11 to Ethernet.

UNIT II **Lectures: 13**

WEP: WEP cryptographic operations, WEP data processing, Problem with WEP, User authentication with 802.1x.802.11i Robust security networks, TKIP, and CCMP: Temporal key Integrity protocol, Counter mode with CCB-MAC, Robust security network operation

Management operations: Association, Power conservation, Timer synchronization, Spectrum management. Contention free service with PCF.

UNIT III **Lectures: 11**

Physical Layer: Physical layer architecture, Radio Link, RF with 802.11, Frequency, GFSK, PLCP, DSSS, HR/DSSS. 802.11a and 802.11j (OFDM Phy), 802.11g (extended rate PHY), 802.11n: MIMO-OFDM.

Experiencing on 802.11 on Windows OS, Linux

802.11 Access point: Functions of AP, Power over Ethernet, Selecting AP.

UNIT IV **Lectures: 9**

Security Architecture: Authentication and Access Point, Ensuring secrecy through encryption, selecting security protocols.

Site Planning and Project Management: Network requirement, PHY layer selection and design, Planning placing AP, Using Antennas to tailor Coverage.

802.11 Network analysis, 802.11 performance tuning.

Text Book:

1. 802.11 Wireless Networks by Mathew S. Gast, SPD

CS152 Mobile Computing

L-T-P-Cr: 3-0-0-3

Objectives: To introduce the concepts of wireless/mobile communication including cellular environment.

Pre-requisites: Fundamentals of Communication, Computer networks

Outcome: A student must be in a position to understand and work on the basic technologies used for Mobile Communication.

UNIT I **Lectures: 6**

Introduction: Applications, Some open research topics, A simplified reference model

Wireless Transmission: Frequencies for radio transmission, Signals, Antennas, Signal propagation Multiplexing, Modulation, Spread spectrum, Cellular systems

UNIT II **Lectures: 13**

Medium Access Control: Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, Comparisons of S/T/F/CDMA

Telecommunications Systems: GSM

UNIT III **Lectures: 11**

Satellite Systems: History, Applications, Basics, Routing, Localization, Handover

Wireless LAN: Infra-red vs. radio transmission, Infrastructure and ad-hoc network, IEEE 802.11, Bluetooth

UNIT IV **Lectures: 12**

Mobile Network Layer: Mobile IP, Dynamic host configuration protocol, Mobile ad-hoc networks
Mobile Transport Layer: Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, Performance enhancing proxies

Text Book:

1. Jochen Schiller, Mobile Communications ,Pearson Education

CS153 Semantic Web

L–T–P:3–0–0-3

Objectives: To introduce the concepts of Ontology used in Semantic Web

Outcome: After taking this course, a student must be in a position to understand and apply the concept of Ontology.

UNIT I **Lectures: 10**

Introduction to the Semantic Web: What is Semantic Web, From today's web to semantic web, Semantic Web Technologies, A Layered Approach, Why do we need Semantic Web?, How do Web Services fit into Semantic Web, Business case for the Semantic Web

Structured Web Document: XML Language, Structuring, Namespaces, Addressing and querying the XML documents, Processing, Why metadata is not enough? Impact of XML on enterprise IT

UNIT II **Lectures: 16**

Describing Web Resources: RDF Basic Idea, XML based syntax, RDF Schema, Semantics for RDF and RDF schema, direct interface between RDF and RDFS, Querying in SPARQL. Case Study – Jena API for building RDF application

Web Ontology Language: Definition, scope, types of ontologies, ontology repositories, OWL and RDF/RDFS, Three sublanguages of OWL, Description of OWL language, Layering of OWL, OWL in OWL, Tools used in building and storing ontologies, Topic Maps, Topic Maps Versus RDF

UNIT III **Lectures: 8**

Logic and Interface: Rules & Applications: Monotonic Rules: Family relationship, Monotonic rule: syntax & Semantic, Description language program, Semantic web rules language (SWRL), Nonmonotonic rules, RuleMarkup Language (RuleML) , Case Study -- Jena inference support

UNIT IV **Lectures: 8**

Applications: Friend of a Friend Application, Sig.ma, Skill Finding at Swiss Life, Think Tank Portal at EnerSearch, Bibster: Data Exchange in a Peer-to-Peer System, Horizontal Information Products at Elsevier, Openacademia: Distributed Publication Management.

Text / Reference Books:

1. A Semantic Web Primer by Grigoris Antoniou and Frank van Harmelen, PHI
2. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management by Michael C. Daconta, Leo J. Obrs, Kevin T. Smith, Wiley
3. Foundations of Semantic Web Technologies, by Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, CRC Press/Chapman and Hall
4. Programming the Semantic Web, by Toby Segaran, Jamie Taylor, and Colin Evans, O'Reilly

5. Semantic Digital Libraries, by Sebastian Ryszard Kruk, Bill McDaniel, Springer
6. Semantic Techniques for the Web, by François Bry and Jan Maluszynski, Springer
7. Semantic Web for Dummies, by Jeffrey T. Pollock, Wiley
8. Semantic Web Programming, by John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, Mike Dean, Wiley,
9. The Social Semantic Web, by John Breslin, Alexandre Passant, Stefan Decker, Springer

CS154 Pattern Recognition

L–T–P: 3 – 0 – 0 Credit: 3

Objectives*:* To carry out different real-life research works in this emerging field.

Outcome: After learning this subject Students will learn the necessity and types of feature extraction techniques for recognizing a pattern, will learn different type of classifiers used for training purpose, different learning techniques, recognition approach etc. and applying these concepts students should be in a position to develop different software for recognizing different patterns.

UNIT I **Lectures: 12**

Pattern Recognition Overview: Overview, Pattern Recognition, Classification and Description, patterns and Feature Extraction, Training and Learning in PR Systems, Pattern Recognition Approaches.

Statistical Pattern Recognition: Introduction, The Gaussian case and Class Dependence Discriminate Functions, Extensions, Classifier Performance, RISK and Errors.

UNIT II **Lectures: 10**

Supervised Learning: Parametric Estimation and Supervised Learning, Maximum Likelihood Estimation Approach, Bayesian Parameter Estimation Approach, Non- Parametric Approaches, Parzen Windows, K-Non-Parametric Estimation. Nearest Neighbor Rule. Linear Discriminate Functions and The Discrete and Binary Feature Cases: Introduction, Discrete and Binary Classification Problems, Techniques to Directly Obtain Linear Classifiers.

UNIT III **Lectures: 10**

Syntactic Pattern Recognition: Overview Quantifying Structure in Pattern Description and Recognitions, Grammar Based Approach and Application, String Generation as Pattern Description. Recognition by String Matching and Parsing. The Cocke-Younger Kasami (ck) parsing algorithm.

UNIT IV **Lectures: 10**

Neural Pattern Recognition: Introduction to Neural Networks, Neural Network Structure from Pattern Recognition Applications. Physical Neural Network. The Artificial Neural Network Model, Neural Network based Pattern Associators.

Text Books:

1. Pattern Recognition and Image Analysis by Gose, Johnsonbaugh, Jost, PHI
2. Pattern Recognition: Technique and Applications by Rajjan Shinghal, Oxford.
3. Pattern Recognition Principles by J.T. Tou and R.C. Gonzalez, Addison Wesley

CS155 Image Processing

L–T–P: 3–0–0-3

Objectives: To carry out different real-life research works in this emerging field.

Outcome: After learning this subject Students will learn the image representation, segmentation and feature extractions on any image, edge detection of any image, different mathematical techniques for processing an image, different filtering techniques for processing an image etc.

UNIT I **Lectures: 12**

Image Representation & Modeling: The Human Eye-Brain System As A Model, Image Formation, Image Models, Basic Image Processing: Sampling and Quantization, Brightness and Colour, Histogram, Filters and Convolution, Frequency Domain Processing, Edge Detection, Boundaries and Line Extraction, Segmentation and Feature Extraction, 2-D Shape Representation and Matching.

UNIT II **Lectures: 7**

3-D Representation and Matching, Visual Perception – The Human Eye, How It Works and Fails, Image Hardware and Software – Cameras, Displays, Frame Grabbers, Image Processing Architectures, Image Formation – 2d Image Acquisition and Sampling Theory.

UNIT III **Lectures: 13**

Image Transforms: Fourier Transform, Application and Use, Wavelet Trans, Hadamard Cosign Transform, Image Enhancement – Point and Region Operators, Unsharp Masking, Image Compresson – Jpeg, Mpeg.

Image Restoration – Direct, Inverse, Pseudo-Inverse, Blurring (Spatial Motion), Implementations – Software and Hardware, Image Interpretation – Edge Detection, Feature Extraction, Template Matching, Hough Transform.

UNIT IV **Lectures: 10**

Case Studies – Ultrasound and Pet Image Analysis: Clinical Feature Extraction

Automatic Gait Recognition: Moving Spectrum Analysis and Description

CS156 Natural Language Processing

L-T-PCr: 3-0-0-3
Objectives: to understand the syntax and semantics of natural languages. How they works and how machine can convert from one natural language to another.
Prerequisite: A course on compiler design and artificial intelligence
Outcome: The student should be able to understand the principle of natural language processing and be able to develop system for conferring one natural language to another.

UNIT I **Lectures: 5**

Introduction: Need for Processing Natural languages, Issues in NLP and Complexity of Processing NLP, Brief history of NLP application development.

Language Modeling: Various types of Languages and its modeling, Grammar based language models, Government and Binding, Lexical Functional Grammar and Paninian Grammar for handling natural languages, Statistical modeling.

UNIT II **Lectures: 10**

Word Level Analysis: Regular expressions, Finite State Automata, Morphological parsing, Spelling Error Detection and Correction, Words and word classes (Hindi and English), Part of speech tagging : Rule-based tagger, Stochastic tagger, Hybrid tagger, Unknown words

Syntactic Analysis: Context Free Grammar, Phrase and sentence level Constructions,

Parsing: Top-down Parsing, Bottom-up parsing, A Basic Top-down Parser, The Earley Parser, The CYK Parser, Probabilistic Parsing : Estimating Rule Probabilities, Parsing PCFGs, Problems with PCFG

UNIT III **Lectures: 9**

Semantic Analysis: Meaning Representation, Characteristics of Meaning Representation Languages, Meaning structure of languages, Syntax-driven semantic analysis, Semantic Grammars, Lexical Semantics, Relationships, Internal structure of words, Ambiguity, Word Sense Disambiguation, Selectional Restriction in Word sense Disambiguation, Context-based Word Sense Disambiguation Approaches, Knowledge sources in WSD, Applications of WSD, WSD Evaluation

Discourse Context and World Knowledge: Local discourse Context and Anaphora Resolution, World Knowledge, Discourse Structure, Discourse Analysis

Language Generation: Architecture of language generators, Template-based, Phrase-based and Feature-based Natural language generation, Knowledge-based Approaches

UNIT IV **Lectures: 9**

Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches: Direct Machine Translation, Rule-based

Machine Translation: Transfer-based and Interlingua based Machine Translation, Corpus-based Machine Translation: Statistical and Example-based Machine Translation, Semantic or Knowledge-based MT systems

Reference Books:

1. Natural language Processing and Information Retrieval: T. Siddiqui and U. S. Tiwary, Oxford Univ. Press
2. Natural Language Understanding: Allen
3. Statistical Language Learning: E. Charniac, MIT Press

CS157 Soft & Evolutionary Computing

L–T–P-Cr: 3–0–0-3

Objectives: Introduce the basic of soft computing and its application areas particularly to intelligent systems.

Pre-requisite: Artificial Intelligence, Intelligent systems

Outcome: By the end of this course, the students should know what Soft computing is and its application areas particularly to Intelligent systems like neuro-fuzzy systems and adaptive control systems.

UNIT I **Lectures: 8**

Neural Networks-1(Introduction & Architecture)

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions,

Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

UNIT II **Lectures: 8**

Neural Networks-II (Back propogation networks)

Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications.

UNIT III **Lectures: 8**

Fuzzy Logic-I (Introduction)

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT IV **Lectures: 8**

Fuzzy Logic –II (Fuzzy Membership, Rules)

Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzificataions, Fuzzy Controller, Industrial applications of fuzzy logic.

UNIT V **Lectures: 8**

Genetic Algorithm (GA)

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

Text Books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India.
2. N.P.Padhy,"Artificial Intelligence and Intelligent Systems" Oxford University Press.

Reference Books:

3. Siman Haykin,"Neural Netowrks"Prentice Hall of India
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
5. Kumar Satish, "Neural Networks" Tata Mc Graw Hill

CS158 Bio Inspired Computing

L–T–P: 3–0–0-3

Objectives: Introduce the basic of bio inspired computing and its application areas particularly to neuromorphic systems.

Pre-requisite: Programming and computing knowledge, Data structures, software engineering.

Outcome: The students will:

- Understand and be able to apply brain-inspired neural network techniques for solving real world problems.
- Appreciate and be able to apply nature-inspired evolutionary computation (genetic algorithm) techniques for solving optimization problems.
- Develop an awareness of the emerging area of neuromorphic systems (including their underlying silicon implementation techniques), and the way forward.

Transferable Skills

- Knowing when and how to apply the techniques associated with biologically inspired neural networks,

genetic algorithms and neuromorphic systems.

UNIT I **Lectures: 5**

Evoolutionary systems: Artificial Evolution, Genetic Representations, Evolutionary measures.

Cellular Systems: Cellular Automata, Modeling with Cellular Systems, Other Cellular systems, Computation, Artificial life, Complex Systems, Analysis and Synthesis of Cellular Systems.

UNIT II **Lectures: 7**

Neural Systems: Biological Nervous Systems, Artificial Neural Networks, Neuron Models, Architecture, Signal Encoding, Synaptic Plasticity, Unsupervised Learning, Supervised Learning, Reinforcement Learning.

UNIT III **Lectures: 10**

Developmental Systems: Potential Advantages of Developmental Representation, Synthesis of Developmental Systems, Evolution and Development, Defining Artificial Evolutionary Developmental Systems, Evolutionary Rewriting Systems. Evolutionary Developmental Programs and Processes.

UNIT IV **Lectures: 13**

Immune Systems: Immune Systems work, Constituents of Biological Immune Systems, Lessons for Artificial Immune Systems, Algorithms and Applications, Shape Space, Negative Selection Algorithm, Clonal Selection Algorithm.

Behavioral Systems: Behavior in Cognitive Science, Artificial Intelligence, Behavior Based Robotics, Inspiration for Robots, Robots as Biological Models, Robot Learning, Evolution of Behavioral Systems, Neural Development in Behavioral Systems, Coevolution of Body and Control, Toward Self-Reproduction, Simulation and Reality.

UNIT V **Lectures: 7**

Collective Systems: Self Organiztion, Ant Colony Optimization, Particle Swarm Optimization, Swarm Robotics, Coevolutionary Dynamics: biological Models, Artificial Evolution of Competing Systems, Artificial Evolution of Cooperation.

Text Books:

- Bio- Inspired Artificial Intelligence theories, methods, and technologies, by Dario Floreano and Claudio Mattiussi, PHI publication, 2010.
- Flake, Gary William. The Computational Beauty of Nature. MIT Press, 1998.

References:
Relevant research Papers.

CS159 Machine Learning

L-T-P: 3-0-0 **Credits: 3**

Objectives: This module covers supervised approaches to machine learning. It starts by reviewing fundamentals of statistical decision theory and probabilistic pattern recognition followed by an in-depth introduction to various supervised learning algorithms such as Perceptron, Back propagation algorithm, Decision trees, instance-based learning, support vector machines. Algorithmic-independent principles such as inductive bias, side information, approximation and estimation errors. Assessment of algorithms by jackknife and bootstrap error estimation, improvement of algorithms by voting methods such as boosting. Introduction to statistical learning theory, hypothesis classes, PAC learning model, VC-dimension, growth functions, empirical risk minimization, structural risk minimization.

Prerequisite: Artificial Intelligence, Pattern Recognition

Outcomes: Gain in-depth familiarity with various classical and contemporary supervised learning algorithms, understand the underlying limitations and principles that govern learning algorithms and ways of assessing and improving their performance, understand the underlying fundamentals of statistical learning theory, the complexity of learning and its relationship to generalization ability.

UNIT I: Overview and Introduction to Bayes Decision Theory **Lectures: 6**

Machine Intelligence and Applications, Pattern Recognition concepts, Classification, Regression, Feature Selection, Supervised Learning, Class conditional probability distributions, Examples of classifiers, Bayes optimal classifier and error, learning classification approaches

UNIT II: Linear machines **Lectures: 6**

General and Linear Discriminants, Decision regions, Single layer neural network, Linear separability, general position, number of dichotomies, General gradient descent, Perceptron learning algorithm, Mean square criterion and Widrow-Hoff learning algorithm

UNIT III: Multi-Layer Perceptrons **Lectures: 6**

Introduction to Neural Networks, Two-Layers, Universal approximates, back propagation, learning, on-line, off-line, Error surface, important parameters

UNIT IV: Learning decision trees **Lectures: 6**

Inference model, general domains, symbolic, Decision trees, consistency, Learning trees from, training examples, Entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm, Continuous test nodes, confidence, Pruning, Learning with incomplete data

UNIT V: Instance-based Learning **Lectures: 6**

Nearest neighbor classification, k-Nearest neighbor, Nearest Neighbor error probability, proof Simplification, Editing, Example: Document retrieval, Case-based reasoning, Example: learning graphical structures

UNIT VI: Machine learning concepts and limitations **Lectures: 6**

Fundamental algorithmic-independent concepts, Hypothesis class, Target class, Inductive bias, Occam's razor, Empirical risk, Limitations of inference machines, Approximation and estimation errors Tradeoff

UNIT VII: Machine learning assessment and Improvement **Lectures: 6**

Statistical Model Selection, Structural Risk Minimization, Practical methods for risk assessment based on resampling, Jackknife, Bootstrap, Improving accuracy of general algorithms, Bagging, Boosting

UNIT VIII: Learning Theory **Lectures: 6**

Formal model of the learnable, Sample complexity, Learning in zero-Bayes and realizable case Growth function, VC-dimension, VC-dimension of Vector space of functions, proof Empirical Risk Minimization over finite classes, sample complexity, proof Empirical Risk Minimization over infinite classes, risk upper bound, proof Lower bound on sample complexity

UNIT IX: Support Vector Machines **Lectures: 6**

Margin of a classifier, Dual Perceptron algorithm, Learning non-linear hypotheses with perceptron Kernel functions, implicit non-linear feature space Theory: zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, Maximal Margin classifier Learning support vector machines as a dual-optimization problem

Text Book:

1. Machine Learning, Tom Mitchell, McGraw , 1997, 0-07-042807-7

Reference Books:

1. Richard Duda, Peter Hart and David Stork, Pattern Classification, 2nd ed. John Wiley & Sons, 2001.
2. Trevor Hastie, Robert Tibshirani and Jerome Friedman, the Elements of Statistical Learning. Springer, 2009

CS160 Information Retrieval

L – T – P: 3 – 0– 0 Credit: 3

Objectives: To provide the foundation knowledge in information retrieval.

- To equip students with sound skills to solve computational search problems.
- To appreciate how to evaluate search engines.
- To appreciate the different applications of information retrieval techniques in the Internet or Web environment.

Outcomes: After taking this course, students will be able to:

(a) Understand and apply the basic concepts of information retrieval;

(b) Appreciate the limitations of different information retrieval techniques;

(c) Write programs to implement search engines;

(d) Evaluate search engines;

UNIT I **Lectures: 11**

Introduction: Motivation, Basic Concept, Past, Present & Future, Retrieval Process

Modelling Information Retrieval System: Taxonomy of Information retrieval System, Retrieval:Adhoc and Filtering, Formal characterization of IR Models, Classical Information retrieval , Alternative Set Theoretical Model, Alternative Algebraic Model, Alternative Probabilistic Models, Structured Text Retrieval Models , Models for Browsing

UNIT II **Lectures: 10**

Query Languages and Query Operations: Keyword-based query, Pattern Matching, Structural Query, User Relevance Feedback, Automatic Local Analysis, and Automatic Global Analysis

UNIT III **Lectures: 16**

Text Operations: Document Pre-processing, Document Clustering, Text Compressing, Comparing Text compressing techniques

Indexing and Searching: Inverted Files, Other Indices for text, Boolean Queries, Sequential Searching, Pattern Matching Structural Queries, Compression

UNIT IV **Lectures: 5**

Multimedia IR: models and languages, Multimedia IR: indexing and searching, searching the web.

Text / Reference Books:

1. Modern Information Retrieval, 1/e by Ricardo Baeza-Yates, Pearson Education
2. Information Retrieval: Data Structures and Algorithms, by William B. Frakes, Pearson Education

CS161 Genetic Algorithms

L-T-P-Cr: 3-0-3

Objectives: The objective of the course is to introduce the role of nature–inspired algorithms in computationally hard problems.

Pre-requisite: Computer Algorithms

Outcome: By the end of the course, students should:

- appreciate the role of using nature-inspired algorithms in computationally hard problems,
- be able to apply what they learnt across different disciplines,

- Appreciate the emergence of complex behaviours in networks not present in the individual network elements.

UNIT I **Lectures: 12**

Introduction to Evolutionary Computation (EC): Biological and artificial evolution, Different branches of EC, e.g., GAs, EP, ES, GP, etc. A simple evolutionary algorithm Search Operators: Recombination/ Crossover for strings (e.g. binary strings), e.g., one point, multipoint and uniform crossover operators, Mutation for strings, e.g., bit flipping, recombination/crossover and mutation rates, Recombination for real –valued representations, e.g. discrete and intermediate recombinations, Mutation for real-valued representations, e.g., Gaussian and Cauchy mutations, self-adaptive mutations, etc. Why and how a recombination or mutation operator works.

UNIT II **Lectures: 20**

Selection Schemes: Fitness Proportional selection and fitness scaling, Ranking, including linear, power, exponential and other ranking methods, Tournament selection, Selection pressure and its impact on evolutionary search. Search Operators and Representations: Mixing different search operators, an anomaly of self-adaptive mutations, the importance of representation, e.g., binary vs. Gray Coding, Adaptive representation, Analysis, some examples

UNIT III **Lectures: 10**

Multiobjective Evolutionary Optimization: Pareto optimality, Multiobjective evolutionary algorithms, computational time complexity of EAs, No free lunch theorem Some Applications

Text Books:

1. David A Coley, "An introduction to Genetic Algorithms for Scientists and Engineers", World scientific publishing company(1997)
2. Mitsuo Gen Runwei Cheng, Wiley-Interscience, "Genetic Algorithms and Engineering Design", 1st Edition, (1997)
3. Thomas Back, "Evolution algorithms in theory and practice evolution strategies, Evolutionary programming, Genetic Algorithms", Oxford University press,(1996)
4. Kalyanmoy Deb, " Multi Objective Optimization using Evolutionary Algorithms", John Wiley and Sons(2001)
5. William M, "Evolutionary Algorithms: The Role of Mutation and Recombination",(Natural Computing Series), Springer-Verlag (2000)

CS162 Neural Networks & Its Applications

L-T-P: 3-0-3

Objectives: This unit examines mathematical and computational fundamentals of artificial neural networks and their applications in signal and image processing, pattern recognition and modelling.

Prerequisite: Basic knowledge of vectors and matrices is assumed. Introduction to AI

Outcomes: Students should be able to apply the concept of Neural Networks into different domains of AI, Data Mining etc.

UNIT I: Basic concepts of neurocomputing **Lectures: 5**

Artificial Neural Networks (ANN) and their biological roots and motivations. ANNs as numerical data/signal/image processing devices. Encoding (training phase) and decoding (active

phase).Taxonomy of neural networks: feedforward and recurrent networks with supervised and unsupervised learning laws. Static and dynamic processing systems. Basic data structures: mapping of vector spaces, clusters, principal components.

UNIT II: Basic terminology related to an artificial neuron **Lectures: 3**

a summing dendrite, synapses and their weights, pre- and post-synaptic signals, activation potential and activation function. Excitatory and inhibitory synapses. The biasing input. Types of activating functions.

UNIT III: The Perceptron **Lectures: 4**

The Perceptron and its learning law. Classification of linearly separable patterns, Structure and learning of perceptrons, Pattern classifier - introduction and Bayes' classifiers, Perceptron as a pattern classifier.

Perceptron convergence, Limitations of a perceptrons.

UNIT IV: Linear Networks **Lectures: 5**

Adaline --- the adaptive linear element. Linear regression. The Wiener-Hopf equation. The Least-Mean-Square (Widrow-Hoff) learning algorithm. Method of steepest descent. Adaline as a linear adaptive filter. A sequential regression algorithm.

UNIT V: Multi-Layer Feedforward Neural Networks **Lectures: 5**

Multi-Layer Perceptrons. Supervised Learning. Approximation and interpolation of functions. Back-Propagation Learning law. Fast training algorithms, Practical and design issues of back propagation learning, Applications of multilayer perceptrons: Image coding, Paint-quality inspection, Nettalk.

UNIT VI Self-Organizing systems **Lectures: 5**

Unsupervised Learning. Local learning laws. Generalised Hebbian Algorithm. The Oja's and Sanger's rules. Principal component analysis --- Karhunen-Loeve transform.

UNIT VII Competitive Learning **Lectures: 5**

MinNet and MaxNet networks. Clustering. Learning Vector Quantisation. Codebooks. Application in data compression.

UNIT VIII Self-Organising Feature Maps **Lectures: 5**

Radial-Basis function networks: Radial-Basis function (RBF) networks and their application in function interpolation, approximation and modelling probability distributions, Pattern separability and interpolation, Regularization Theory, Regularization and RBF networks, RBF network design and training, Approximation properties of RBF

Kohonen networks.

Recurrent networks: Hopfield networks.

Unit IX: Applications: Competitive Learning and Self organizing ANN Lectures: 5

General clustering procedures, Learning Vector Quantization (LVQ), Competitive learning algorithms and architectures, Self-organizing feature maps, Properties of feature maps.

Fuzzy Neural Networks- Neuro-fuzzy systems, Background of fuzzy sets and logic, Design of fuzzy stems, Design of fuzzy ANNs. **Support Vector machines-** Linear separability and optimal hyperplane, Determination of optimal hyperplane, Optimal hyperplane for nonseparable patterns, Design of an SVM, Examples of SVM.

Text Books:

1. Simon Haykin, *Neural Networks -- a Comprehensive Foundation,* Prentice Hall, 2nd ed., 1999, ISBN 0-13-273350-1

Reference Books:

1. Andrew P. Paplinski -- Lecture notes: ~app/CSE5312
2. H. Demuth, M. Beale, *Neural Network Toolbox User's Guide. For use with MATLAB,* The MathWorks Inc, (file:/sw/matlab/help/fulldocset.html from Unix workstations)
3. Martin T. Hagan, H. Demuth, M. Beale, *Neural Network Design,* PWS Publishing, 1996, ISBN 0-534-94332-2

CS163 Data & Text Mining

L-T-P-Cr: 3-0-0-3

Objectives: This course will introduce the essential techniques of data and text mining, understood here as the extension of data mining's standard predictive methods to unstructured text. This course will discuss these standard techniques, and will devote considerable attention to the data preparation and handling methods that are required to transform unstructured text into a form in which it can be mined.

Outcomes: After taking this course, students will be able to:

1. Learn the concepts of database technology evolutionary path which has led to the need for data mining and its applications
2. Examine the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system
3. Explore DWH and OLAP , and devise efficient & cost effective methods for maintaining DWHs.
4. Discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems , make predictions of outcomes
5. Comprehend the roles that data mining plays in various fields and manipulate different data mining techniques
6. Evaluate systematically supervised and unsupervised models and algorithms w.r.t their accuracy.

UNIT I **Lectures: 2**

Introduction to Information Retrieval. Inverted indices and boolean queries. Query optimization. The nature of unstructured and semi-structured text.

UNIT II **Lectures: 2**

Text encoding: tokenization, stemming, lemmatization, stop words, phrases. Further optimizing indices for query processing. Proximity and phrase queries. Positional indices.

UNIT III **Lectures: 7**

Index compression:lexicon compression and postings lists compression.Gap encoding, amma codes, Zipf's Law.Blocking. Extreme compression. Query expansion:spelling correction and synonyms. Wild-card queries, permuterm indices, n-gram indices. Edit distance, soundex, language detection. Index construction. Postings size estimation,merge sort, dynamic indexing, positional indexes, n-gram indexes,real-world issues.

UNIT IV **Lectures: 10**

Parametric or fielded search. Document zones. The vector space retrieval model. tf.idf weighting. Scoring documents. Vector space scoring. The cosine measure. Efficiency considerations. Nearest neighbor techniques, reduced dimensionality approximations, random projection. Results summaries:static and dynamic.Evaluating search engines.
User happiness, precision,recall, F-measure.Creating test collections:kappa measure, interjudge agreement. Relevance,approximate vector retrieval.

UNIT V **Lectures: 2**

Relevance feedback.Pseudo relevance feedback. Query expansion. Automatic thesaurus generation. Sense-based retrieval. Experimental results of performance effectiveness.

UNIT VI **Lectures: 8**

Probabilistic models for text problems. Classical probabilistic IR. Language models. Introduction to text classification. Naive Bayes models. Spam filtering. Probabilistic language models for IR. Bayesian nets for IR.

UNIT VII **Lectures: 5**

Introduction to the problem. Partitioning methods. K-means clustering. Mixture of gaussians model. Clustering versus classification. Hierarchical agglomerative clustering. Clustering terms using documents. Labelling clusters. Evaluating clustering. Text-specific issues. Reduced dimensionality/spectral methods. Latent semantic indexing (LSI). Applications to clustering and to information retrieval.

UNIT VIII **Lectures: 4**

Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support Vector machine classifiers. Kernel functions. Text classification. Exploiting text-specific features. Feature selection. Evaluation of classification. Micro- and macro averaging. Comparative results.

Reference Books

1. **Data Mining: A Tutorial Based Primer,** Michael Geatz and Richard Roiger, Pearson Education
2. **Data and Text Mining: A Business Applications Approach,** Thomas W. Miller, Pearson Education
3. **Introduction to Data Mining,** Pang-Ning Tan, Michael Steinbach,Vipin Kumar, pearson Education
4. **Modern Information Retrieval,** R. Baeza-Yates and B. Ribeiro-Neto, Pearson Education, 1999
5. **Information Retrieval: Algorithms and Heuristics**. D.A. Grossman, O. Frieder. Springer, 2004.
6. **Information Retrieval: Data Structures and Algorithms**, W. Frakes and R. Baeza-Yates, Pearson Education, 1ST EDITION.

CS164 VLSI & EVOLUTIONARY COMPUTING

L-T-P-Cr 3-0-0-3

Objectives - This course provides an introduction of CMOS circuits, layered Design Rule, switching Characteristics and Programmable Logic. The Objectives of this course: each student should be able to design, simulate, and develop fabrication specs for CMOS VLSI digital circuits. Students should have created awareness contemporary research problems faced in the design of VLSI circuits.
Prerequisites – Brief knowledge of in the following topics: Logic Circuit Design, Microelectronics, MOSFET Operation, MOS-based Logic gates, Sequential Circuits, Fundamental programming skills
Outcome- After taking this course, students will be able to: RTL synthesis, HDL Design, Schematic, Layout Design and genetic programming.

UNIT I **Lectures: 10**

Introduction to CMOS circuits: MOS Transistors, MOS transistor switches, CMOS Logic, The inverter, Combinational Logic, NAND gate, NOT Gate, Compound Gates, Multiplexers, Memory-Latches and Registers. Circuits and System Representation: Behavioural Representation, structural representation, and physical representation, CMOS Processing Technology: Silicon Semiconductor Technology- An Overview, wafer processing, oxidation, epitaxy deposition, Ion-implantation and diffusion, The Silicon Gate Process- Basic CMOS Technology, basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator, CMOS process enhancement-Interconnect, circuit elements, 3-D CMOS.

UNIT II **Lectures: 13**

Layout Design Rule: Layer Representations, CMOS n-well Rules, Design Rule of background scribe line, Layer Assignment, SOI Rule, Latch up: Physical origin of Latch up, Latch up triggering, Latch prevention, Internal Latch up prevention techniques, I/O Latch up Prevention

Switching Characteristics: analytic delay models, empirical delay model, gate delay. Power Dissipation: Static dissipation, Dynamic dissipation, short-circuit dissipation, total power dissipation. CMOS design Methods: Design Strategies, Structural design strategies, Hierarchy, Regularity , Locality.

UNIT III **Lectures: 9**

Programmable Logic: Programmable Logic structure, Programmable interconnect, and Reprogrammable Gate Array: Xilinx Programmable Gate Array, Algortomix, concurrent logic, Gate array design, Full custom mask design

Design Methods: Behavioural Synthesis, RTL synthesis, Placement, Routing, Layout Synthesis. Design Capture Tools: HDL Design, Schematic, Layout Design, Floor planning, Chip composition, Design Verification: Simulation, Timing verifier, Netlist Comparisons

UNIT IV **Lectures: 10**

Genetic Algorithm: Introduction of evolutionary computing, Representation of individuals, mutation, Recombination, population model, Parent selection, Survivor selection, learning classifier systems

Text Books:

1. Principles of CMOS VLSI Design: A System Perspective by Neil H.E. Weste and Kamran Eshraghian; Addison Wesley Publication.
2. Digital Integrated Circuits by Demassa & Ciccone, Willey Pub.
3. Modern VLSI Design: system on silicon by Wayne Wolf; Addison Wesley Longman Publisher
4. Basic VLSI Design by Douglas A. Pucknell & Kamran Eshranghian; PHI
5. Digital Integrated Circuits: A Design Perspective by Jan M. Rabaey; PHI

CS165 Real Time Systems

L–T–P: 3–0–0-3

Objectives: To develop different real-life research works in this emerging field.

Outcome: After learning this subject students will learn various types of Real Time Systems, Periodic and Aperiodic tasks, different types of scheduling algorithms in RTS(Clock Driven, Priority Driven), Priority Driven Scheduling Of Periodic Tasks, Priority Driven Scheduling Of Aperiodic and Sporadic Jobs, Different protocols for resource access controls, Scheduling approach in multiprocessor Real Time Systems etc.

UNIT I:

Lectures: 10

Introduction: Hard vs. Soft real time systems, A reference model of real time system. **Real-time scheduling:** Clock driven approach, Weighted Round-robin approach, Priority driven approach, Dynamic vs. static system, Effective Release Times and Deadlines, EDF and LST algorithm, Optimality and Non-Optimality of the EDF and LST algorithms, Off line vs. online Scheduling.

UNIT II: **Lectures: 6**

Clock-Driven Scheduling: Static, Time-Driven scheduler, General structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time Of Aperiodic Jobs, Scheduling Sporadic Jobs.

UNIT III: **Lectures: 7**

Priority Driven Scheduling Of Periodic Tasks: Fixe-priority vs. Dynamic priority algorithms, Maximum Schedulable Utilization, Optimality of the RM and DM algorithms, A Schedulability test for fixed-priority tasks with short response times, Sufficient Schedulability conditions for the RM and DM algorithms.

UNIT IV: **Lectures: 6**

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumptions and Approaches**,** Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth and Weighted Fair-Queueing Servers.

UNIT V: **Lectures: 8**

Resources and Resource Access control: Resource contention, resource access control, Nonpreemptive critical section, Basic Priority-Inheritance protocol, Basic Priority Ceiling Protocol, Stack based, Priority-ceiling protocol, preemption ceiling protocol.

UNIT VI: **Lectures: 5**

Multiprocessor scheduling, Resource Access Control, and Synchronization: Model of multiprocessor & distributed systems, task assignment, multiprocessor Priority-ceiling protocol, Elements of Scheduling Algorithms For End-to-End Periodic Tasks- IPS protocols, PM protocols, MPM protocol.

Text Books:

1. Real-Time system by Jane W. S. Liu, Pearson Education
2. Real-Time Systems by C. M. Krishna and K. G. Shin, McGraw Hill

CS166 Distributed Operating Systems

L-T-P-Cr: 3-0-0-3

Objectives: This course is designed to explain the principles of distributed systems so that a student can understand and work on distributed OS.

Prerequisites: Operating Systems.

Outcome: Students is expected to understand principles of distributed systems design and implementation so that she/he can work on distributed OS.

UNIT I **Lectures: 12**

Introduction and Review

Definitions, Hardware concepts, Software concepts, Design Issue

Communication in Distributed Systems

Layered protocols, Asynchronous transfer mode Networks, The Client – Server Model, Remote procedure call, Remote object invocations, and Group communication

UNIT II **Lectures: 10**

Synchronization in Distributed Systems

Clock Synchronization, Event Ordering, Mutual Exclusion, Election Algorithms, Atomic transactions, Deadlock in Distributed Systems

Processes and Processors in Distributed Systems

Threads, System Models, Process Allocation, Scheduling in Distributed Systems, Fault Tolerance, Real Time Operating Systems

UNIT III **Lectures: 8**

Distributed File Systems

Distributed File System Design, Distributed File Systems Implementation, Trends in Distributed File Systems

UNIT IV **Lectures: 12**

Distributed Shared Memory

What is Shared Memory, Consistency Models, Page based Distributed Shared Memory, Shared Variable Distributed Shared Memory, and Object based Distributed Shared Memory

Text book:

1. Distributed Operating Systems, Andrew S. Tanenbaum, Pearson Education.

Reference Book:

1. Distributed Operating Systems: Concepts and Design, Pradeep K. Sinha, Prentice Hall of India.

CS167 Cyber Security

L-T-P-Cr:3-0-0-3

Objectives - The Objective of this course is to expose students to multiple cyber security technologies, processes, and procedures, learn how to analyze the threats, vulnerabilities and risks present in these environments, and develop appropriate strategies to mitigate potential cyber security problems.

Prerequisites – Brief knowledge of the subject Network Security and Cryptography.

Outcome - After taking this course, students will be able to identify the security solutions that are most important for protecting our perimeter, understand attacks that affect security for the network. They can plan and implement the desired e-security solutions.

UNIT I **Lectures: 12**

Cyber Security Fundamentals: Introduction, cybercrime and Information Security, Classification of Cybercrimes, Cybercrime the legal Perspective, Cyberoffences,, Cyber-attacks, Social engineering, Cyberstalking, Botnets, Attack Vector, Cybercrime and cloud computing, Cybercrimes on mobile and wireless devices, Attacks on mobile/cell phones, Authentication service security, Organizational security policies and measures in mobile computing

UNIT II **Lectures: 10**

Ethics in Cyber Security: Privacy, Intellectual Property in the cyberspace, Professional Ethics, Freedom of Speech, Fair User and Ethical Hacking, Trademarks, Internet Fraud, Electronic Evidence, forensic Technologies, Digital Evidence collection

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Phishing and Identity Theft, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer overflows

UNIT III **Lectures: 10**

Cybercrimes and Cybersecurity: Cybercrime and Legal Landscape around the world, Cyberlaws, The Indian IT Act, Challenges, Digital Signatures and Indian IT Act, Amendments to the Indian IT Act, Cybercrime and punishment, Cost of Cybercrimes and IPR Issues, Web threats for Organizations, Social Computing and associated Challenges for Organizations.

UNIT IV **Lectures: 10**

Cybercrime Examples and Mini-Cases: Career Paths in Cybersecurity, Honeypots, Case study (Official Website Hacking, E-mail spoofing, Banking related Frauds, Credit Card related Frauds)

Text Books:

1. Cyber Security by Nina Godhole, Sunit Belapure, Wiley India.
2. Cyber Security Essentials by James Graham, Ryan Olson, Rick Howard CRC Press, Taylor & Francis Group, 2011 ISBN: 978-1-4398-5123-4

CS168 Intrusion Detection Systems

L-T-P: 3-0-0-3

Objectives - The Objective of this course is to build further on the grounding of principles in the earlier security courses, and to apply those principles to currently popular technologies such as firewalls and intrusion detection systems, widely sold as commercial solutions. Students will construct and adapt firewalls and intrusion detectors and analyse their architectures of this course.

Prerequisites – Brief knowledge of the subject Network Security, TCP/IP, Network programming skills.

Outcome - After taking this course, students will be able to identify the security solutions that are most important for protecting our perimeter, understand attacks that affect security for the network. They also understand the complexities of IP and how to identify malicious packets.

UNIT I **Lectures: 12**

Intrusion Detection and Prevention Principles: Understanding Intrusion Detection, Uses of IDPS Technologies, Key Functions of IDPS Technologies, Common Detection Methodologies, Signature-Based Detection, Anomaly-Based Detection, Stateful Protocol Analysis.

Theoretical Foundations of Detection: Taxonomy of anomaly detection system, fuzzy logic, Bayes theory, Artificial Neural networks, Support vector machine, Evolutionary computation, Association rules, Clustering.

UNIT II **Lectures: 12**

Architecture: IDS and IPS architecture, IDS and IPS internals, Types of IDPS Technologies Security Capabilities, Management, Network based IDPS, Network architectures and sensor locations, Security Capabilities

IDS Challenges: IDS Scalability in Large Networks. Vulnerabilities in Operating Systems, Limits in Network Intrusion Detection Systems, Challenges with Wireless Technologies, Over-Reliance on IDS

UNIT III **Lectures: 8**

Security and IDS Management: Data Correlation, Incident Response, Policy and Procedures, Law, Standards and organizations, Security Business issues, Future of Intrusion Detection and Prevention

UNIT IV **Lectures: 10**

Implementation and Deployment: Internet Security System's Real Source, Snort, NFR Security, IDS Tools.

Detail case study of IDS in different networks like Ethernet Networks, 802.11 Networks, Mobile Networks, Ad-hoc Networks, and Wireless Sensor Networks

Text Book:

1. Intrusion Detection & Prevention by Carl Endorf, Eugene Schultz, and Jim Mellander, TMH

Reference Book:

1. Implementing Intrusion Detection Systems by Tim Crothers, Wiley

CS169 PKI & Trust Management

L-T-P: 3-0-0-3

Objectives: This course is a graduate introduction to Public Key Infrastructure. The emphasis will be on proof techniques.

Outcomes: After taking this course, students will be able to learn the methods of conventional encryption. They will learn the concepts of public key encryption, digital certificates, authentication and Hash functions. They will learn the system level security used.

UNIT I **Lectures: 12**

Public Key Cryptography: Symmetric v/s Asymmetric ciphers, Secret key, New Directions: Public key, public/private key pair, Services of public key cryptography

Algorithms: Diffie Hellman key exchange algorithm, RSA algorithm.

UNIT II **Lectures: 18**

Digital certificate and Public Key Infrastructure: Digital Certificates, private key management, the PKIX model, public key cryptography standards, Certification authority, certificate repository, certificate revocation, cross certification. Hierarchical PKI, Mesh PKI, What does PKI offer, Simple Public Key Infrastructure, Pretty Good Privacy, X509 Version 3 Public Key Certificate, Secure Electronic Transaction Certificate, Attribute Certificate, Certificate Policies

UNIT III **Lectures: 12**

Trust Model: Strict hierarchy of certification authority, loose hierarchy of certification authority, Four-Corner Model.

Text Books:

1. Atul Kahate, "Cryptography and Network Security", TMH
2. Understanding PKI: Concepts, Standards and Deployment, Considerations, Second Edition by Crlisle Adams, Steve Loyd, Addision-Wesely Professional

CS170 Network Security

L-T-P: 3-0-0-3

Objectives: This course provides an essential study of computer security issues and methods in networking systems. Topics to be covered include review of networking, advanced cryptography, access control, distributed authentication, TCP/IP security, firewalls, IPSec, Virtual Private Networks, intrusion detection systems, and advanced topics such as wireless security, identity management, etc.

Prerequisite: Computer Security, Network Protocols

Outcomes: By the end of this course, students will be able to:

Explain concepts related to applied cryptography, including plaintext, ciphertext, symmetric cryptography, asymmetric cryptography, and digital signatures. Explain the theory behind the security of different cryptographic algorithms. Explain common network vulnerabilities and attacks, defense mechanisms against network attacks, and cryptographic protection mechanisms. Outline the requirements and mechanisms for identification and authentication. Identify the possible threats to each mechanism and ways to protect against these threats. Explain the requirements of real-time communication security and issues related to the security of web services. Explain the requirements of non-real time security (email security) and ways to provide privacy, source authentication, message integrity, non-repudiation, proof of submission, and proof of delivery, message flow confidentiality, and anonymity

UNIT I **Lectures: 3**

Physical Network Security: Physical Layer Security, Physical Network Security: Copper Media, Physical Network Security: Optical Media, Physical Security: Wireless Media

UNIT II **Lectures: 10**

Data Center and Enterprise Networks LAN Security, The Six Dumbest Ways to Secure a Wireless LAN., LAN Switch Security- RootGuard, BPDUGuard, uRPF, Control Plane Policing, dynamic ARP inspection, Building Resilient IP Networks-_BFD, Five nines availability, OIR, Route Processor Redundancy, SSO, NSF, HSRP, VRRP, FCAPS, ECMP, Fast Reroute, GD release, Hello Packets, L2TP, life cycle management, MTBF and MTTR, MIB, MPLS, MBGP, NetFlow, NAT, operations: IP SLAs, the items under "optimization", soft reset, PVLANs, P and PE routers, PVST, reverse proxy caching, RSTP

UNIT III **Lectures: 8**

Router Mechanisms for Security: Router and Switch Architectures, Lookup and Classification Algorithms, Packet scheduling and fair queuing, Queuing and Scheduling Algorithms.

UNIT IV **Lectures: 4**

Network Configuration and Defense: Internet Policy Routing- BGP Routing Policies in ISP Networks, a Survey of BGP Security Issues and Solutions

UNIT V: **Lectures: 2**

Securing Distributed and Networked Systems: Securing Distributed Algorithms

UNIT VI: **Lectures:8**

Web Security: Web Security Threats, Web Traffic Security Approaches, Overview of Secure Socket Layer and Transport Layer Security, Overview of Secure Electronic Transaction, Web and DNS security

UNIT VII: **Lectures: 4**

Intruders and Viruses: Intruders, Intrusion Techniques, Password Protection, Password Selection Strategies, Intrusion Detection, Malicious Programs, Nature of Viruses, Types of Viruses, Macro Viruses, Antivirus Approaches

UNIT VIII: **Lectures: 3**

Firewalls: Firewall Characteristics, Types of Firewalls, Firewall Configuration

Text Books:

1. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson
2. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson

Reference Books:

1. **Network Algorithmics**, 1st Ed. (2004), by George Varghese.
2. **LAN Wiring**, 3th Ed. (2007), by James Trulove.
3. **LAN Switch Security: What Hackers Know About Your Switches**, 1st Ed. (2007), by Eric Vyncke and Christopher Paggen.
4. **Building Resilient IP Networks**, 1st Ed. (2012), by Kok-Keong Lee and Beng-Hui Ong.
5. **CSSP All-In-One Exam Guide**, 6th Ed. (2012), by Shon Harris.
6. "Designing Network Security", Merike Kaeo, 2nd Edition, Pearson Books
7. "Building Internet Firewalls", Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly
8. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

CS171 Information Security

L-T-P-Cr 3-0-0-3

Objectives: To make the student aware of the growing need of the Information Security in the day to day life and to make him/her understand the concepts and technologies behind Information Security
Prerequisite: Prior knowledge of fundamentals of Computer Networks, Operating Systems, Database Management System
Outcome: The student must be able to understand and handle the Information Security issues of IT field.

UNIT I **Lectures: 9**

Introduction and Crypto Basics: Classic Crypto, Modern Crypto History, A Taxonomy of Cryptography and Cryptanalysis
Symmetric Key Crypto: Stream Ciphers, Block Ciphers, Integrity

UNIT II **Lectures: 14**

Public Key Crypto: Knapsack, RSA, Diffie-Hellman, Elliptic Curve Cryptography, Public Key Notation, Uses for Public Key Crypto, Public Key Infrastructure.
Hash Functions: What is Hash Function?, Non-Cryptographic Hashes, Tiger Hash, HMAC, Uses of Hash Functions

UNIT III **Lectures: 10**

Authentication: Authentication Methods, Passwords, Biometrics, Something You Have, Two-Factor Authentication, Single Sign-On and Web Cookies.
Authorization: Access Control Matrix, Multilevel Security Models, Multilateral Security, Covert Channel, Inference Control, CAPTCHA, Firewalls, Intrusion Detection.

UNIT IV **Lectures: 9**

Software flaws and malware: Software Flaws, Malware

Operating Systems and Security: Operating System Security Functions, Trusted Operating System, Next Generation Secure Computing Base.

Text Book:

1. Information Security -Principles and Practice, Deven N. Shah, Wiley India

CS172 Wireless & Mobile security

L-T-P-Cr: 3-0-0-3

Objectives: This course will address various issues (attacks and defense strategies) in wireless and mobile security, including WEP and WPA, wireless jamming attacks, device fingerprinting, key management, location based access control, location privacy, wireless paring, mobile health security, vehicle network security, RFID hacking and authentication, smartphone system security, etc. It is intended for Master or Doctoral students who are interested in the current development of wireless and mobile security.

Prerequisite: **Knowledge of wireless networks and mobile communication**

Outcomes: The outcome of this course is to familiarize students with the issues and technologies involved in designing a wireless and mobile system that is robust against various attacks. Students will gain an understanding of the various ways in which wireless networks can be attacked and tradeoffs in protecting networks. At the end of this course, students will have a broad knowledg e of the state-of-the-art and open problems in wireless and mobile security, thus enhancing their potential to do research or pursue a career in this rapidly developing area.

UNIT I **Lectures: 6**

Basic Security Concepts; Crypto Review; Introduction to Wireless Networks

UNIT II **Lectures: 3**

802.11 WEP and WPA

UNIT III **Lectures: 6**

Key Management in Sensor Networks

UNIT IV **Lectures: 3**

Vulnerabilities in Cellular Services, Cellular Jamming Attacks & Mitigation, Wireless Jamming Attacks, Security in Cellular VoIP Services, Mobile application security

UNIT V **Lectures: 3**

Device Fingerprinting and Wireless Pairing One Week

UNIT VI **Lectures: 3**

Attack (clone, sybil, compromised node/insider, etc.) Detection

UNIT VII **Lectures: 3**

Location Based Access Control and Location Privacy

UNIT VIII **Lectures: 3**

Mobile Health Security

UNIT IX **Lectures: 10**

Overview of WLAN security, Mobile IP security -, Attacks on 802.11 networks, Introduction/overview of ad hoc networks, Trust & reputation in ad hoc networks , Secure MANET routing, Node replication attacks, Collaborative cross-layer attacks, MAC misbehavior in MANETs, Security in hybrid

systems, Location security & privacy , Location security & privacy, Vehicle Network Security, RFID Hacking and Authentication, Smartphone System Security, Smart Grid Security

Reference Books:

1. "802.11 Wireless Networks: The Definitive Guide", by Matthew Gast, O'reilly Mideia; 2nd Edition; October 2011.
2. "Hacking Exposed Wireless", by Johnny Cache, Joshua Wright, and Vincent Liu, McGraw-Hill Osborne Media; 2nd Edition; July 2010.
3. "Wi-Foo: The Secrets of Wireless Hacking" by Andrew Vladimirov, Konstantin V. Gavrillenko, and Andrei A. Mikhailovsky, Addision-Wesley Professional; 1st Edition, July 2004.

CS173 Object Oriented Analysis & Design

L-T-P-Cr:3-0-0-3

Objectives: To do analysis of the software which is to be implemented as well as to design the software based on object oriented technology.

Prerequisite: Knowledge of Software Engineering

Outcomes: After going through this subject students will learn the different modelling diagrams, software requirements analysis and specification, design of software, object modeling techniques, and how to deploy the software on the given system.

UNIT I **Lectures: 8**

Introduction, Modeling Concepts, class Modeling: What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history

Modeling as Design Technique: Modeling; abstraction; The three models.

Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.

Advanced Class Modeling: Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes;

UNIT II **Lectures: 8**

Advanced Class Modeling contd.: Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages;

State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior.

Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models

UNIT III **Lectures: 8**

Interaction Modeling: Use case models; Sequence models; Activity models.

Use case relationships; Procedural sequence models; Special constructs for activity models.

Process Overview, System Conception, Domain Analysis: Process Overview: Development stages; Development life cycle.

System Conception: Devising a system concept; Elaborating a concept; Preparing a problem statement.

Domain Analysis: Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis.

UNIT IV **Lectures: 8**

Application Analysis, System Design: Application Analysis: Application interaction model; Application class model; Application state model; Adding operations.

Overview of system design; Estimating performance; Making a reuse plan; Breaking a system in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of data

storage; Handling global resources; Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example.

Class Design: Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recursing downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example.

UNIT V **Lectures: 10**

Implementation Modeling: Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; realizing associations; Testing.

Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance.

Design Patterns: What is a pattern and what makes a pattern? Pattern categories;
Relationships between patterns; Pattern description

Text Books

1. Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML, 2nd Edition, Pearson Education, 2005.(Chapters 1 to 17, 23)
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal: Pattern-Oriented Software Architecture, A System of Patterns, Volume 1, John Wiley and Sons, 2006.

(Chapters 1, 3.5, 3.6, 4)

Reference Books:

1. **Object-Oriented Analysis and Design with Applications** - Grady Booch et al, 3rd Edition, Pearson, 2007.
2. **Practical Object-Oriented Design with UML -** Mark Priestley, 2nd Edition, Tata McGraw-Hill, 2003.
3. **Object-Oriented Design with UML and JAVA -** K. Barclay, J. Savage, Elsevier, 2008.
4. **The Unified Modeling Language User Guide -** Booch, G., Rumbaugh, J., and Jacobson, I, 2nd Edition, Pearson, 2005.
5. **Design Patterns- Elements of Reusable Object-Oriented Software -** E. Gamma, R. Helm, R. Johnson, J. Vlissides, Addison-Wesley, 1995.
6. **Object-Oriented Systems Analysis and Design Using UML** - Simon Bennett, Steve McRobb and Ray Farmer, 2nd Edition, Tata McGraw-Hill, 2002.

CS174 Introduction to Computer

L-T-P-Cr: 3-0-0-3

Objectives: 1. Gain an understanding and appreciation for God, the Creator, who is orderly, precise and infinite.

2. Use the computer as a tool and be able to demonstrate its use in creating an electronic product.

3. Demonstrate knowledge of the main computer applications used in business and be able to choose the appropriate application for a given task.

Outcome: After taking this course, students will be able to demonstrate the use of computer in creating an electronic product. They will also gain the knowledge of the main computer applications used in business and be able to choose the appropriate application for a given task.

UNIT I **Lectures: 14**

The Amazing Computer:

History of Computer, Generation of Computer, Classification of Computers, The Shapes of Computers Today: Supercomputers. Mainframe Computers, Minicomputers, Workstations.

Microcomputers or Personal Computers, Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit.

Interacting With Your Computer:
Standard Methods of Input: The Keyboard, The Mouse, Variants of the Mouse. Alternative Methods of Input**:** Devices for the Hand, Optical Input Devices, Audiovisual Input Devices, Output Devices: Monitors and Sound Systems: Monitors, PC Projectors, Sound Systems. Devices That Output Hard Copy**:** Overview of Printers, Dot Matrix Printers, Ink Jet Printers, Laser Printers, Snapshot Printers, Other High-Quality Printers

UNIT II **Lectures: 10**

Processing data:
Transforming Data into Information: How Computers Represent Data, How a Computer Processes Data, Factors Affecting Processing Speed, Extending the Processor's Power. CPUs Used in Personal Computers: Intel Processors Advanced Micro Devices (AMD), Cyrix Processors, Motorola Processors, RISC Processors, Parallel Processing.
Storing Information in a Computer:
Types of Storage Devices: Categorizing Storage Devices, Magnetic Storage Devices, Optical Storage Devices. Measuring Drive Performance: Average Access Time, File Compression, Data
Transfer Rate, Drive-Interface Standards.

UNIT III **Lectures: 9**

Number System:
Binary & Allied number systems representation of signed and unsigned numbers. BCD, ASII. Binary Arithmetic & logic gates
Types of Software:
Application Software and System Software, compiler, Basic concepts of assembler, loader, linker, Operating System, Assembly language, Machine level language, high level
Language

UNIT IV **Lectures: 7**

The Operating System and User Interface:
Operating Systems Basics: The User Interface, Running Programs, Managing Files, Managing Hardware, Utility Software. PC Operating Systems: UNIX, DOS, The Macintosh Operating System, Windows 3x, OS/2 Warp, Windows NT, Windows 95 and 98, Linux,
Windows 2000.

Text Books:

1. Norton Peter. Peter Norton's Introduction to Computers Fourth Edition. Ohio: Glencoe/McGrawHill. ISBN 0-07-821058-5 © 2001
2. New Perspectives on Computer Concepts- Essentials 5th Edition ISBN: 0-619-16164-7 © 2003

CS175 Cryptography & Network Security

L-T-P-Cr: 3-0-0-3

Objectives: This course is a graduate introduction to cryptography. Topics include encryption, pseudo-random generation, digital signatures, two-party protocols and zero-knowledge. The emphasis will be on proof techniques.

Prerequisite: General ease with algorithms, elementary number theory and discrete probability. Mathematical background: review probability theory, information theory, complexity theory, number theory, abstract algebra, finite field, etc. and their relationship.

Outcomes: To know the methods of conventional encryption. To understand the concepts of public key encryption and number theory. To understand authentication and Hash functions. To know the network security tools and applications. To understand the system level security used.

UNIT I **Lectures: 4**

Introduction: What is cryptology: (cryptography + cryptanalysis), Overview of cryptology: How cryptography works?, how to break a cryptographic system ? Classical conventional encryption, modern conventional encryption, public key encryption, hashing algorithm. OSI Security Architecture, Cryptanalysis of Classical Cryptosystems, Shannon's Theory

UNIT II **Lectures: 8**

Symmetric Cipher: Classical Encryption Techniques, Symmetric Cipher Model, Block Cipher Principles, DES, Triple DES, **Cryptanalysis of Symmetric Key Ciphers:** Differential and Linear Cryptanalysis, Block Cipher Design Principle, The Euclidean Algorithm, Finite field of Form GP(p), Advance Encryption Standard (AES), AES Cipher, Multiple Encryption and Triple DES, Stream Cipher and RC4, Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random number generation

System Security: Intrusion detection, Password Management, Virus countermeasure, Denial of Service Attack, Firewall design principles, Trusted System

UNIT III **Lectures: 8**

Public Key Cryptography: Key Management - The Discrete Logarithm Problem (DLP) and the Diffie Hellman Key Exchange algorithm, Cryptanalysis of DLP, Elliptic Curve Architecture and Cryptography - Confidentiality using Symmetric Encryption - Public Key Cryptography, RSA, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA ElGamal Cryptosystems,

UNIT IV **Lectures: 8**

Authentication and Hash Function: Authentication requirements - Authentication functions - Message Authentication Codes - Hash Functions - Security of Hash Functions, Hash functions: The Merkle Damgard Construction and MACs - MD5 message Digest algorithm - Secure Hash Algorithm - RIPEMD – HMAC, CMAC, Whirlpool and Comparative analysis. Digital Signatures - Authentication Protocols - Digital Signature Standard.

UNIT V **Lectures: 5**

Network Security: Authentication Applications: Kerberos - X.509 Authentication Service - Electronic Mail Security - PGP - S/MIME - IP Security - Web Security

UNIT VI **Lectures: 5**

System Level Security: Intrusion detection - password management - Viruses and related Threats - Virus Counter measures - Firewall Design Principles - Trusted Systems.

UNIT VII **Lectures: 4**

Cryptanalysis: Differential Cryptanalysis, Linear Cryptanalysis, Truncated differential cryptanalysis, etc

Assignments (not limited to this): including Cryptographic standards, application of cryptosystems, network security (IPSEC, VPN, Web Security), privilege management infrastructure (PMI) and Access Control, e-Commerce and Smart IC cards)

Text Books

1. William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall of India, Third Edition, 2003.

Reference Books

1. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.

2. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson Education, 2003.

Detailed Syllabus of B.Tech. (INFORMATION TECHNOLOGY)

Syllabus with effect from session 2013-14

IT101 IT Services management

L – T – P: 3-1-0-4

Objectives: The objective of the course is to introduce students with basics of Management Information Systems and IT Services Management.

Prerequisite: Basic knowledge of Information Technology, Software Engineering, Operations Research.

Outcome: The Candidate acquires the knowledge of managing the IT services efficiently and effectively and would know how to utilize the resources optimally.

UNIT I **Lectures: 6**

Foundation of Information Systems: Introduction to information system in business, fundamentals of information systems, Solving business problems with information systems, Types of information systems, Effectiveness and efficiency criteria in information system.

UNIT II **Lectures: 8**

An overview of Management Information Systems: Definition of a management information system, MIS versus Data processing, MIS & Decision Support Systems, MIS & Information Resources Management, End user computing, Concept of an MIS, Structure of a Management information system.

UNIT III **Lectures: 9**

Concepts of planning & control: Concept of organizational planning, The Planning Process, Computational support for planning, Characteristics of control process, The nature of control in an organization.

UNIT IV **Lectures: 11**

Business applications of information technology: Internet & electronic commerce, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information System for Managerial Decision Support, Information System for Strategic Advantage.

Managing Information Technology: Enterprise & global management, Security & Ethical challenges, Planning & Implementing changes.

UNIT V **Lectures: 8**

Advanced Concepts in Information Systems: Enterprise Resource Planning, Supply Chain Management, Customer Relationship Management, and Procurement Management.

Text Books

1. O Brian, “Management Information System”, TMH
2. Gordon B. Davis & Margrethe H. Olson, “Management Information System”, TMH.

Reference Books

1. O Brian, “Introduction to Information System”, MCGRAW HILL.
2. Murdick, “Information System for Modern Management”, PHI.
3. Jawadekar, “Management Information System”, TMH.
4. Jain Sarika, “Information System”, PPM
5. Davis, “Information System”, Palgrave Macmillan

IT103 Web Technology

L – T – P-Cr: 3-1-0-4

Objectives: The objective of the course is to make the students familiar with plain HTML and JAVA programming.

Outcome: Student should have the knowledge of Web Page design using HTML, CSS, JavaScript and Java.

UNIT I **Lectures: 6**

Web Introduction: Domain name, IP Address concepts, World Wide Web

HTML & CSS: Introduction to HTML, Tags, Commands, Formatting web page, Font Tag, Links and Listings, Images and its Mapping, Tables, Frameset Definition, Forms, Cascading Style sheet (CSS).

UNIT II **Lectures: 12**

JavaScript : Introduction, data types, variables, operators, Array Objects, Date Objects, String Objects, Document Object Model, Image Object, Event Handling, Browser Object, Window Object, Location Object, History Object, Submit event and data validation.

Dynamic Hypertext markup language (DHTML): Introduction to DHTML, Dragging and Dropping data, working layers.

UNIT III **Lectures: 12**

Java Fundamental: Introduction to Java, Java and the Internet, Data type, Variables, Operators, Strings, Input and Output, Control Flow, Arrays., Object and classes, members of classes, Inheritance, Interfaces.

UNIT IV **Lectures: 12**

Graphics and Applet programming in Java: Introduction to Abstract Window Toolkit (AWT) and Swing, Event Handling, Working with Text input, Choice Components, Menus, Dialog Boxes. Applets and deploying Applets with HTML, Jar Files, Exception Handling, Introduction to Multi-Threading in Java

Database Programming: JDBC API.

Text Books:

1. HTML Black Book By Steven Holzner(Wiley India)
2. JAVA - How To Programm, by Deitel & Deitel, (Pearson)

Reference Books:

1. HTML, CSS, Java Script, Perl, Python & PHP (Web Standard Programming Reference) By (Wiley India)
2. JAVA: The Complete Reference, J2SE, 5/e, by Schildt (TMH)
3. Web Programming by Bates, Wiley
4. Core JavaTM Volume I & II by Cay S. Horstmann & Gary Cornell (Pearson)
5. Internet & WWW How to program by by Deitel & Deitel, (Pearson)
6. HTML & XHTML: The Complete Reference by Powell, (TMH)

IT102 Web Technology Lab

L – T – P-Cr: 0-0-3-1

List of Programs

1. Write a program to create a HTML page using different HTML Tags.
2. Write a program to create a table using HTML Tags.
3. Write a program to create a form using HTML Tags.
4. Write a program to create a HTML page for Hypertext to invoke another page.
5. Write a program to create a table using HTML and design the table using CSS.
6. Create a HTML form and validate and design the form using CSS.
7. Create a registration form using Servlet.
8. Create a student information record using Servlet.
9. Database Connectivity to store data using Oracle or MySQL.
10. Create a form to store data of student and validate the form using Servlet.
11. Write a Java script program for creating Msg Window and Alert function
12. Write a Java script program for Form validation.
13. Write a servlet program to save, delete and update the student record using Java script validation and CSS style.
14. Develop and design a website for hospital to manipulate the doctor – patient – ward – payment and store the records using Java Script validation
15. Write a program to create a chat collaboration using Java-RMI.
16. Write a program to request from a client and respond from the server using Java RMI method.

IT104 Cloud Computing

L-T-P: 3-1-0-4

Objectives: The objective of the course is to get the Students Introduced with Distributed computing in form of Cloud Computing.
Outcome: Should know nuts and bolts of Cloud and principle behind working of Cloud computing

UNIT I **Lectures: 6**

Introduction: Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies.
Principles of Parallel and Distributed Computing: Eras of Computing, Parallel vs. Distributed Computing, Elements of Parallel Computing, Elements of Distributed Computing, Technologies for Distributed Computing.

UNIT II **Lectures: 8**

Virtualization: Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples.

UNIT III **Lectures: 12**

Cloud Computing Architecture: Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges Cloud Application Platform: Anatomy of the Aneka Container, Building Aneka Clouds, Cloud Programming and Management High-Throughput Computing: Task Programming: Task Computing, Task-based Application Models, Aneka Task-Based Programming.

UNIT IV **Lectures: 12**

Data Intensive Computing: Map-Reduce Programming: What is Data-Intensive Computing? Technologies for Data-Intensive Computing.

Cloud Applications: Scientific Applications, Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Biology: Gene Expression Data Analysis for Cancer Diagnosis, Business and Consumer Applications, Multiplayer Online Gaming.

UNIT V **Lectures: 4**

Advanced Topics in Cloud Computing: Energy Efficiency in Clouds, Market Based Management of Clouds

Reference Book:

1. Cloud Computing : by Rajkumar Buyya, TMH

IT161 VLSI & Embedded system

L-T-P-Cr: 3-0-0-3

Objectives - This course provides an introduction of CMOS circuits, layered Design Rule, switching Characteristics and Programmable Logic. The Objectives of this course: each student should be able to design, simulate, and develop fabrication specs for CMOS VLSI digital circuits. Students should have created awareness contemporary research problems faced in the design of VLSI circuits**.**

Prerequisites – Brief knowledge of in the following topics: Microcontroller and microprocessor Architecture, Assembly language Programming Microcontroller peripherals, Analog Design, Digital Design, Compilers, Assemblers

Outcome- After taking this course, students will be able to design embedded microprocessors and Field Programmable Gate Arrays (FPGA's).

UNIT I **Lectures: 10**

Logic Design with MOSFETs: MOSFET as switches, Complex Logic gates in CMOS, Transmission Gate Circuits, Clocking and Dataflow control. Physical Structure of CMOS Integrated circuits, Fabrication Structure of CMOS Integrated Circuits, Elements of Physical Design: Layout of basic structures, Cell concepts, FET sizing and the Module transistor, Physical design of Logic gates.

UNIT II **Lectures: 10**

Electrical Characteristics of MOSFETs: FET RC Model, Modeling of Small MOSFETs, Electronic analysis of CMOS Logic gates: DC characteristics of the CMOS inverter, inverter switching characteristics, power dissipation, dc characteristics: AND and NOR gates, NAND and NOR transient response, Analysis of Complex Logic gates, gate design for transient performance, transmission gates and pass transistors, gate delays, driving large capacitive loads

UNIT III **Lectures: 6**

Behavioural Synthesis, RTL synthesis, Placement, Routing, Layout Synthesis. Design Capture Tools: HDL Design, Schematic, Layout Design, Floor planning, Chip composition, Design Verification: Simulation, Timing verifier, Netlist Comparisons

UNIT IV **Lectures: 6**

System-level physical design: Large scale physical design, Interconnect delay modeling, crosstalk, interconnect scaling, Floor planning and Routing, Input and Output Circuits, Power distribution and consumption.

UNIT V **Lectures: 5**

Introduction to Embedded systems design: Introduction to Embedded system, Embedded System Project Management, ESD and Codesign issues in System development Process, Design cycle in the development phase for an embedded system, Use of target system or its emulator and In-circuit emulator, Use of software tools for development of an ES.

UNIT VI **Lectures: 5**

8051 Microcontroller: Microprocessor V/s Micro-controller, 8051 Microcontroller: General architecture; Memory organization; I/O pins, ports & circuits; Counters and Timers; Serial data input/output; Interrupts,8051 Instructions, 8051 Interfacing and application.

Text / Reference Books:

1. Principles of digital VLSI design – A system perspective by Neil H E Weste and Kamran Esraghian, Addison Wesley, 2004
2. Digital Integrated Circuits by Demassa & Ciccone, Willey Pub.
3. Principles of CMOS VLSI Design – A System Perspective by Neil H.E. Weste and Kamran Eshraghian, Addison Wesley Pub
4. Embedded Systems by Raj Kamal, TMH, 2006.
5. The 8051 Microcontroller by K Ayala, 3rd Ed., Thomson Delmar Learning, 2007
6. Basic VLSI Design by Douglas A. Pucknell & Kamran Eshranghian, PHI
7. Digital Integrated Circuits: A Design Perspective by Jan M. Rabaey, PHI

IT162 Pattern Recognitions & Image Processing

L-T-P: 3-0-0-3

Objectives: To carry out different real-life research works in this emerging field.

Outcome: After learning this subject Students will learn the necessity and types of feature extraction techniques for recognizing a pattern, will learn different type of classifiers used for training purpose, different learning techniques, recognition approach, image representation, segmentation and feature extractions on any image, edge detection of any image, different mathematical techniques for processing an image, different filtering techniques for processing an image etc.

UNIT I **Lectures: 6**

Pattern Recognition Overview: Overview, Pattern Recognition, Classification and Description, patterns and Feature Extraction, Training and Learning in PR Systems, Pattern Recognition Approaches.

UNIT II **Lectures: 6**

Statistical Pattern Recognition: Introduction, The Gaussian case and Class Dependence Discriminate Functions, Extensions, Classifier Performance, RISK and Errors.

UNIT III **Lectures: 9**

Supervised Learning: Parametric Estimation and Supervised Learning, Maximum Likelihood Estimation Approach, Bayesian Parameter Estimation Approach, Non- Parametric Approaches, Parzen Windows, K-Non-Parametric Estimation. Nearest Neighbor Rule. Linear Discriminate Functions and The Discrete and Binary Feature Cases: Introduction, Discrete and Binary Classification Problems, Techniques to Directly Obtain Linear Classifiers.

UNIT IV **Lectures: 12**

Image Representation & Modeling: The Human Eye-Brain System as a Model, Image Formation, Image Models, Basic Image Processing: Sampling and Quantization, Brightness and Colour, Histogram, Filters and Convolution, Frequency Domain Processing, Edge Detection, Boundaries and Line Extraction, Segmentation and Feature Extraction, 2-D Shape Representation and Matching.

UNIT V **Lectures: 9**

Image Transforms: Fourier Transform, Application and Use, Wavelet Trans, Hadamard Cosign Transform, Image Enhancement – Point and Region Operators, Unsharp Masking, Image Compresson – Jpeg, Mpeg.

Image Restoration – Direct, Inverse, Pseudo-Inverse, Blurring (Spatial Motion), Implementations – Software and Hardware.

IT163 IT Project Management

L-T-P-Cr: 3-0-0-3

Objectives: The objective of the course is to get the students familiar with IT Project Management.

Outcome: Should know the different phases of IT Project Management, tools and practising them for real life projects.

UNIT I **Lectures: 8**

Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.

UNIT II **Lectures: 12**

Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

UNIT III **Lectures: 10**

Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource Constraints: Resource Leveling and Resource Allocation. Time Cost Tradeoff: Crashing Heuristic.

UNIT IV **Lectures: 12**

Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management; Post Project Analysis.

Text/Reference Books:

1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, PH Inc.
2. Lock, Gower, Project Management Handbook.
3. Cleland and King, VNR Project Management Handbook.
4. Wiest and Levy, Management guide to PERT/CPM, PHI.

5. Horald Kerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002.
6. S. Choudhury, Project Scheduling and Monitoring in Practice.
7. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.

IT164 XML and Web Applications

L-T-P-Cr: 3-0-0-3

Objectives: The objective of the course is to make the students aware about how transferring of data happens when one web application needs to talk to some other web applications.

Outcome: By the end of the course, students should learn XML, their creation, storage, parsing and transfer and creating J2EE applications / components capable of holding and/or transferring data.

UNIT I **Lectures: 5**

Introduction to SGML – features – XML, XML as a subset of SGML – XML Vs HTML – Views of an XML document – simple XML documents – Starting & Ending of Tags – Attributes of Tags – Entity References – Comments – CDATA section

UNIT II **Lectures: 7**

Document Type declarations – Creating XML DTDs – Element type declaration – Attribute List Declaration – Attribute types – Attribute defaults – Displaying XML Data in HTML browser as HTML tables – Storing XML data in HTML document – Converting XML to HTML with XSL minimalist XSL style sheets – XML applications

UNIT III **Lectures: 8**

Java Beans: Features – Designing Java Beans – Creating and using properties – Induced – bound and constrained properties – using and creating events – Introspection – creating & using BeanInfo clauses – customization – providing custom property editors and GUI interfaces.

UNIT IV **Lectures: 12**

JSPs – Creating simple JSP Pages – templating – Request time expression – Request & Response objects – Reading parameter values – Using Javabeans in JSPs – Reading & setting Properties of JavaBeans – Connecting forms & bean properties – Serialized beans – declaring variables & methods in pages – scriptlets – conditionals, loops & execution handling in JSPs with scriptlets – Accessing beans via scriptlets.

UNIT V **Lectures: 10**

EJB – Basics of EJB – Types of Beans – Development of Session Beans – Steps – Creating & Implementing Interfaces – Writing Deployment descriptors – Packaging and deploying bean – using the bean from a client – Development of stateful session bean. Entity beans – Features (Basics of developing and using entity beans)

Text/Reference Books

Module 1, 2

1. XML by Example: Building Ecommerce applications – Sean McGrath, Pearson Education
Module 3

2. Using JAVA 2 Platform Special Edition Java 2, AWT, Swing, XML and Java Beans – Joseph L. Weber, Prentice Hall of India

3. Programming Black Book – Steven Holzner, Wiley Dreamtech

Module 4

4. Java Server pages – Larne Pekowsky – Pearson Education Asia

5. JSP: Java server pages – Barry Burd, IDG Books India

Module 5

6. Mastering Enterprise Java Beans and the Java 2 Platforms, Enterprise Edition – EdRoman (WILEY computer publishing)

7. EJB Design Patterns – Floyd Marinescu

Additional Reference

8. Internet & Web Technologies – Raj Kamal, TMH

IT165 Computer Graphics

L-T-P-Cr: 3-0-0-3

Objectives: To develop the algorithm design capability for creating different 2-D and 3-D graphical objects so that these knowledge can be utilized in different research works on *Pattern Recognition* and *Image Processing*.

Outcome: After learning this subject students will learn to write algorithms for generating different 2-D graphical objects like circle, line, ellipse, polygon etc., for filling a polygon, different 2-D transformation techniques(rotation, scaling, translation etc.), different line and polygon clipping algorithms, different types of projections in 3-D vector algebra, different 3-D transformation techniques, different types of spline curves and surfaces, Fractal geometry methods, different types of visible-surface detection methods of 3-D objects, different surface-rendering and polygon rendering methods etc.

UNIT I **Lectures: 4**

Introduction of computer Graphics and its applications, Overview of Graphics systems, Video display devices, Raster scan display, Raster scan systems, video controller, Raster scan display processor, Random scan display, random scan systems, color CRT monitor, Flat panel display, Interactive input devices, Logical classification of input devices, Keyboard, mouse, Trackball and spaceball, Joysticks, Image scanner, Light pens, Graphics software, Coordinates representations, Graphics functions.

UNIT II **Lectures: 10**

Line drawing algorithms, DDA, Bresenham's, Circle generating, Mid-point circle algorithm, Ellipse generating, Polynomials, polynomial filling Algorithms: Scan-line polygon fill, Boundary fill, Flood Filling Algorithm, anti-initialising Techniques.

UNIT III **Lectures: 08**

Basic 2D transformations: Translation, Rotation, Scaling, Matrix representation's & homogeneous co-ordinates, Composite transformations, Reflection, Two dimensional viewing, Two dimensional clipping: Line Clipping: Cohen-Sutherland algorithm, NLN algorithm, Polygon Clipping: Sutherland-Hodgeman algorithm, Weiler-Atherton algorithm, Curve Clipping.

UNIT IV **Lectures: 05**

Review of 3D vector algebra: parallel and perspective projections along with matrix derivations, 3D-transformation: Translation, Rotation, and Scaling with necessary derivations.

UNIT V **Lectures: 08**

3D Object Representations: Spline representation, Cubic spline, Bezier curve, Bezier surfaces, Beta spline, B spline surfaces, B-spline curve, Fractal-geometry methods, Fractal generation procedures, Classification of Fractals, Fractal dimension, Fractal Construction methods.

UNIT VI **Lectures: 07**

Visible-Surface Detection Methods: Back-face detection, Depth-Buffer method, A-Buffer method, Scan-Line method, Area-Subdivision method, Ray-Casting method, Illumination models and Surface-Rendering methods: Basic Illumination models, Polygon Rendering Methods: Constant Intensity Shading, Gouraud Shading, Phong Shading, Basic Ray-Tracing Algorithms, Radiosity Lighting Model, Basic Radiosity Model, Radiosity Method.

Text Books:

1. Computer Graphics C version by Donald Hearn, and M. Pauline Baker, Pearson Education
2. Mathematical Elements for Computer Graphics by Roger, Tata McGraw Hill

IT166 Data Mining and Warehousing

L-T-P: 3-0-0-3

Objectives: The objective of the course is to get the students introduced with Data Mining and Data Warehousing field.

Outcome: By the end of the course, students should have introductory level of understanding of Data Mining and Warehousing.

UNIT I **Lectures: 4**

Data Mining, Data Mining task primitives, Integration of Data Mining system with the database, Major issues in Data Mining, Data Preprocessing, Descriptive data summarization, Data cleaning, Data integration and transformation, Data reduction.

UNIT II **Lectures: 6**

Data Warehouse, Multidimensional data model, Data Warehouse architecture, Three tier Data Warehouse architecture, Metadata repository, OLAP operations, OLAP Benefits, Codd's Rules for OLAP Tools ,Types of OLAP servers.

UNIT III **Lectures: 12**

Frequent patterns, Market basket analysis, Association Rule, Support and Confidence, overview of multilevel association rule, multidimensional association rule, closed itemset, maximal itemset, Apriori algorithm, Generating association rule from frequent itemset, Mining frequent itemsets without candidate generation (FP- growth), Mining multilevel association rules, Mining multidimensional association rules, Mining quantitative association rules, Association analysis to correlation analysis.

UNIT IV **Lectures: 10**

Classification and Prediction, Classification by Decision Tree Induction, Attribute selection measures, Bayes Theorem, Predicting a class label using Bayesian classification, Classification by Backpropagation, A multilayer feed forward neural network, Prediction: Linear Regression, Nonlinear Regression

UNIT V **Lectures: 10**

Cluster Analysis: Types of Data in Cluster Analysis, Categorization of the major clustering methods, Partitioning methods: k-Means and k-Medoids.

Item-based filtering: Adjusted Cosine Similarity, Slope One, Making predictions with Weighted Slope One.

Text Books:

1. Data Mining Concepts and Techniques by Jiawei Han, Micheline Kamber, Elsevier.
2. Database Systems by Thomas M. Connolly, Carolyn E. Begg, Pearson Education
3. Data Mining. A tutorial-based Primer by Roiger, Michael W. Geatz and Pearson Education.

IT167 Server Side Programming

L-T-P-Cr: 3-0-0-3

Objectives: To have better understanding of the client server architecture, specially the programming at the server side

Prerequisite: Core Java Programming language.

Outcome: Able to develop web application and business application for the enterprises based on the client and server technology.

UNIT I **Lectures: 5**

Client Server Architecture, Networking Fundamentals, InetAddressClass, Datagram, Writing Server Side Application, Writing Client Side Application, TCP/IP, Socket Class, ServerSocket Class.

UNIT II **Lectures: 9**

Remote Method Invocation, Architecture of RMI, Responsibility of Stub class, Responsibility of Skeleton class, RMI Registry, Registering Object into registry, looking up a remote object, RMI Compiler.

UNIT III **Lectures: 8**

Servlet, Servlet doGet( )/doPost( ), Servlet life cycle, Servlet session, Storing and retrieving data in database using Servlet.

UNIT IV **Lectures: 10**

Understanding of JSP, JSP Life cycle, JSP declarations, JSP Scriptlets, JSP Expression, JSP directive, JSP implicit objects, JSP user defined tags.

UNIT V **Lectures: 10**

Properties of EJB, Types of Beans, J2EE specification for Enterprise Beans, Session Bean Lifecycle, Session Beans: Stateful Session Beans, Stateless Session Beans, Entity Beans: Bean-Managed Persistent Entity Beans, Container-Managed Persistent Entity Beans, Message-Driven Beans: JMS Architecture

Reference Books:

1. Java Fundamentals: Herbert Schildt, Dale Skrien, McGraw-Hill
2. Head First Servlets and JSP: Bryan Basham, Kathy Sierra, Bert Bates, O'Reilly

IT168 E-Commerce and ERP

L-T-P: 3-0-0-3

Objectives: The objective of the course is to get the students familiar with E-commerce, challenges faced by E-commerce, ERP as a part of E-commerce.

Outcome: Gets well-versed with the concepts of e-commerce, security involved in e-commerce and gains the ability to managing enterprise.

UNIT I: Business Models of E–Commerce **Lectures: 6**

E–Commerce Organization Model Based On Transaction Type, Model Based On Transaction Party: B2B, B2C, C2B, C2C, E– Governance; Limitations & Scope. E–strategy: Overview, Strategic Methods for developing E – commerce. Four C's: (Convergence, Collaborative Computing, Content Management & Call Center)

UNIT II: Electronic Commerce Providers **Lectures: 4**

On-line Commerce options: Company profiles. Electronic Payment Systems: Digital payment systems; First virtual Internet payment system; Cyber cash model. On-line Commerce Environments: Servers and commercial environments; E-Commerce servers.

UNIT III: E–Payment Mechanism **Lectures: 10**

Payment through card system, E–Cheque, E–Cash, E –Payment, Threats & Protections. E–Marketing: Home–Shopping, E-Marketing, Tele-Marketing. Electronic Data Interchange (EDI): Concepts, Benefits and Applications; EDI Model, EDI Protocols (UN EDI FACT / GTDI, ANSI X–12), Operational process of Digicash, Ecash Trail; Using Ecash; Smart cardsData Encryption (DES / RSA). Risk of E –Commerce: Overview, Security for E–Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

UNIT IV: Enterprise Resource Planning (ERP) **Lectures: 7**

Introductory Concepts: Scope of ERP, Benefits of ERP, Importance of ERP in the E-Business era. Supply Chain Management: Origin of the term, Role of ERP in SCM, ERP Features and capabilities. Overview of Commercial Software, re-engineering work processes for IT applications, Business Process Redesign, Knowledge engineering and data warehouse, Advantages & disadvantages of ERP.

UNIT V: ERP–Business Modules **Lectures: 11**

Functional and Process of Resource. Management, Introduction to basic Modules of ERP System: HRD, Personnel Management, Training and Development, Skill Inventory, Material Planning and Control, Inventory, Forecasting, Manufacturing, Production Planning, Production Scheduling, Production Control, Sales and Distribution, Finance, Resource Management in global scenario.

UNIT VI: ERP - Case Study **Lectures: 4**

ERP as an Integrated System, Data Base Approach,

Workflows in ERP, ERP and Corporate Portal, ERP Implementation: ERP Life Cycle Model, Information Systems Planning, Critical Success Factors of ERP Implementation, Extended ERP Applications: Customer Relationship Management, Supply Chain Management, Product Life Cycle Management.

Text Books:

- Adesh k. Pandey, “Electronic Commerce” (Fourth Edition) : Pete Loshin
- Dave Chaffey, “E-Business and E-Commerce Management”, 3rd Edition, 2009, Pearson Education Inc., New Delhi.
- ii) Ellen Monk, Bret Wagner, “Concepts in Enterprise Resource Planning”, 2nd Edition, CENGAGE Learning India Pvt.Ltd., New Delhi.

Reference Books

i) K.K. Bajaj, D. Nag “E-Commerce”, 2nd Edition, McGraw-Hill Education, New Delhi.

ii) Gary P. Schneider, “Electronic Commerce”, 7th Edition, Cengage Learning India Pvt. Ltd., New Delhi.

iii) P.T. Joseph, “E-Commerce An Indian Perspective”, PHI Publication, NewDelhi.

iv) Bhaskar Bharat, “Electronic Commerce-Technology and Application”, McGraw-Hill Education, New Delhi.

v) Mary Sumner, “Enterprise Resource Planning”, 2005, PHI Learning India Pvt. Ltd./Pearson Education, New Delhi.

vi) Chan, “E-Commerce fundamentals and Applications”, Wiley India, New Delhi.

IT169 E-Governance

L-T-P-Cr: 3-0-0-3

Objectives: Get the students familiar with E-governance, it's benefit, execution challeneges.

Pre-requisites: Basic knowledge of public administration, software engineering, web technology and applications.

Outcome: Students get acquainted about the working strategies of various bodies of the government, how E-Governance would help the citizens of the country and would know how to implement and manage e-governance projects. It also enables to gain knowledge of Electronic Governance, National E-Governance Plan and the issues related to the implementation of large E-Governance Projects. It also aims at comprehending the networking and information security implementation in organizations and understanding implications of cyber security and data audit norms for public sector applications.

UNIT I **Lectures: 5**

INTRODUCTION: Meaning of E-Governance, Concepts of E-Governance, Implementing E-Governance. Overview of E-Government and E-Governance, Stages of E-Governance, IT Act 2000 and the related cases in India, Change Management Issues.

UNIT II **Lectures: 13**

TECHNIQUES OF E – GOVERNANCE: GIS based Management, Citizen Database and Human Development, Video Conferencing. National E-Governance Plan (NeGP), Mission Mode Projects and their implementation status. E-Governance Systems Development Practices, E-Governance Project Management Practices, Models of E-Governance Projects

E - GOVERNANCE IN INDIA: E-Governance Policy, E-Governance Projects in States, E-Governance in India.

UNIT III **Lectures: 5**

THE CHALLENGES OF E – GOVERNANCE: A prerequisite of good Governance, E-Governance in Democratic set-up, E-Governance Infrastructure, Security concerns. Business Process Reengineering in government, E-Governance success stories and implementation challenges.

UNIT IV **Lectures: 10**

SECURITY IN E_ GOVERNANCE: Security threats and Cyber Forensics, Symmetric and Asymmetric cryptography (including Credit Card/Electronic data capture), establishing security norms in cyberspace [ISO 270001], Cyber security and cyber audit implications for e-governance.

UNIT V **Lectures: 9**

INDIAN THEORY AND PUBLIC ADMINISTRATION: Utilizations of Indian Theory in Public Administration, Raising Competence of Administration: Role of Indian Theory, Indian Theory and Good Governance, Indian Theory and Administrative Culture in India.

Text Books:

1. Richard Hecks, Implementing and Managing E-Governance, Vistaar Publications.
2. Gupta, M.P., Kumar, Prabhat, and Bhattacharya, Jaijit, Government Online, Tata Mcgraw-Hill, 2004.
3. M.G. Gupta and R.K. Tiwari (eds.), Reinventing the Government, IIPA, 1998

Reference Books and Articles:

1. Heeks Richard, Implementing and Managing e-Government, Sage Publications, New Delhi, 2004.
2. Satyanarayana, J, e-Government: The Science of Possible, Prentice Hall of India, New Delhi, 2004.

3. "Insider Attack and Cyber Security; Beyond the Hacker" by Stolfo, S.J.; Bellovin, S.M.; Hershkop, S.;
4. Keromytis, A.; Sinclair, S.; Smith, S.W. (Eds.) Series: Advances in Information Security, Vol. 39, 2008, Springerlink
5. "Handbook of Cyber Laws" by Vakul Sharma, Macmillan India Ltd., 2008
6. Jan Erik Lane, New Public Management, Rout ledges, 2000
7. Work Bank Report, Good Governance: The Business of Government, 1997
8. IJPA Special No. on "Indian Theory and Public Administration", July-September, 2000
9. IJPA Special No. on "Towards Good Governance", July-September, 2000
10. Articles on Indian Theory, E-Governance and Good governance for IJPA, ISDA Journal and Administrative Change.

IT170 Optimization Techniques

L-T-P-Cr: 3-0-0-3

Objectives: The objective of the course is to prepare a base for optimization techniques.
Outcome: By the end of the course, students should be able to apply optimization techniques in different disciplines to get better outcomes. Students are able to apply optimization techniques for the organization.

UNIT I **Lectures: 6**

Linear Programming problem Mathematical formulation, assumptions in linear programming, graphical method of solution, simplex method, Big-M method and Two phase method, Dual simplex method.

UNIT II **Lectures: 8**

Integer Programming Introduction, Gomory's cutting plane method, Fractional cut method-
Mixed integer and branch and bound techniques.
Transportation Problem-General transportation problem, Finding an initial basic feasible solution, Loops in transportation tables, Degeneracy, Optimality method-MODI method.
Assignment Problem- Hungarian Method, Traveling salesman problem.

UNIT III **Lectures: 8**

Game theory Introduction, two-person zero-sum games, some basic terms, the max mini minimax principle, games without saddle points-Mixed Strategies, graphic solution of 2 * n and m*2 games, dominance property.
Simulation Introduction, Definition of Monte-Carlo Simulation.

UNIT IV **Lectures: 10**

Dynamic Programming Introduction, The Recursive equation approach, Algorithm, Solution of a L.P.P by Dynamic Programming.
Sequencing Models-Processing n jobs through 2 machines, n jobs through 3 machines, two jobs through m machines.
Networking Analysis CPM&PERT – Network minimization, shortest route problem, maximal-flow problem, Project scheduling, critical path calculations, PERT calculation.

UNIT V **Lectures: 10**

Queuing Theory Introduction, Queuing system, Elements of Queuing system, Characteristics of Queuing system, Classification of Queuing Models, Poisson Queuing systems-Model I (M/M/1): (∞:FIFO)-Characteristics of Model I and waiting time characteristics. Characteristics of (M/M/1):(N/FIFO), (M/M/C):(∞ /FIFIO), (M/M/C):(N/FIFO)-all without derivation

Text Books

1. Operation Research-An introduction by Hamdy A Taha, Prentice Hall.

Reference Books

1. Introduction to Management Science, Anderson, Thomson Learning, 11Edn.
2. Operation Research Applications and Algorithms, Winston, Thomson Learning, 4Edn.
3. Introduction to Operation Research by Hiller/Lieberman. McGraw Hill.
4. Operation Research by Dr. Kalavathy.S. Vikas Publishing

IT171 Servers & Storage

L–T–P-Cr: 3-0-0-3

Objectives: The objective of the course is to get the students one step ahead about computer from personal computing to server based computing.

Outcome: By the end of the course, students should be able to know how Server based computing is different and better than personal computing.

UNIT I: Introduction: **Lectures: 4**

- History: computing, networking, storage
- Need for storage networking
- SAN, NAS, SAN/NAS Convergence
- Distributed Storage Systems
- Mainframe/proprietary vs. open storage
- Storage Industry Organizations and Major
- Vendors Market
- Storage networking strategy (SAN/NAS or
- Distr storage)
- Impact of Regulations: existing and new

UNIT II: Technology **Lectures: 6**

- Storage components
- Data organization: File vs. Block, Object;
- Data store; Searchable models
- Storage Devices (including fixed content
- storage devices)
- File Systems
- Volume Managers
- RAID systems
- Caches, Prefetching

UNIT III Network components **Lectures: 4**

- Connectivity: switches, directors, highly
- available systems
- Fibre Channel
- 1GE/10GE, Metro-ethernet
- Aggregation
- Infiniband

UNIT IV: Error Management **Lectures: 4**

- Disk Error Mgmt
- RAID Error Mgmt
- Distr Systems Error Mgmt

UNIT V: Highly available and Disaster-tolerant designs **Lectures**: **6**

- Ordered writes, Soft updates and
- Transactions

- 2 phase, 3 phase, Paxos commit protocols
- Impossibility Results from Distributed Systems
- Choose 2 of 3: Availability, Consistency and Partition Tolerance

UNIT VI: Layering and Interfaces in Storage Protocols: **Lectures: 2**

- eg. SCSI 1/2/3SNIA model

UNIT VII: SAN Components **Lectures: 4**

- Fibre Channel
- IP-based Storage (iSCSI, FCIP, etc.)
- Examples
- NAS
- NFS
- CIFS
- DAFS

UNIT VIII: Large Storage Systems **Lectures: 4**

- Google FS/BigTable
- Cloud/Web-based systems (Amazon S3)
- FS+DB convergence
- Programming models: Hadoop

UNIT XI: Archival Systems **Lectures: 8**

- Content addressable storage
- Backup: server less, LAN free, LAN
- Replication issues
- Storage Security
- Storage Management
- Device Management
- NAS Management
- Virtualization
- Virtualization solutions
- SAN Management
- Storage Provisioning
- Storage Migration
- SRM
- Summary

Reference Books:

1. G. Somasundaram, Alok Shrivastava, " Information Storage and Management Storing, Managing,

and Protecting Digital Information", EMC Education Services, Wiley India Edition, 2009.

2. Marc Farley, "Storage Networking Fundamentals", CISCO Systems, First edition, 2004.
3. Gupta Meena, "Storage Area Network Fundamentals", Pearson Ed.
4. Robert Spalding, "Storage Networks: The Complete Reference", Tata Mcgraw Hill, 2003.
5. Marc Farley Osborne, "Building Storage Networks", Tata McGraw Hill, Second edition, 2001.
6. Relevant research papers from the journals

EC101 Elements of Electronics Engineering

L-T-P-Cr: 3-1-0-4

Module1. Semiconductor Diodes **(6 Lectures)**

- Semiconductor materials- intrinsic and extrinsic types
- Ideal Diode
- Terminal characteristics of diodes:

p-n junction under open circuit condition

p-n junction under forward bias and reverse bias conditions

p-n junction in breakdown region

- Diode small signal model
- Zener diode and applications
- Rectifier Circuits
- Clipping and Clamping circuits

Module2. Bipolar Junction Transistors (BJTs) **(8 Lectures)**

- Physical structure and operation modes
- Active region operation of transistor
- D.C. analysis of transistor circuits
- Transistor as an amplifier
- Biasing the BJT: fixed bias, emitter feedback bias, collector feedback bias and voltage divider bias
- Basic BJT amplifier configuration: common emitter, common base and common collector amplifiers
- Transistor as a switch: cut-off and saturation modes
- High frequency model of BJT amplifier

Module 3. Field Effect Transistor (FET) **(4 Lectures)**

- Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics
- Depletion-type MOSFET
- D.C. operation of MOSFET circuits
- MOSFET as an amplifier
- Biasing in MOSFET amplifiers
- Basic MOSFET amplifier configuration: common source, common gate and common drain types
- High frequency model of MOSFET amplifier
- Junction Field-Effect Transistor (JFET)

Module 4. Operation Amplifier (Op-amps) **(5 Lectures)**

- Ideal Op-amp, CMRR and its applications as Differential amplifier
- Practical op-amp circuits: inverting amplifier, non -inverting amplifier, weighted summer, integrator, differentiator, Active Filter (2^{nd} Order)

Module 5. Logic circuits and Applications **(5 Lectures)**

- Logic gates and circuit,
- Logic circuit implementation using diodes and transistors
- Combinational logic Circuit
- SOP and POS, Minimization Techniques

Module 6. Sequential Circuit **(10 Lectures)**

- Sequential Logic Design: Latches and Flip flops
- Flip-flops: RS- FF, JK-FF, D- FF and T- FF
- Counters, Multiplexor and De-multiplexor

Module 7. Analog Communication **(4 Lectures)**

- Basics of Communication system (AM, FM, PM)
- Demodulation Circuits

Suggested Readings:

1. Nashelesky & Boylestead, "Electronic Devices and Circuit Theory", PHI/Low price edition.
2. Sedra and Smith, "Microelectronic Circuits",
3. Millman & Gabrial, "Microelectronics", McGraw Hill
4. Paul Horowitz and Winfield Hill, " The Art of Electronics", Cambridge University Press
5. Morris Mano, Digital Electronics
6. Flecher, Digital System

Course Assessment Method common to all Subjects:

Type of Assessment	Type of Assessment Tasks	Weightage
Continuous Assessment	Two Class Tests, Mid-Semester Exam, Attendance, and Assignments	5% □ 5% □ 20% □ 10%
Semester End Assessment	Written Exam	60%

EC101 Elements of Electronics Engineering

L-T-P-Cr: 3-1-0-4;

***Prerequisites*:** Circuit Analysis

***Objective**:* The comprehensive idea of this course is to make students familiar with the operational principle, analysis, design and application of semiconductor devices like diodes, bipolar junction transistors, and field effect transistors, op-amps, digital logic gates and SCR. After obtaining clear understating wide variety of circuits are analyzed in analog circuits, digital circuits and communication systems.

Course Outcome: Upon successful completion of this course, students should be able to:

Understand the principle of electronic devices, and develop skills to use and design diodes as power supply rectifiers

Understand the operation of transistors in switching circuits

Design logic gates using diodes and transistor

Understand the main elements of power electronics devices, and the principles related to its operation.

Topics Covered

Part I:

Unit 1: Semiconductor diodes **(6 Lectures)**

Semiconductor materials-Intrinsic and Extrinsic types, Ideal diode, Terminal Characteristics of diodes: p-n junction diode under open circuit, forward bias, and reverse bias conditions, Photodiode, Light

Emitting Diode, Diode Applications-Half-wave Rectifiers, Full-wave Rectifiers & Filters, Clipping & Clamping Circuits, Breakdown mechanism in diode, Zener diode & its application as voltage regulator

Unit 2: Bipolar Junction Transistor **(8 Lectures)**

BJT Introduction: Basic theory and operation of PNP and NPN transistor, Basics of C-B, C-E, C-C amplifier configuration, DC analysis of Transistor circuits, Transistor DC Biasing: Load line analysis, operating point, Biasing of BJT: Emitter feedback bias, Voltage Divider bias, Transistor as a switch: cut-off and saturation modes, High frequency model of BJT amplifier (brief description)

Unit 3: Field Effect Transistor **(8 Lectures)**

FET: Introduction, operation, JFET parameters, JFET characteristics, JFET amplifiers, MOSFET: introduction, Depletion type MOSFET and Enhancement type MOSFET, MOSFET parameters, D.C. operation of MOSFET circuits, MOSFET as an amplifier, Brief description of basic MOSFET amplifier configurations: common source, common gate and common drain types, Biasing in MOSFET amplifiers, High frequency model of MOSFET amplifier (brief description)

Unit 4: Operational Amplifier **(4 Lectures)**

Ideal Op-amp, CMRR, and its application as differential amplifier, Practical op amp circuits: inverting and non-inverting amplifier, summer, integrator, differentiator

Unit5: Logic circuits and Applications **(5 Lectures)**

Logic gates and circuit, logic circuit implementation using diodes and transistors, combinational logic circuit, SOS and POS minimization methods

Unit 6: Principles & application of SCR & UJT **(4 Lectures)**

Silicon Controlled Rectifier, Uni-junction Transistor and its applications

Unit 7: Measuring Instruments (3 Lectures)

Cathode Ray Oscilloscope & Multi-meter

Text Books:

1. Electronic Devices & Circuits, Mottorshed
2. Electronic Devices & Circuit Theory by Boylestad and Nashelsky, Pearson
3. Electronic Principles, Albert Malvino & Davis J.Bates, 7th Ed. TMH

Reference Books:

1. Electronic Circuit & System by R. J. Smith, Wiley
2. Microelectronics, Millman and Gabrial, McGrath Hill
3. Digital Electronics, Morris Manno

EC102 Elements of Electronics Lab

L-T-P-Cr: 0-0-3-1;
Total Lab Sessions-12

***Prerequisites**:* EC-101

***Objective*:** This lab course indented to make students familiar with all varieties of basic electronics devices and their operational principle. The lab course consists of analysis, design and application of semiconductor devices like diodes, bipolar junction transistors, and field effect transistors, op-amps. After obtaining clear understating wide variety of circuits are analyzed in analog circuits.

Course Outcome: Upon successful completion of this course, students should be able to:

Understand the working of semiconductor devices, and attain skills to design diodes in rectifiers, clippers and clampers.

Understand the operation of transistors as common base and common emitter.

Understand the operational amplifier circuits.

Understand basic digital logic circuits.

List of Experiments of Elements of Electronics Lab

Experiment No.01:-Study of Cathode Ray Oscilloscope (C RO) (a) Measurement of amplitude, time period and frequency of unknown continuous tirpe signals.(b) Use of Lissajous pattern for unknown frequency measurement of signal.

Experiment No.02: Identification of Active and Passive component.

Experiment No. 03: Study of characteristics of P-N junction diode under (a) Forward bias, and (b) Reverse bias

Experiment No. 04: Study of characteristics of zener diode under (a) Forward bias (b) Reverse bias (as voltage regulator)

Experiment No. :- 05: Study of clipping circuits and clamping circuits.

Experiment No. :- 06: Study of performance of Full wave Bridge Rectifier with filter circuits.

Experiment No. :- 07: Study of input and output characterization of common base (CB) BJT (Bipolar junction transistor)

Experiment No. :- 08: Study of input and output characterization of CE (common emitter) transistor.

Experiment No. :- 09: Study of frequency response of common Emitter BJT.

Experiment No. :- 10: Study of output and transfer characterization of JFET (Junction field effect transistor)

Experiment No. :- 11: Study of Operational Amplifier as (i) Inverting (ii) Non-inverting using uA741 IC.

Experiment No. :- 12: Construction and Verification of all other gate (AND, OR, NOT, XOR) using only a) NOR gate b) only NAND gate\

EC103 Digital Electronics

L-T-P-Cr: 3-1-0-4;
Total 42 Lectures

***Prerequisites**:* EE-101

***Objectives**:* This course is intended to provide the students with a good knowledge of all varieties of Digital Circuits (both combinational & sequential circuits) & timing circuits, IC Chips, their design & applications along with Analog to Digital & Digital to Analog conversion of Signals. The students are also exposed to different types of RAMs & ROMs with their in depth knowledge.

***Course Outcome**:* Upon successful completion of this course, students should be able to:

Design & implement digital circuits using logic gates IC chips.

Design & implement digital circuits using multiplexer & demultiplexer IC chips.

Design & implement registers & counters using different flip-flop IC chips.

Design & implement different timing circuits (e.g Monostable & Astable Multivibrator circuits) using Timer-555

Convert Analog to Digital & Digital to Analog Signals by different methods.
Different Digital circuits & semiconductor memories using Multi-SIM.
Topics Covered

Unit 1: Introduction **4 Lectures**

Digital Principle –Analog vs Digital, Number system, Computer Codes, Digital Signals, Waveforms positive and Negative logic, Logic Gate: basic, universal and others, Truth Table, Logic functions, IC Chips, Timing Diagram, Electrical Analogy

Unit 2: Boolean Laws and Theorems **5 Lectures**

Logic Functions; conversion of Logic functions into Truth Table and Vice–versa; SOP and POS forms of representation- Min terms and Max terms, Simplification of Logic functions by theorems and

Karnaugh's Map; Don't care conditions; Design of Special Purpose Computers and related Practical problems, Quen Mclusky method of minimization.

Unit 3: Integrated Circuit Logic Families **4 Lectures**

RTL, DTL, TTL, CMOS, IIL/ I2L (Integrated Injection Logic & Emitter Coupled Logic)

Unit 4: Analysis and Synthesis of Combinatorial Logic Circuits (6 Lectures)

Adders and Substructures (look-ahead adders); Multiplexers; De-multiplexers; Encoders; Priority Encoder; Decoders; Code Converters; Magnitude Comparators; Parity generators and Checkers

Unit 5: Sequential Circuits (10 Lectures)

Sequential Circuit Blocks-Latches, Flip Flops- Race around condition, Master-Slave and edge triggered, SR, JK, D & T Flip Flop; Shift Registers; Counters -Synchronous and synchronous, design of ripple counter. Finite state machine (Mealy and Moore Type)

Unit 6: Timing Circuits (4 Lectures)

Multi-vibrators - Mono-stable and Astable Timer: LM555

Unit 7: Data Converters (4 Lectures)

Use of basic building block in designing larger systems such as Digital to Analog Converters (DAC) - Weighted resistor and R-2R,Analog to Digital (ADC)-Comparator, Counter and Succession

Unit 8: Memories (5 Lectures)

Static and dynamic RAMs; ROM; PLA; PAL; Sequential circuit design using ROM.

Text Books:

1. Digital Systems- Principles & Applications by Tocci, Widmar and Jain, Pearsons
2. Digital Fundamentals by Floyd and Jain, Pearson
3. Digital Circuits (Vol-I & vol-II) By D. Roychowdhary, Platinum Publishers.

References Books:

1. Fundamentals of VHDL Design by Stephen Brown and Zovenkeo Vrasesic, TMH
2. Introduction to Logic Design with CDROM by Alan B. Marcovity, TMH
3. Fundamentals of Digital Logic with Verilog Design by Stephen Brown, TMH
4. Modern Digital Electronics by R. P. Jain, TMH.
5. Problems and solution on Digital circuits (Vol-I & Vol-II) By D. Roychowdhary, Platinum Publishers.

EC104 Digital Logic & Circuit Lab

L-T-P: 0-0-3;
Total 12 Sessions

***Prerequisites*:** i) EC-101

***Objective*:** This lab course indented to make students familiar with all varieties of Digital Circuits (both combinational & sequential circuits) & timing circuits, their design & applications along with Analog to Digital & Digital to Analog conversion.

Course Outcome: Upon successful completion of this course, students should be able to:

Learn the basic methods for the design of digital circuits and provide the fundamental concepts used in the design of digital systems.

Understand and design combinational circuits such as logic gates, adder, subtractor, parity generator and checker, Decoder, Multiplexer and De-multiplexer.

Understand and design sequential circuits such as flip-flops, shift registers, counters

Design astable and monostable multivibrator using IC-555.

Analyze and design various analog to digital & digital to analog converters

Design digital circuits using MultiSIM

List of Experiments

Experiment No. :- 01: Universal Gates (i) Identification and verification of NAND gate (IC #7400) and NOR gate (IC #7402). (ii) Construction and Verification of all other gate (AND, OR, NOT, XOR) USING a) Only NAND gate b) Only NOR gate

Experiment No. :- 02: Code Convertor & Parity Generator and checker. (i) Identification & verification of NOT (7404), AND (7408) OR (7432) & XOR (7486) gates. (ii) Design, construction and verification of 3-bit Binary to Gray convertor and 3-bit Grey to Binary convertor circuit. (iii) Design, construction and verification of 3-bit odd/even Parity Generator and 4-bit odd/even parity checker circuit.

Experiment No. :- 03: Adder, Subtractor & Magnitude comparator circuits. (i) Design, construction and verification of Half Adder and Half Subtractor circuit. (ii) Design, construction and verification of Full Adder and Full Subtractor circuit. (iii) Design, construction and verification of 1-bit and 4-bit Magnitude comparator. (iv) BCD Adder/Subtractor

Experiment No. :- 04: Decoder, MUX & DMUX (i) Construction and verification of BCD to 7-segment decoder using IC # 7447 (ii) Verification of 4:1 MUX, 8:1 MUX & 16:1 MUX.

(iii) Verification of 1:4 DMUX, 1:8 DMUX (iv) Cascading of MUIX and Cascading of Decoders.

Experiment No. :- 05: Latches and Flip Flops (i)Construction and Verification of a Latch circuit using NAND/NOR gates. (ii) Construction and Verification of S-R Flip Flop using above Latch circuits. (iii) Verification of J-K Flip Flop using IC # 7476 (Dual J-KFF) (iv) Construction and Verification of D-Flip Flop and T-Flip Flop using J-K FF (IC #7476). (v) Construction and Verification of Master Slave J-K Flip Flop.

Experiment No. :- 06 Shift Registers (i) Verification of D-FF using IC # 7474 (Dual D- FF). (ii) Construction and verification of a 2-bit Shift Right Register using IC # 7474 (iii) Construction and verification of a 2-bit Shift Left Register using IC # 7474 (iv) Verification of SISO, SIPO, PISO & PIPO Shift Registers.

Experiment No. :- 07: Synchronous & Asynchronous Counters (i) Construction and verification of 2-bit Ripple counter using J-K FF. (ii) Construction and verification of Mod-3 up and Mod-3 down synchronous counter. (iii) Construction and verification of 2-bit Ring counter using J-K FF. (iv) Construction and verification of 2-bit twisted Ring (Johnson) counter using J-K FF.

Experiment No. :- 08: Astable Multivibrator- Construction of Astable MV using Timer-555 and measuring the following parameters on CRO and compare them with their theoretical values:

a) Charging time $T_{ON} = 0.0693 (R_1 + R_2)C_1$(Theoretical)

b) Discharging time $T_{OFF} = 0.693 R_2 C_1$ (Theoretical)

c) Total time period and Frequency, $T_{total} = (T_{ON}+TO_{FF})$, $f = 1/T_{total}$

d) % Duty cycle = $(T_{ON} / T_{total})x 100$

Experiment No. :- 09: Monostable Multivibrator-Construction of Monostable MV using Timer-555 and measuring the time period and frequency of waveform on CRO and compare them with their theoretical values.

a) Time period $T_P = 1.1 RC$ (theoretical)

b) Frequency $f = 1 / T_P$

Experiment No. :- 10: Digital to Analog Converter (DAC). Construction & Verification of D/A converters using following methods.

a) Weighted Resistor type

b) R-2R ladder network type

Experiment No. :- 11: Analog to Digital Converter (ADC). Construction & Verification of A/D Converter using following methods.

a) Counter type

b) Successive Approximation type

Experiment No. :- 12: Familiarization with multisim. Design of various Digital Circuits using multisim.

EC104 Electromagnetic Field Theory

L-T-P: 3-0-0; Total 42 Lectures

Prerequisites: Vector Calculus &Basic Electromagnetism

Objective**:** This course intends to provide the students with an understanding of fundamental concepts of electricity and magnetism and to enable them to use these concepts in applications.

Course Outcome: Upon successful completion of this course, students should be able to:

Identify and calculate the physical quantities of the static electric field.
Identify and calculate the physical quantities of the static magnetic field.
Understand the coupling between electric and magnetic fields through Maxwell's equations.
Understand constitutive parameters and boundary conditions and be able to analyze the relationships between fields and flux densities in material media.
Analyze electromagnetic waves in different media, and the reflection and transmission of these waves between different media.
Interpret the energy and power associated with electromagnetic fields.
Analyze and design basic transmission lines and different types of impedance transformers

Unit I: Vector Calculus & Coordinate System (3 Lectures)

Gradient, Divergence, Curl and Laplacian Operator; Divergence Theorem and Stokes Theorem; Important Vector Identities; Cartesian, Cylindrical, and Spherical Coordinate Systems and Coordinate Transformation

Unit II: Electrostatics (4 Lectures)

Coulomb's Law and Gauss's Law; Electric Scalar Potential; Recapitulation of Capacitance; Energy Stored in Electric Field; Electric Field in Dielectric Material and Polarization; Electric Field at Material Boundary

Unit III: Magneto-statics (5 Lectures)

Lorentz Force; Gauss's Law for Magnetism; Biot-Savart Law and Ampere's Law; Self and Mutual Inductance; Energy Stored in Magnetic Field; Magnetic Vector Potential and Coulomb's Gauge; Magnetization; Magnetic Field at Material Boundary

Unit IV: Electrodynamics and Maxwell's Equations (6 Lectures)

Faraday's Law: Induced EMF due to Change in Area and Flux Density; Displacement Current; Magnetic Current; Maxwell's Set of Equations; Derivation of Charge Continuity from Maxwell's Equations; Generalized Electric Potential; Relation Between Electric Scalar Potential and Magnetic Vector Potential using Lorentz Gauge; Solution of Maxwell's Equation in Terms of Electric Scalar Potential and Magnetic Vector Potential; Introduction to Electric Vector Potential and Magnetic Scalar Potential; Duality

Unit V: Wave Propagation (8 Lectures)

Generation of Plane Wave from Infinite Sheet of Oscillating Current; Recapitulation of Wave Equation in 1-D and its Extension to Vector Wave Equation; Uniform Wave and Plane Wave; Polarization of EM Wave; Time Harmonic Fields and Maxwell's Equations in Frequency Domain; Power and Energy of EM Wave; Poynting Theorem (Both in Time Domain and Frequency Domain); Wave Equation of Time-Harmonic Fields; Propagation Constant and Wave Impedance

Unit VI: Wave Propagation through Different Medium (8 Lectures)

Wave Propagation through lossy Dielectric; Complex Permittivity and Loss Tangent; Wave Propagation through Good Conductor; Skin Depth; Surface Impedance; Normal Incidence of Plane

Wave at Dielectric Interface and Dielectric Metal Interface; Reflection; Formation of Standing Wave; Oblique Incidence of Plane Wave at Dielectric Interface; Derivation of Snell's Law; Brewster Angle and Total Internal Reflection

Unit VII: Theory of Transmission Line (8 Lectures)

Wave Propagation on Transmission Line; Power Flow on Transmission Line; Computation of Characteristic Impedance of Parallel Wire TL (with Rectangular and Circular Cross-section) and Coaxial Cable; Reflection, Return Loss, Insertion Loss and VSWR; Input Impedance of Terminated TL; The OC and SC TL; Quarter-Wave Impedance Transformer and Impedance Matching; Exponential, Binomial, and Chebyshev Impedance Transformer; Pulse Propagation on TL terminated with R, L, and C; Phase Velocity, Group Velocity and Dispersion

Text Books:

1. C. R. Paul, Introduction to Electromagnetic Fields, 3rd Ed. Tata McGraw Hill, 2007.

Reference Books:

1. H. P. Neff, Basic electromagnetic Fields. Harper & Row, 1981.
2.R. F. Harrington, Time-Harmonic Electromagnetic Fields. John Wiley, 2001 .
3. C. A. Balanis, Advanced Engineering Electromagnetics, 2nd Ed. John Wiley, 2012
4. E. C. Joardan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd Ed. PHI, 1965.
5. R. P. Feynman, R. B. Leighton, and M. Sands, The Feynman Lectures on Physics, vol. II, Narosa, India, 2013.

EC107 Semiconductor Devices

L-T-P: 3-0-0; Total 42 Lectures

Prerequisites: i) EC-101 course, ii) Basics of circuits

***Objective*:** This course is intended to provide students with a good understanding of basic properties of semiconductors, physical principles and operational characteristics of semiconductor devices, and advanced device issues relevant to integrated-circuit technologies. The primary focus will be on silicon based devices.

Course Outcome: Upon successful completion of this course, students should be able to:

Understand the operation of semiconductor devices such as diode, BJT, JFET, MOSFET, and Optoelectronic devices,

Use models of semiconductor devices to predict terminal characteristics under diverse operating conditions

Learn conceptual understanding of how electronic circuits work and principles behind the operation of semiconductor devices, how they are made and the history of their development.

Design circuits that avail themselves of the semiconductor devices chosen for the circuit design

Topics Covered

Unit1: Introduction 2 Lectures

History of development of Electron Devices from Vacuum Tube Technology to Solid State Technology to Nano-Technology Era-the Harbinger of The Third Wave of Civilization.

Unit2: Semiconductor Physics, Carrier Modelling and Carrier Action 6 Lectures

Physics of Semiconductor; Fermi-Dirac Distribution of Fermions, Intrinsic Semiconductor, Extrinsic Semiconductor, Intrinsic Carrier Concentration, Thermal Equilibrium values of Majority and Minority Carrier Concentration, Law of Mass Action, Compensation, Space Charge Neutrality, Recombination: Shockley-Hall Read Recombination and Auger Recombination, Life-Time of excess minority carriers, mobility, electric drift current, diffusion current, continuity equation in steady state condition

Unit3: Classical diodes (6 Lectures)

Derivation of Ideal Diode Equation/Shockley Equation, Real Diode Equation, Ideality Factor, temperature dependence of reverse leakage current, temperature dependence of forward bias voltage, Avalanche Breakdown, Zener Breakdown, Backward diode, Tunnel Diode, Varactor Diode, Schottky Diode, difference between rectifying contact and ohmic contact, Junction Capacitance, Diffusion Capacitance, Incremental Circuit Model of a Diode (low frequency and high frequency), Switching Characteristics of a Diode

Unit4: Physics of Operation of BJT (8 Lectures)

Emitter injection efficiency, base transport factor, multiplication factor, base transit time, short circuit forward current transfer ratio (α_F and α_f), short-circuit forward current gain (β_F and β_f) ,transit frequency (w_T), Incremental Circuit Model of CB BJT (T-Model at low and high frequencies), Incremental Circuit Model of CE BJT(Universal Hybrid-π Model at low and high frequencies). Output Characteristics of CB BJT, Output Characteristics of CE BJT (Forward Active Mode, Inverse Active Mode, Saturation Mode, Cut-off Mode), Switching Transient of RTL inverter circuit. Need for multistage amplifier; Gain of multistage amplifier; Different types of multistage amplifier like RC coupled, transformer coupled, direct coupled, and their frequency response and bandwidth.

Unit5: Physics of Operation n JFET (5 Lectures)

Ohmic or Triode Region of operation, Saturation or Pentode Region of Operation, Transfer Characteristics, Output Characteristics (Depletion Type Device or Normally-On device), Symbol of nJFET and pJFET, incremental model of CS nJFET (at low and high frequencies)

Unit6: Physics of Operation nMOS (5 Lectures)

Ohmic or Triode Region of operation, Saturation or Pentode Region of Operation, Transfer Characteristics, Output Characteristics, Symbol of NMOSFET, PMOSFET and CMOS, incremental model of CS NMOSFET (at low and high frequencies), Transfer and Output Characteristics of NMOS(E)-enhancement type and NMOS(D)-depletion type.

Unit7: Photonics (8 Lectures)

Direct and Indirect bandgap semiconductor, Element and Compound Semiconductor, BandGap Engineering, Homo and HeteroJunction Diode, Homo and HetroJunction BJT, Fabrication and Physics of Operation of Photo-Diode, Fabrication and Physics of Operation of Light Emitting Diode(LED), BandGap Engineering of LED to obtain different coloured LED, Fabrication and Physics of Operation of LASER-Diode. IR Source and Detector.

Unit8: Charge Coupled Devices (2 Lectures)

Basic Structure of Charge Coupled Devices (CCD) and its application as a CCD Camera in Space Applications

Book List

1. R.S. Muller and T.I. Kamins, Device Electronics for Integrated Circuits, Wiley, 1986
2. B. Van Zeghbroeck, Principles of Semiconductor Devices
3. D. A. Neamen, Semiconductor Physics and Devices, 3rd Ed., McGraw Hill, 2003
4. B. G. Streetman, Solid State Electronic Devices, 5th Ed., Prentice Hall, 2000
5. S. M. Sze, Physics of Semiconductor Devices, 2nd Ed., John Wiley & Sons, 1981.

EC108 Semiconductor Devices Lab

L-T-P: 0-0-3; Total Lab sessions: 12

***Prerequisites**:* Basic knowledge of electronic devices like diodes, LED's, transistors, and elementary circuits

Objective: This course indented to give provides a basis for understanding the characteristics, operation and limitations of semiconductor and optoelectronic devices. This course brings together the semiconductor device physics, optoelectronic device principles.

Course Outcome*:* Upon successful completion of this course, students should be able to:

Understand fundamental principles of modern semiconductor devices

Learn and describe the impact of semiconductor device capabilities and limitations

Analyze optoelectronics devices such as LED's and opt coupler

List of Experiment for SSPD Lab

Experiment No. :- 01 Study of Clipper circuit. To study various Clipper circuit using Diode, Resistor and DC Source.

Experiment No. :- 02: Study of Clamper Circuit. To study various Clamper Circuit using Diode, Capacitor, Resistor and DC source.

Experiment No. :- 03: Study of Integrator circuit. To study RC Low Pass Filter (also as Integrator) with range of frequencies of square wave input.

Experiment No. :- 04: Study of Differentiator circuit. To study RC High Pass Filter (also as Differentiator) with range of frequencies of square wave input.

Experiment No. :- 05 Study of Component Testing and Flickering Frequency of LED (Light Emitting Diode) with Square pulse input.

Experiment No. :- 06 To study intensity (Low, Medium, High) of light using Transistor, LED, DC source and Square pulse input.

Experiment No. :- 07 Study of MOSFET. To study component testing of MOSFET and use it as inverter with Square pulse input.

Experiment No. :- 08 Study of IR source and detector. To study component testing of IR (Infra-Red) source and detector and use it to make Burglar Alarm.

Experiment No. :- 09 : Study of UJT (Uni-junction Transistor). To study UJT (Uni-junction Transistor) & design of Relaxation Oscillator.

Experiment No. :- 10 Study of Surface Mounting Device (SMD). To study component testing of various Surface Mounting Device (SMD).

Experiment No. :- 10 Assembly of RC coupled amplifier

(a) To measure gain & bandwidth of degenerate amplifier

(b) To measure gain & bandwidth of emitter bypass capacitor amplifier

Book List

1. Electronics Principles by Malvino, Tata McGraw Hills, New Delhi
2. Electronic Devices and Circuits by Millman and Halkias, McGraw Hills, New Delhi

EC109 Signals and System Analysis

L-T-P: 3-1-0; Total 42 Lectures

Prerequisites*:* (i) Engineering Mathematics –I , (ii) Engineering Mathematics –II

Objectives*:* This course concerns with both characterization and analysis of signals and systems both in continuous and discrete time. This course also provides a through treatment on transformation of different types of signals from time to frequency domain and vice versa.

Course Outcome*:* Upon successful completion of this course, students should be able to understand the following:

Different types of signals and systems and their properties.

Time and frequency characterization of signals and systems.

Fourier representation of continuous and discrete time periodic and aperiodic signals and it's requirements for signal processing applications.

The Laplace transform and it's requirements.

The Z-transform and it's requirements.

The applications of signals and systems analysis for different signal processing tasks

Course Detail

Unit 1. **Introduction to Signals and Systems**: Definition of Signals, Unit step Signal, unit-impulse function, Exponential Signals, Signum Function, Periodic and non-periodic signals, Energy and power signal, Complex conjugate symmetry and anti-symmetry. Decomposition of any arbitrary signal into its even and odd components (Both in Continuous-time and Discrete-time domains). Definition of a System and their characteristics such as linearity, time invariancy, Causality, Stability, Memory less. Invertible systems.

Analogous systems: Force voltage analogy, Force current analogy, Mechanical coupling devices, Electro-mechanical system.

Unit 2. **Convolution:** Convolution both in continuous & discrete time domains. Properties of convolution and its applications in solution of problems, Unit step response of a system.

Unit 3. **Fourier series**: Fourier series representation of periodic signal both in continuous time and discrete time domains. Existence of Fourier series. Properties of FS (both in CT and DT domains). Application of Fourier series in solving problems with particular emphasis to LTI system.

Unit 4. **Continuous-Time Fourier Transform (CTFT):** Continuous Time Fourier transform of non-periodic and periodic signals, and inverse Fourier transform, Properties of CTFT and their applications in solving problems with emphasis on signal transmission through LTI systems.

Unit 5. **Discrete-Time Fourier Transform (DTFT):** Fourier transform representation of non-periodic and periodic discrete-time signals, inverse DTFT Properties of DTFT and their applications in solution of problems, Signal transmission through LTI systems.

Unit 6. **Sampling:** Sampling, impulse train sampling, Sampling theorem for low-pass signals, Reconstruction of a signal from its samples, Sampling of band-pass signals.

Unit 7. **Laplace Transform (LT):** Bilateral Laplace transform and its inverse. Relationship between LT and CTFT, Region of convergence and its properties, Properties of Laplace transform, Analysis and characterization of LTI systems, concept of poles and zeros, Unilateral Laplace transform and its properties, Solution of differential equations using unilateral Laplace transform.

Unit 8. **Z-Transform (ZT):** Definition of Z-transforn and inverse Z-tranform, Properties of Z-transform, Region of convergence of Z transform and its properties, Analysis of signal and system using z-transform, Concept of Poles and Zeros, Unilateral z-transform and its properties, Solution of difference equations. Block diagram representation of Continuous time and discrete time systems.

Text Book:

1. A V Oppenheim and A I. Wilsky with S. Hamid Nawab, Signals & Systems, Prentice-Hall India.
2. D. K. Cheng , Analysis of Linear System by, Narosa Publishing House
3. J.P. Tiwari , Modelling & Analysis of Linear System Dhanpat Rai & Sons

Reference Books

1. H.P. Hsu , Signals & Systems, Tata McGraw Hill
2. S Haykin, B V Veen, Signal and Systems, Wiley India.
3. Tarun Kumar Rawat, Signal and systems, Oxford University Press, India.
4. B P Lathi, Signal and Systems, Oxford University press.

EC110 Passive and Active Network- Analysis & Synthesis

L-T-P: 3-0-0; Total 42 Lectures

Syllabus in place of EE105 or EE105A Netwok analysis and Synthesis (with effect from session 2015-16)

1. Controlled sources, voltage amplifier CCVS (CFA), trans conductance amplifier- VCCS (OTA)
2. Characterization of one-port & two port networks and computation of one port and two port parameters.
3. Realizibility theory, positive real functions, Synthesis of driving point immittances, Elements of transfer function synthesis
4. OPAMP and its application in realizing active networks, current to voltage & voltage-to-current converters, current amplifiers, differential amplifier, instrumentation amplifiers, inverse function generation, generalized impedance converter, design of Log and antilog amplifiers, Analog multipliers and its applications, Active filters, switched capacitor filters
5. Static OPAMP Limitation:- simplified OPAMP circuit diagram, input offset currents, low input bias current OP-AMP, input offset voltage, low input offset voltage OPAMP, i/p offset error compensation
6. Non-linear OPAMP circuits:- voltage comparator and its application, Schmitt trigger, precision rectifiers, Analog switches, sample-and-hold, single Generator:- Linear oscillator (sine wave generator), multi vibrators, triangular wave generator, saw tooth wave generators
7. Dynamic OPAMP Limitations:- open loop response, closed loop response, input and output impedances, transient Response, Effect of finite GBP on integrator circuit, Effect of finite GBP on filters
8. One-pole and two pole models of the OPAMP, Active-R impedances, Active- R filters, Active-R oscillators.
9. OTA (operational trans conductance Amplifiers) and its applications in realization of both positive and negative grounded and floating imprudence, OTA-C oscillators and filters
10. Operational trans conductance Amplifier (CFA) and its applications: Realization of impedances, NIC, NII and GIE, oscillators and filters
11. Voltage references and regulators: performance specification, voltage references and their applications, switching regulators.

Text books/Reference Books:

1. F. F. Kuo, Network Analysis and synthesis, wiley 1968
2. Sergis franco, 'Design with operation Amplifiers and Analog integrated circuits 'Tata McGraw –Hill Edition-2002
3. Gobind daryanani, Principles of Active Networks synthesis & design, iley, 1979
4. P. V. Anand Mohan, 'Current –mode VLSI Analog filters', Birkauser, 2003
5. Raj senani, D. R. Bhasker, A. K. Singh & V.K Singh, 'current feedback operation amplifiers and their applications', Springer 2013.

EC111 Analog Electronics

L-T-P: 3-1-0; Total 42 Lectures

***Prerequisites*: i**) EC-101 (Elements of Electronics Engg. Course)

***Objective*:** The objective of this course is to provide students with a working knowledge of all varieties of Analog Circuits IC Chips: their design, applications and their Frequency Response.

Course Outcome: Upon successful completion of this course, students should be able to:

Analyze frequency response of BJT and MOS amplifiers

Understand use current mirrors and widlar current sources as the building Block of differential amplifiers,

Understand and apply concept of feedback to improve stability of circuits.

Understand all variety of analog IC Chips namely op-Amp, voltage controlled oscillator, phase locked loop and switched capacitor filters.

Topics Covered

Unit-I: BJT-Small signal operation and module, (3.6) collector current and the trans-conductance, Base current and the input resistance at the base, Emitter current & i/p resistance at the emitter, voltage gain, separating the signal & DC quantities; Hybrid π model, T-model, Application of small signal equivalent circuits, performing small signal analysis directly on the circuit diagram, Account of Early effect, BJT internal capacitances & high frequency hybrid-π model (3.9), The cut-off frequency, High frequency response, Dependence of β on IC

Unit-II: MOSFET-The basic MOSFET CS, CG amplifiers, small signal- The comm. Drain or source Amplifier, Operations models of MOSFET (4.6), The MOSFET internal capacitances (4.8) & High frequency models, The body effect and the role of substrate, modelling of body effect (4.11), temp. effect, break-down as input-protection. MOSFET unity-gain frequency (f_T).

Unit-III: IC Amplifiers-High frequency response- High frequency gain function, determining the 3-dB frequency fH, methods and Miller's thereom.

- Some useful transistor pairing:- CD-CS, CC-CE and CD-CE configurations, the Darlington configurations, CC-CB & CD-CG configurations.
- The wide band amplifier configurations:- obtaining wideband amplification by source & emitter degeneration, CD-CS, CC-CE, & CD-C configaration, CC-CB and CD-CG configuration.
- Current Mirror circuits with improved performance, cascade MOS mirrors, A bipolar mirror with base current compensation, Wilson current mirror, Wilson MOS mirror, Widlar current source.

Unit-IV: Feedback Amplifier- Feedback configurations (topologies), Effect of feedback on mplifier poles, stability study using Bode-plot, frequency compensation.

Unit-V: Multistage & Differential

1. MOS Differential pair- operation with a common-mode i/p voltage, operation with a differential input voltage, large signal operation.
2. Small-signal operation of the MOS differential pair- differential gain, differential half circuit, differential Amplifier with Cs loads, cascode differential amplifier, common mode gain and common mode rejection ratio.
3. BJT differential pair :- Basic operation, input common mode range, large signal operation, small signal operation.
4. Other non-ideal characteristics differential amplifier :- input offset voltage of MOS differential pair, input offset voltage of Bipolar differential pair, input bias and offset currents of bipolar pair, input common mode range.

5. Differential Amplifier with active load :- differential-to-single ended conversion active-loaded MOS : differential pair, differential gain of active loaded MOS pair, common mode gain & CMRR, Bipolar differential pair with active load.

6. Frequency response of the differential amplifier :- Analysis of resistively loaded MOS amplifier, analysis of active-loaded MOS amplifier.

7. Multistage amplifiers: - A two-stage CMOS op-Amp, a bipolar op-Amp.

Unit-VI: Output stages and Power Amplifiers-

Classification of output stages,

- Class A output stage :- transfer characteristics, signal waveforms, power dissipation, power conversion efficiency, transformer coupled power amplifier, class B transformer coupled amplifier.
- Class B output stage :- Circuit operation, transfer characteristics, power-conversion efficiency, power dissipation, reducing cross over distortion, single supply operation.
- Class AB output stage :- Circuit operation, output resistance.
- Class C output stage :- Efficiency of class C amplifier.

Text Books:

1. Sedra & Smith-Microelectronic Circuits- Oxford University Press
2. Franco-Design with Operational Amplifiers & Analog Integrated Circuits , 3th edition, McGraw Hill
3. Op-amps and Linear IC's, R.A. Gayakwad, PHI
4. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill,2006

Reference Books:

1. Millman & Halkias - Integrated Electronics, McGraw Hill, 2006.
2. Rashid- Microelectronic Circuits-Analysis and Design- Thomson (Cenage Learning)
3. Schilling & Belove - Electronic Circuit: Discrete & Integrated , 3th edition , McGraw Hill
4. Razavi- Fundamentals of Microelectronics- Wiley
5. Tobey & Grame - Operational Amplifier: Design and Applications, McGrawHill.

EC112 Digital & Analog Electronics Lab

L-T-P: 0-0-3; Total Lab Sessions-12

Prerequisites: Basic knowledge of electronic devices like diodes, transistors, and elementary circuits

Objective: This lab is indented to make students familiar with all varieties of Digital Circuits (both combinational & sequential circuits) & Analog Circuits which they study in analog electronics and digital logic and circuit course. The experiments covered in this lab are as per theory syllabus, so that students might be able to understand the practical aspects of analog and digital electronic systems. The main purpose of this course is to give introduction to various steps required in the design of analog and digital systems. Students will able to build simple circuits by gaining knowledge of electronics schematics and set working prototype circuits.

Course Outcome: Upon successful completion of this course, students should be able to:

- Understand and design combinational circuits such as logic gates, adder, subtractor, parity generator and checker, Decoder, Multiplexer and De-multiplexer.
- Understand and design sequential circuits such as flip-flops, shift registers, counters
- Design astable and mono-stable multi-vibrator using IC-555.
- Analyze and design various analog to digital & digital to analog converters
- Understand working of Tuned amplifier and Power amplifier

- Design and test various op-amp circuits such as instrumentation amplifier, differentiator and integrator.
- Test RC and LC oscillators circuits
- Have sound knowledge of basic circuit analysis and its behavior and their practical limitations.

List of Experiments

Students have to perform 12 experiments taking at least five from each section.

Section-A

Experiment No. :- 01: Universal Gates. (i) Identification and verification of NAND gate (IC #7400) and NOR gate (IC #7402). (ii) Construction and Verification of all other gate (AND, OR, NOT, XOR) USING a) Only NAND gate b) Only NOR gate

Experiment No. :- 02: Code Convertor & Parity Generator and checker. (i) Design, construction and verification of 3-bit Binary to Gray convertor and 3-bit Grey to Binary convertor circuit. (ii) Design, construction and verification of 3-bit odd/even Parity Generator and 4-bit odd/even parity checker circuit.

Experiment No. :- 03: Adder, Subtractor & Magnitude comparator circuits. (i) Design, construction and verification of Half Adder and Half Subtractor circuit. (ii) Design, construction and verification of Full Adder and Full Subtractor circuit (iii) Design, construction and verification of 1-bit and 4-bit Magnitude comparator. (iv) BCD Adder/Subtractor

Experiment No. :- 04 Decoder, MUX & DMUX (i) Construction and verification of BCD to 7-segment decoder using IC # 7447 (ii) Verification of 4:1 MUX, 8:1 MUX & 16:1 MUX. (iii) Verification of 1:4 DMUX, 1:8 DMUX (iv) Cascading of MUIX and Cascading of Decoders.

Experiment No. :- 05 Latches and Flip Flops (i) Construction and Verification of a Latch circuit using NAND/NOR gates. (ii) Construction and Verification of S-R Flip Flop using above Latch circuits. (iii) Verification of J-K Flip Flop using IC # 7476 (Dual J-KFF) (iv) Construction and Verification of D-Flip Flop and T-Flip Flop using J-K FF (IC #7476). (v) Construction and Verification of Master Slave J-K Flip Flop.

Experiment No. :- 06 Shift Registers. (i) Verification of D-FF using IC # 7474 (Dual D- FF). (ii) Construction and verification of a 2-bit Shift Right Register using IC # 7474 (iii) Construction and verification of a 2-bit Shift Left Register using IC # 7474 (iv) Verification of SISO, SIPO, PISO & PIPO Shift Registers.

Experiment No. :- 07 Synchronous & Asynchronous Counter (i) Construction and verification of 2-bit Ripple counter using J-K FF. (ii) Construction and verification of Mod-3 up and Mod-3 down synchronous counter. (iii) Construction and verification of 2-bit Ring counter using J-K FF. (iv) Construction and verification of 2-bit twisted Ring (Johnson) counter using J-K FF.

Experiment No. :- 08 Astable Multivibrator-Construction of Astable MV using Timer-555 and measuring the following parameters on CRO and compare them with their theoretical values:

a) Charging time $T_{ON} = 0.0693 (R_1 + R_2)C_1$ (Theoretical)

b) Discharging time $T_{OFF} = 0.693 R_2 C_1$ (Theoretical)

c) Total time period and Frequency, $T_{total} = (T_{ON}+TO_{FF})$, $f = 1/T_{total}$

d) % Duty cycle = $(T_{ON} / T_{total})x 100$

Experiment No. :- 09: Monostable Multivibrator- Construction of Monostable MV using Timer-555 and measuring the time period and frequency of waveform on CRO and compare them with their theoretical values.

a) Time period $T_P = 1.1 RC$ (theoretical)

b) Frequency $f = 1 / T_P$

Experiment No. :- 10 Digital to Analog Converter (DAC). Construction & Verification of D/A converters using following methods.

a) Weighted Resistor type

b) R-2R ladder network type

Experiment No. :- 11 Analog to Digital Converter (ADC). Construction & Verification of A/D Converter using following methods.

a) Counter type

b) Successive Approximation type

Experiment No. :- 12. Familiarization with multisim .Objectives: Design of various Digital Circuits using multisim.

Section-B

Experiment No. :- 01 Introduction to Op-Amp (a) To measure slew rate of Op-Amp (b) To measure full power & unity gain bandwidth of Op-Amp

Experiment No. :- 02 Application to Op-Amp (a) Assembly of integrator circuit and observe output waveform for different input waveform (b) Assembly of differentiator circuit and observe output waveform for different input waveform

Experiment No. :- 03 Design of a first order RC Low Pass filter and high pass filter circuit & observing its frequency response and time response.

Experiment No. :- 04 Design of second order LCR filter circuit & observing its frequency response and time response

Experiment No. :- 05 Study of VCO and PLL. To study the circuit of VCO and PLL and observe various waveforms

Experiment No. :- 06 Study of (IF) Tuned Amplifier .To study the circuit of (IF) Tuned Amplifier & observe waveforms.

Experiment No. :- 07 Study of Complementary Symmetry Amplifier. To study circuit of Complementary Symmetry Amplifier and observe waveforms.

Experiment No. :- 08 Study of Power Amplifier (Class A, B, C & AB)

Experiment No. :-9 Study of different Audio frequency oscillator (RC phase shift & Wien Bridge)

Experiment No. :-10 Study of various radio frequency oscillators (Colpitts, Hartley etc.)

Experiment No. :-11 Study of IC voltage regulator

Book List

1. Electronic Devices and Circuits by Millman and Halkias, McGraw Hills, New Delhi
2. Operational Amplifiers and Linear Integrated Circuits by Ramakant A. Gaykwad

EC113 RF and Microwave Engineering

L-T-P: 3-1-0; Total 42 Lectures

Prerequisites: i) Vector Calculus ii) Differential Equation iii) Electromagnetic Field Theory

Objective: This course is intended to provide students with a good understanding and working knowledge of the circuits, components, and sources at RF and microwave frequency range.

Course Outcome: Upon successful completion of this course, students should be able to:

Solve transmission line related problems using Smith Chart and design impedance matching networks.

Understand and apply the important concepts and theorems of microwave engineering.

Analyze wave propagation modes in rectangular waveguide, circular waveguides, coaxial lines etc.

Analyze and design cavity resonator.

Understand the general concepts in analysis of microwave networks and design microwave network using various waveguide components.

Design planar transmission lines and planer microwave components.

Analyze and model various microwave sources.

Topics Covered

Unit I: Smith Chart and its Application (3 Lectures)

Smith Chart and its Application; Single Stub Matching; Introduction to Double Stub Matching and its Advantage; Slotted Line Guide and Microwave Test Bench

Unit II: Important Concepts and Theorems (3 Lectures)

Uniqueness Theorem; Image Theory; Duality; Reciprocity Theorem; Equivalence Principle – Love's Equivalence; Perfect Electric and Perfect Magnetic Boundary Condition; Surface Current Density and its Relation with Magnetic Field

Unit III: Rectangular Waveguide and Cavity (10 Lectures)

Construction of Plane Wave Function; TEM, TE, and TM Wave; TE and TM Mode Propagation in Rectangular Wave Guide; Current Distribution on Wave Guide; Radiating and Non-Radiating Slot; Perturbation Technique; Power Loss and Attenuation in Rectangular Wave Guide; Resonant Cavity; Q of Resonant Cavity

Unit IV: Cylindrical Waveguide (4 Lectures)

Cylindrical Wave Function; TE and TM Mode Propagation in Cylindrical and Coaxilal Wave Guide

Unit V: Introduction to Microwave Network (7 Lectures)

Two Port Networks, ABCD, Z, Y and S Matrix; Impedance and Admittance of N-Port Network; Scattering Parameter; Calculation of S-Parameter of a Resistive T-Network and a Transmission Line Section; Loss-Less Network and Reciprocal Network; Various Wave Guide Components

Unit VI: Planar Transmission Line (4 Lectures)

Strip Line, Microstrip Line, Coplanar Strips, Slot Line; Microstrip Impedance Transformer, Power Divider, Directional Coupler etc.

Unit VII: Microwave Sources (11 Lectures)

Klystron; Reflex Klystron; Magnetron; Travelling Wave Tube; IMPATT Diode; Gunn Oscillator

Book List

1. 1. C. A. Balanis, Advanced Engineering Electromagnetics, 2nd Ed. John Wiley, 2012. (Textbook for concepts and theorems, waveguide, and cavity resonator)
2. 2. R. E. Collin, Foundation of Microwave Engineering, 2nd Ed. John Wiley, 2007. (Textbook for impedance matching and microwave network)
3. 3. P. A. Rizzi, Microwave Engineering: Passive Circuits, 1st Ed. Prentice Hall India, India, 2008. (Textbook for planar transmission line)
4. 4. S. Y. Liao, Microwave devices and circuits, 3rd Ed. Pearson, 2003. (Textbook for Microwave Sources)
5. 5. D. M. Pozzar, Microwave Engineering, 4th Ed. John Wiley, 2012. (Reference Book)
6. 6. R. F. Harrington, Time-Harmonic Electromagnetic Fields. John Wiley, 2001 (Reprint). (Reference Book)

EC114 RF and Microwave Engineering Lab

L-T-P: 0-0-3; Total Lab Sessions

***Prerequisites**:* i) Electromagnetic Theory (EC105), ii) RF and Microwave Engg (EC113)

***Objective**:* The objective of this course is to introduce undergraduate students to the fundamentals of RF and Microwave Engineering and to make students familiar with the microwave measurements and different microwave passive components. Students will also get familiar with antenna measurements and design

***Course Outcome**:* Upon successful completion of this course, students should be able to:

Characterize different microwave components.

Design the antenna and its measurements.

List of Experiments:

Experiment No 01: Determination of I-V characteristics of a Gunn Diode

Experiment No 02: Measurement of waveguide parameters

Experiment No 03:Measurement of coupling coefficient, directivity & insertion loss of a multi-hole directional coupler.

Experiment No 04: Measurement of coupling coefficient of E-Plane Tee.

Experiment No 05: Measurement of coupling coefficient of H-Plane Tee.

Experiment No 06: Measurement of coupling coefficient and isolation of Magic Tee.

Experiment No 07: Study of Reflex Klystron

Experiment No 08: Measurement of unknown impedance of a DUT.

Experiment No 09: Measurement of VSWR for different load.

Experiment No 10:

Experiment No 01:Study of Yagi Uda antenna (Radiation pattern and beamwidth)

Experiment No 11: Measurement of gain and directivity of a Yagi Uda antenna

Experiment No 12: Design of basic probe fed microstrip antenna using IE3D Software.

EC115 Analog Communication

L-T-P: 3-1-0; Total 42 Lectures

Prerequisites: i) Integral and Differential Calculus, ii) Signals and Systems.

Objective: The objective of this course is to introduce undergraduate students to the fundamentals of communication systems. After a brief review of signals and systems (mainly Fourier analysis), techniques of transmitting and receiving information signals using analog carrier modulation techniques (AM, FM, PM) are studied. The course also aims to introduce students the performance of these systems in the presence of channel noise.

Course Outcome: Upon successful completion of this course, students should be able to:

Determine the spectral content of periodic and non-periodic signals by applying Fourier analysis.

Describe and analyse the mathematical techniques of generation, transmission and reception of amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM) signals.

Evaluate the performance levels (Signal-to-Noise Ratio) of AM, FM and PM systems in the presence of additive white noise.

Describe and analyse the generation and reception of analog pulse modulation and evaluate their performance in presence of noise

Topics Covered:

Unit: 1- Signal Analysis: Lectures-10

Introduction to Communication Engineering; Block Diagram Representation of a Communication System; Time Domain and Frequency Domain Representation of Signals; Types of Signals; Fourier series & Transform and their Properties; Energy and power spectral density spectrum; Distortion less transmission; Causality and Physical realizability; Linear Time-invariant System; Hilbert transform; Pre-envelope and canonical representation of band pass signals.

Unit: 2- Amplitude Modulation: Lectures-10

Basics of Amplitude Modulation (AM); Double–Sideband–Suppressed–Carrier; Conventional Amplitude Modulation; Single Sideband AM and Vestigial Sideband AM; Implementation of Modulators and Demodulators (AM, DSB-SC, SSB) – Square-law modulator, Switching Modulator, Balanced and Ring Modulators, Frequency Discrimination and Phase Discrimination Modulators; Square law demodulator, Envelope Detector, Coherent Detection of AM, DSB-SC, and SSB-SC Signals; Quadrature Amplitude Modulation; Signal Multiplexing (TDM and FDM); Super-heterodyne Receiver and its Characteristics.

Unit: 3- Angle Modulation: Lectures-9

Frequency Modulation (FM) and Phase Modulation (PM); Narrowband and Wideband FM; Spectral Analysis of Single-Tone FM Signals, NBFM and WBFM; Indirect and direct methods of FM generation, Narrowband-to-Wideband Conversion; Average Power and Bandwidth; NBFM Demodulation by Envelope Detector, Frequency Discriminator, Phase Locked Loop Demodulator, Super-heterodyne F.M. Receiver.

Unit: 4- Digital Baseband Transmission for Analog Signal: Lectures-6

Sampling Theorem, Sampling of Low Pass Signals; Reconstruction of Sampled Signals, Interpolation; Aliasing Effects, Aperture Effect; PAM, PWM, PPM, Modulation and Demodulation; Their Spectral Analysis and Effects of Noise.

Unit: 5- Noise in Communication System: Lectures-7

Introduction To Noise, Thermal Noise, Shot Noise, Low Frequency or Flicker Noise; Noise Evaluation – Overview, Thermal Noise, Noise Voltage Spectral Density, Resistors in Series, Resistors in Parallel, Noise Figure, Noise Temperature, Noise Equivalent Bandwidth, Cascaded Networks, System Noise Figure, System Noise Temperature; Algebraic Representation of Noise; Additive White Gaussian Noise; Filtered Noise. Effect of Noise on Analog Communication System; Effect of Noise on Linear Modulation System – Effect of Noise on Baseband System, Effect of Noise on Conventional AM, DSB-SC AM and SSB-SC AM; SNR for Coherent Detection of DSB-SC, SNR for Coherent Reception with SSB modulation, SNR for AM Receiver using Envelope Detection; Effect of White Noise on Carrier-Phase Estimation with a PLL; Effect of Noise on Angle Modulation – Signal to Noise Ratio; Threshold Effect; Pre emphasis & De-emphasis in FM; Effects of Transmission Losses and Noise in Analog Communication System – Characterization of Thermal Noise Sources, Effective Noise Temperature and Noise Figure, Transmission Losses, Repeaters for Signal Transmission.

Text Books:

1. B.P. Lathi and Zhi Ding, 'Modern Digital and Analog Communication Systems', 4th Edition, Oxford University Press, 2009.
2. S. Haykin, 'Communication Systems', 4th Edition, John Wiley & Sons, 2001.

References:

1. J G Proakis & M Salehi, 'Communications Systems Engineering', 2nd edition, Prentice-Hall, 2005.
2. G. Kennedy and B. Davis, 'Electronic Communication System', 4th Edition, Tata McGraw- Hill Education, 1999.

EC116 Analog Communication Lab

L-T-P: 0-0-3; Total 12 Sessions

***Prerequisites**:* i) Analog Communication ii) Elements of Electronics Lab iii) Signal & System Lab

Objective: The goal of this Lab is to gain understanding of the different components of an Analog Communication system. This Lab also will provide in-depth understanding of signals in time-domain and frequency domain. Specifically we will be implementing the Analog Modulation/Demodulation techniques. This Lab will provide the exposure of Analog Pulse Modulation/Demodulation. The aim of this Lab to get the students acquainted with the experiments in MATLAB, in SDR and in Hardware. The Lab also aims to introduce students the performance of these systems in the presence of channel noise.

Course Outcome: After completion of this Lab, students should be able to:

Determine the spectral content of periodic and non-periodic signals.

Generate analog modulated waves and demodulate the and also able to analyze the time domain and frequency domain representation of analog modulated wave.

Evaluate the performance levels (Signal-to-Noise Ratio) of AM, FM and PM systems in the presence of additive white noise.

Generate and analyse the Analog Pulse Modulation/Demodulation and evaluate their performance in presence of noise.

Topics Covered

A. MATLAB Simulation based Experiments

1. Introduction to MATLAB, Simulink and the Communication Toolbox
2. Representation of Signals in the Time Domain, Power and Energy
3. Waveform generation in MATLAB – Sine and Cosine Wave, Unit Step Function, Ramp Function, Rect, Triangular and Signum Function.
4. Fourier Series and Fourier Transform implementation in MATLAB.
5. Analog Modulation using MATLAB — DSB-SC, SSB-SC and AM waveform generation, FM and PM Modulation; Time Domain and Frequency Domain Representation. Analog Demodulation in MATLAB – Coherent AM Demodulation, Envelop Detection of AM wave.
6. Design of Pulse Modulation and Demodulation System using MATLAB.

B. Software Defined Radio based Experiments

1. Familiarization of the Software Defined Radio platform
2. A simple transmitter and receiver implementation in SDR with Sinusoidal baseband signal.
3. Transmission and Reception of AM Waves; Demodulation of AM, DSB-SC and SSB-SC waves. Their time domain and frequency domain presentation.
4. FM transmitter and receiver in SDR platform.

C. Breadboard Level Experiments

1. Generation of AM wave using 2N2222 BJT Modulator circuit
2. Implementation of Voltage to Frequency Converter using IC 555 Timer.
3. AM Modulator Circuit, DSB-SC Balanced Modulator/Demodulator Circuit with MC 1496 IC.

EC117 Digital Signal Processing

L-T-P: 3-1-0; Total 42 Lectures

Prerequisites: **(i)** Signals and System Analysis **(EE109)**

Objectives: This course concerns with different concepts of Digital Signal Processing and it's need for different real world applications.

Course Outcome: Upon successful completion of this course, students should be able to understand the following:

Representation of discrete time signals in temporal and spectral domain.

Processing of the Discrete-time signals in temporal and spectral domain.

Analysis and design of different Infinite Impulse Response (IIR) filters and Finite Impulse Response (IIR) filters.

Realization of digital filters.

The concepts of Multirate digital signal processing and it's need for signal processing task.

The applications of digital signals processing for different real world applications.

Course Detail

UNIT –I: Review of z-transform and DTFT-Review of z-transform and DTFT.

UNIT –II: Discrete Fourier Transform (DFT)-Frequency domain sampling (Sampling of DTFT), DFT and its inverse, zero padding, DFT as a linear transformation (matrix method), properties. Spectrum analysis using DFT. Filtering of long data sequences using DFT: overlap save method, overlap add method.

UNIT –III: Fast Fourier Transform (FFT): Radix-2 FFT algorithms- Decimation-in-time (DIT-FFT) algorithm, Decimation-in-frequency (DIF-FFT) algorithm. Inverse DFT using FFT algorithms. Goertzel algorithm, Chirp-z transform algorithm.

UNIT –IV: Filter Concepts- Frequency response and filter characteristics, phase delay and group delay, zero-phase filter, linear-phase filter, Simple FIR filters, Simple IIR filters, All pass filter, Minimum-phase system, Averaging filter, Comb filter, Digital resonator, Notch filter, Digital sinusoidal oscillator.

UNIT –V: FIR Digital Filter- Desirability of linear-phase filters, Frequency response of linear phase FIR filters, Filter specifications: absolute specifications, relative specifications, analog filter specifications. Design techniques: windowing, frequency sampling method, digital Hilbert transformer.

UNIT –VI : IIR Digital Filter- Analog filters, Butterworth and Chebyshev approximation. Bilinear transformation method, warping effect. Spectral transformation. Design of low pass ,high pass, band pass and band elimination filter.

UNIT –VII: Realizations of Digital Filters- FIR filter structures: direct form, cascade form, linear-phase form, FIR Lattice structure. IIR filter structures: direct form-I, direct form-II, cascade form, parallel form, All pole lattice structure, lattice-ladder (pole-zero) lattice structure.

UNIT –VIII: Multirate Signal Processing- Decimation, Interpolation, The polyphase decomposition, Digital filter banks, Nyquist filters, Two-channel QMF.

Text Book:

1. Digital Signal Processing by Alan V. Oppenheim, Ronald W. Schafer , PHI

Reference Book:

1. S K Mitra, Digital Signal Processing- A Computer Based Approach, Tata McGraw Hill.
2. Digital Signal Processing by John G. Proakis, Dimitris K Manolakis, Pearson.

EC118 Digital Signal Processing Lab

L-T-P: 0-0-3; Total 12 Sessions

Objectives: This Lab concerns with hands on exposure of different theoretical concepts on digital signal processing.

Lab Outcome: After successful completion of this Lab, students should be able to understand the following concepts:

Representation of discrete time signals in temporal and spectral domain.

Processing of the Discrete-time signals in temporal and spectral domain.

Analysis and design of different Infinite Impulse Response (IIR) filters and Finite Impulse Response (IIR) filters.

Realization of digital filters.

The concepts of Multirate digital signal processing.

The applications of digital signals processing for different real world applications.

List of Experiment:

Expt.1 Computation of N-point DFT of the length-N sequence

Expt.2 Evaluation of Fast Fourier Transform using (a) Decimation in Time algorithm (b)Decimation in Frequency algorithm

Expt.3 Design of FIR Low pass, High pass, Band pass and Band stop filters using rectangular and Bartlett window.

Expt.4 Design of FIR Low pass, High pass, Band pass and Band stop filters using (i) Blackman window (ii) Hamming window (iii) Hanning window

Expt.5 Design of IIR Digital- (i) Low pass (ii) High pass (iii) Band pass (iv) Band stop filter using Butterworth approximation

Expt.6 Design of IIR Digital (i) Low pass (ii) High pass (iii) Band pass (iv) Band stop filter using CHEBYSHEV TYPE-I approximation and CHEBYSHEV TYPE-II approximation.

Expt.7 Conversion of Analog to Digital Frequencies using Bilinear Transformation

Expt.8 Cascade realization of the given Linear-Phase FIR/ IIR transfer functions

Expt.9 Decimation and interpolation and poly phase decomposition

Expt.10 Sampling and reconstruction of a band limited signal

Expt.11 Real time filtering of signals like speech/audio/ biomedical

Expt.12 Real time filtering of a blurred image

Expt.13 Edge detection of a image

The experiments are to be done on TMS320C6713 DSP trainer kit/ MATLAB environment

EC119 Digital Communication

L-T-P: 3-1-0; Total 42 Lectures

Prerequisites: i) Probability Theory, statistics and random variable, ii) Analog Communication, iii) Signal and Systems, iv) Digital Signal Processing

Objective*:* This is an introductory course in digital communications intended for undergraduate and graduate students in Electrical and Telecommunications Engineering programs. A brief review of random processes and signal-space concept will be provided. Digital modulation schemes will be introduced. Furthermore, optimum receiver architectures for the reception

of digitally modulated signals will be discussed. System performance will be discussed in terms of bit error rate and spectral efficiency.

***Course Outcome**:*Upon successful completion of this course, students should be able to:

Design optimum receivers (waveform-based or KL expansion based) for a given signal-space structure for additive Gaussian channels.

Assess performance of digital communications receivers for additive Gaussian channels,

Design digital communications links to meet prescribed performance metric(s), and

Analyze performance of receivers for band-limited channels

Topics Covered:

Unit-1: Introduction to Digital Communications **Le**ctures-3

Introduction to Digital Communications; Block Diagram of Digital Communication System; Information Theoretic Approach to Digital Communications; Digital Communication Blocks Realized as Software-Defined-Radio.

Unit 2: Probability and Random processes Lectures-10

Review of Probability and Random Variables-Sample Space, Events and Probability, Joint and Conditional Probability, Introduction to Random Variables, CDF, PDF and Moments of a Random Variable, Some Useful Distributions, Multiple Random Variables, Sums of Random Variables, Function of a Random Variables.

Random Processes: Basic Concepts- Introduction to Stochastic Processes, Statistical Averages, Autocorrelation and Cross-correlation, Orthogonality and Statistical Independence, Stationary and Ergodic Process, Wide – Sense Stationary Processes, Response of Linear System to Random Processes, Power Spectral Density of Stationary Processes and Sum Process, Statistical Properties of Additive White Gaussian Noise

Unit-3: Quantization and Pulse Coding Lectures-4

Quantization and Preprocessing, Pulse Code Modulation (PCM),Logarithmic Pulse Code Modulation (Log PCM) and Companding, Differential Pulse Code Modulation (DPCM), Delta Modulation and Adaptive Delta Modulation

Unit 4: Digital Carrier Modulation Lectures-4

Introduction to Carrier Modulation, ASK,BPSK, QPSK, BFSK, M-ary PSK, M-ary FSK, Modulations, QAM, MSK and GMSK Modulation, Differential Encoding and Decoding

Unit-5: Optimum Reception of Digital Signal through AWGN Baseband Channel Lectures-14

Binary Pulse Shaping and Optimum Threshold Detection, Optimum Receiver for Binary Pulse Shaped Signals in AWGN Channel-Correlation Receiver Structure; Matched Filter, Equivalence between Correlation Decoder and Matched Filter; Eye Diagram. The Performance of the Optimum Detector for Binary Signals; Derivation of Probability of Error for ASK, BPSK, QPSK and M-Ary PSK. Geometric Representation of Waveforms in Signal Space; Optimum M-Ary receiver; Maximum A-posteriori Detection and Maximum Likelihood Detection. Digital Transmission through Band-limited AWGN Channel-Nyquist Filtering and Inter Symbol Interference, Pulse Shape Design for Channels with ISI; Equalization.

Unit-6: Elements of Information Theory and Coding Lectures-5

Information, Mutual Information, Measure of Information, Entropy, Information Rate, Shannon's Theorem, Channel Capacity, Capacity of Gaussian Channel, Bandwidth-SNR Trade-off; Coding for Discrete Sources- Need for coding source letters, Variable length coding, Prefix – condition code, Huffman Coding; Introduction to channel coding; Error Control coding;

Unit-7: Few Advanced Topics of Digital Communication Lectures-2

Spread spectrum Communication and Multicarrier Communication.

Text Books:

1. S. Haykin, “Communication Systems”, 5th ed., John wiley, 2008.
2. B. P. Lathi and Z. Ding,"Modern Digital and Analog Communication Systems" 4th ed., Oxford University Press, 2009
3. H. Taub and D. L. Schilling, “Principles of communication systems”, 2n ed., McGraw-Hill, 1986

Reference Book:

1. J. Proakis and M. Salehi, “Digital Communications”, 5th ed., McGraw-Hill Higher Education, 2013.
2. B. Skalar, “Digital Communications: Fundamentals & Applications”, 2nd ed., Pearson Education India, 2009.

Web courses:

NPTEL Lectures on “Digital Communication” by Prof Saswat Chakrabarti and Prof. R. V. Rajakumar-.
NPTEL Lectures on “Probability and Random Processes” by Prof Mrityunjoy Chakraborty.

EC120 Digital Communication Lab

L-T-P: 0-0-3; Total 12 Sessions

Prerequisites: i) Probability Theory, Random Variable and Random Processes ii) Analog Communication iii) Digital Communication iv) Signal & System Lab

Objective: The goal of this Lab is to gain understanding of the different components of a Digital Communication system. This Lab also will provide in-depth understanding of all the blocks of a digital communication system, such as, Information Source, Sampling, Quantization, Carrier Modulation/Demodulation, Pulse Shaping, Matched Filter and Integrate-and-dump circuit, Coding/Decoding etc. The Lab also aims to introduce students the performance of the digital communication systems in the presence of channel noise. This Lab will provide the exposure of Monte-Carlo Simulation based experiments. The aim of this Lab to get the students acquainted with the experiments in MATLAB, in SDR Platform and in Hardware.

Course Outcome*:*After completion of this Lab, students should be able to:

Generate discrete and continuous random variables and study their statistical properties. They will also be able to understand random processes and their statistical properties. Able to do the Monte-Carlo Simulation.

Generate PN sequence, study their properties and implement various line coding techniques.

Study and analyze the effects of channel bandwidth and channel noise on transmitted waveform.
Design optimum receivers for a given signal-space structure for additive Gaussian channels and assess performance of digital communications receivers for additive Gaussian channels.
Study the effect of ISI and Equalization in digital communication.

Topics Covered

A. MATLAB Simulation based Experiments

1. Study of properties of discrete and continuous random variables; Uniform and Gaussian random variables in terms of their pdfs and cdfs; Statistical measures of mean, variance and mean-square power; Generation of Gaussian Random Variables; Monte-Carlo Simulation.
2. Study of wide-sense stationarity and ergodicity. Investigate the relationship between a random process, its autocorrelation function and the power spectral density function. PSD of white noise.

PN sequence generation and various line coding methods. Power spectral density functions associated with various line codes. Simulation of the characteristics of a communications channel. Effects of channel bandwidth and channel noise on transmitted waveform. Obtain Eye Diagram considering different line codes.

3. Investigate the characteristic of Matched Filter and implement Matched Filter based signal detection. Investigate eye diagrams.

4. Generation of digital modulated waveforms using MATLAB and Simulink. Coherent and non-coherent detection of modulated signals. System performance in presence of noise. Probability of error calculation and scatterplot.

5. Simulation of baseband and band-pass digital communication system in MATLAB and Simulink.

B. Software Defined Radio based Experiments

1. Source Coding Lab: Cosine Transform (DCT), sample quantization, and Huffman coding

2. Generation of I/Q Signals; Determine the frequency discrepancy between the transmitter and the receiver

3. Introduction to Modulation and Demodulation/Decoding: BPSK & QPSK; Study the frequency offset between the transmitter and receiver. Also study the error performance.

4. Introduction to FSK Transmitter and Receiver; Determine the frequency offset between the transmitter and receiver. Also study the error performance.

5. Experiment on ASK modulation/Demodulation and QAM Modulation/Demodulation. Also study the error performance. Clock recovery in QAM.

6. Execute the experiment of pulse shaping in digital communication system. Obtain frequency domain analysis.

7. Determine the presence of an OOK signal using energy detection. Demodulate the input OOK signal into a square waveform. Separate the PWM signal into short and long pulses.

8. Simulation of a QPSK modulated Digital Communication system considering channel effect and noise.

9. Experiment on equalization in a band-limited digital communication system.

10. Introduction to OFDM system simulation and study of error performance.

C. Hardware Kit based Experiments

1. Experiment on Sampling & Reconstruction on trainer kit.

2. Data Formatting and Carrier Modulation trainer based experiments.

3. ASK, FSK & PSK modulation/demodulation Trainer based experiments.

4. QPSK and QAM Modulation/Demodulation Trainer based experiments.

5. TDM-PCM trainer based experiments.

EC121 VLSI Design

L-T-P: 3-1-0; Total 42 Lectures

***Prerequisites**:* Basic device electronics, MOSFET properties, and logic circuits

Objective: This course is intended to impart in-depth knowledge about analog and digital CMOS circuits.The focus is on CMOS technology. Issues to be covered include deep submicron design, clocking, power dissipation, CAD tools and algorithms, simulation, verification, testing, and design

methodology. This course also dealt with design analysis techniques for the static and dynamic evaluation of CMOS circuits and memory elements including flip-flops, SRAM, and DRAM.

Course Outcome: Upon successful completion of this course, students should be able to:

Analyze the operation of CMOS inverter

Understand the design rules and layout diagram

Analyze the physical design process of VLSI design flow

Understand the design of CMOS Memories

Design and analyze VLSI chips using CMOS technology

Understand design issues at the layout, transistor, logic, and register transfer levels

Topics Covered

Unit 1: Introduction to VLSI design **6 Lectures**

Introduction to VLSI Design; Moore's Law; Scale of Integration; Types of VLSI Chips; Design principles (Digital VLSI); Design Domains(Y-Chart), Challenges of VLSI design- power, timing area, noise, testability reliability, and yield; CAD tools for VLSI design

Unit 2: Introduction to VLSI Technology **8 Lectures**

VLSI Technology-An Overview-Wafer Processing, Oxidation, Epitaxial Deposition, Ion-implantation and Diffusion; The Silicon Gate Process- Basic CMOS Technology; basic n-well CMOS process, p-well CMOS process; Twin tub process, Silicon on insulator; CMOS process enhancement-Interconnect; circuit elements; 3-D CMOS

Unit 3: Analysis of CMOS logic Circuits **7 Lectures**

MOSFET as Switch; Recapitulation of MOS; CMOS Inverter, CMOS logic circuits; NAND gate and NOR Gate; Complex logic circuits; Pass transistor logic; CMOS Transmission gate; CMOS full adder

Unit4: Advanced Techniques in CMOS logic circuit **5 Lectures**

Pseudo nMOS; Tri-state; Clocked CMOS; Dynamic CMOS logic- Domino, NORA, Zipper, etc.; Dual rail logic networks

Unit5: Memories **5 Lectures**

Static RAM; SRAM arrays; Dynamic RAMs; ROM arrays; Logic arrays

Unit 6: Timing issues in VLSI system design **4 Lectures**

Timing classification- synchronous timing basics, skew and jitter, latch based clocking, self timed circuit design; self timed logic; completion signal generation; self timed signaling–synchronizers and arbiters

Unit 7:CMOS Testing **4 Lectures**

CMOS Testing; Need for testing; Test Principles; Design Strategies for test; Chip level Test Techniques; System-level Test Techniques; Layout Design for improved Testability.

Unit 7: Verilog Hardware Description language (4 Lectures)

Overview of digital design with Verilog HDL; Hierarchical modeling concepts; Modules and port definitions; Gate level modeling; Data flow modeling; Behavioral modeling; Task & functions; Test bench

Text books-

1. Neil H. E. Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", 2nd edition, Pearson Education Asia, 2000.

2. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley and Sons, Inc., 2002.
3. Samir Palnitkar, “Verilog HDL”, 2nd Edition, Pearson Education, 2004.

References-

1. Eugene D. Fabricius, “Introduction to VLSI Design”, TMH International Editions, 1990.
2. Bhasker J., “A Verilog HDL Primer”, 2nd Edition, B. S. Publications, 2001.
3. Pucknell, “Basic VLSI Design”, Prentice Hall of India Publication, 1995.
4. Wayne Wolf, “Modern VLSI Design System on chip”, Pearson Education, 2002.

EC122 VLSI Design Lab

L-T-P: 0-0-3; Total 12 Sessions

Prerequisites: Basic knowledge of digital logic design, fundamentals of CMOS Inverter

Objective: Thiscourse givesthe opportunity to the students to learn about the configuration and simulation of Very Large Scale Integrated Circuits & Systems. The main purpose of this lab course is to explore various design style of simple and complex Integrated Circuits(IC) near to students. In this laboratory students are able to understand about models and model parameters of MOSFET amplifier CMOS Inverter etc. which are suited for IC Technology.

*Course Outcome:*Upon successful completion of this course, students should be able to:

Understand the concepts of digital system design methods through practical domain.

Design combinational and sequential circuits

Analyse and layoutdesign of CMOS circuits in micron and submicron level using any platform

Learn techniques and engineering tools (suchas HDL, Xilinx / Altera) to design, implement

List of Experiments for VLSI Design

Experiment No. :- 01Familiarization with MOS model parameters in PSPICE software.

Experiment No. :- 02 Simulation of MOS Inverter with different loadsusing PSPICE software.

Experiment No. :- 03 Simulation of CMOS Inverter for different parameters K_n, K_p as a design variablein PSPICE software.

Experiment No. :- 04Study of the switching characteristics of CMOS Inverter and find out noise margins.

Experiment No. :- 05 Simulate CMOS amplifier using PSPICE software.

Experiment No. :- 06 Layout design of a CMOS Inverter using any layout design tool.

Experiment No. :- 07 Layout design of a 2-input CMOS NAND/NOR gate using any layout design tool.

Experiment No. :- 08 Simulate 1-bit full adder following behavioral and structural modeling using VHDL\Verilog.

Experiment No. :- 09 Design of a 4-bit Multiplexer using VHDL\Verilog.

Experiment No. :-10 Design of a decade counter using VHDL\Verilog.

Experiment No. :- 11Design of a 3-input NAND gate and its simulation using Modelsim.

Experiment No. :- 12 Implementation of Expt. 7 and Expt. 8 using FPGA kit

Book List

1. Douglas L.Perry**,** “VHDL: Programming by Example”, McGraw-Hill, 2002.
2. Charles H. Roth, Lizy Kurian John, “Digital systems design using VHDL”, Thomson, 2008.

EC141 Antennas and Propagation

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites*:** i) Vector Calculus ii) Electromagnetic Field Theory iii) RF and Microwave Engineering

***Objective**:* This course is intended to provide students with a good understanding of the general characteristics of different antennas, the principles and theory behind their operation, and modeling techniques for different antenna systems. In addition, the principles and characteristics of radio waves propagating in various environments and wireless channels are dealt with.

***Course Outcome**:*Upon successful completion of this course, students should be able to:

Describe and analyze some simple radiating systems.

Analyze basic antenna arrays.

Describe and analyze the general characteristics of different types of wire antennas and aperture antennas.

Analyze and model the ionospheric, tropospheric, surface wave, and ground wave propagation.

Analyze and model the propagation mechanism of modern mobile communication.

Topics Covered

Part I:

Unit I: Introduction **4 Lectures**

Introduction to Antennas; Spherical Coordinate System and Solid Angle; Fundamental Parameters of Antennas; Equivalent Circuit of Transmitting and Receiving Antennas

Unit II: Wire Antenna **14 Lectures**

Radiation Integral and Auxiliary Potential Functions; Analysis of Hertzian Dipole, Short and Long Linear Dipole; Calculation of Phase-Error Introduced in Far-Field Approximation of Linear Dipole; Half-Wavelength Dipole and Quarter-Wavelength Monopole Antenna; Duality Principle and Infinitesimal Loop Antenna; Consideration of Impedance Matching; BALUN; Broadband and Frequency Independent Antennas; Helical Antenna; Log-Periodic Antenna

Unit III: Antenna Arrays **6 Lectures**

Pattern Multiplication; N-Element Linear Array; Endfire and Broadside Array; Linear Phased Array; Synthesis of linear Array, Yagi-Uda Passive Array

Unit IV: Aperture Antennas **9 Lectures**

Equivalence Principle (Love's Equivalence); Babinet's Principles; Rectangular Slot in Infinite Ground Plane Excited by Rectangular Waveguide; Radiation from Open Ended Waveguide; Horn Antenna− E-plane and H-plane of radiation, Pyramidal Horn; Introduction to Reflector Antenna, Dielectric Lens Antenna, and Microstrip Antenna

Part II:

Unit I: Ionospheric Propagation **3 Lectures**

Layers of Ionosphere and their Characteristics; Effect of Earth's Magnetic Field; Mechanism of Reflection and Refraction; Critical Frequency; Virtual Height, Maximum Usable Frequency, Skip Distance, Optimum working Frequency, Ionospheric Abnormalities, Ionospheric Absorption, multi-hop propagation

Unit II: Tropospheric Propagation **2 Lectures**

Attenuation by Rain, Fog, Snow etc.; Radius of Curvature of Path; Effective Earth's Radius; Effect of Earth's Curvature; Field Strength Calculations; Atmospheric Ducts and Nonstandard Refraction

Unit III: Ground Wave and Surface Wave Propagation **2 Lectures**

Wave Tilt, Flat and Spherical Earth Considerations; Surface Wave and Its Characteristics

Unit IV: Propagation for Modern Mobile Communication **2 Lectures**

Free-Space Propagation, Friis Transmission Formula and Path Loss; Two Ray Model; Multipath Propagation in Different Propagation Terrain; Diffraction and Ray Tracing; Scattering Based Propagation Models for Macro-, Micro-, and Pico-cells with Reference to COST Models

Book List

1. C. A. Balanis, Antenna Theory - Analysis and Design. John Wiley and Sons, Inc, India, 2005. (Textbook for Antenna)
2. John D. Kraus and Ronald J. Marhefka, Antennas for All Applications, 3rd Ed. Tata McGraw Hill, New Delhi, India, 2003. (Reference Book for Antenna)
3. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd Edition. Prentice Hall India, India, 2000. (Textbook for Propagation)
4. R.E. Collin, Antennas and Radiowave Propagation. McGraw-Hill, 1985. (Reference Book for Propagation)
5. S. Saunders and A. Aragón-Zavala, Antennas and Propagation for Wireless Communication Systems, 2nd Ed. Wiley India, India, 2007. (Textbook for Propagation in Modern Mobile Communication)
6. W. L. Stutzman and G. A. Thiele, Antenna Theory and Design, 2nd Ed. John Wiley 1998. (Reference Book for Antenna)

EC142 Information Theory and Coding

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites**:* i) Probability Theory ii) Analog and Digital Communication Engineering

***Objective**:* To expose to students some concepts in information theory, and the performance characteristics of an ideal communications system. To expose to students fundamentals in coding and its applications.

***Course Outcome**:*Upon successful completion of this course, students should be able to:

Have understood the notion of information in the quantitative sense
Have understood how the quantity of information could be measure
Have understood the concept and properties of entropy and mutual information as it applied to information
Have understood, and be able to prove, the noiseless coding theorem (Shannon's First Theorem)
Be able to construct compact and non-compact codes for a given data ensemble
Have understood the notions of channels, different classes of channel, and channel capacity
Have understood the fundamental coding theorem for noisy channels (Shannon's Second Theorem), and its implications
Have understood simple methods for construction of error correction codes

Topics Covered

Unit 1: Introduction to Information Theory **Lectures-7**

Introduction to Information Theory and Coding; Definition of Information Measure and Entropy, Relative Entropy, Extension of An Information Source and Markov Source, Adjoint of An Information Source, Joint and Conditional Information Measure, Properties of Joint and Conditional Information Measures and A Morkov Source, Asymptotic Properties of Entropy and Problem Solving in Entropy, Estimation of Probability Density and Probability Mass Functions, Expectation-Maximization algorithm, Maximum Entropy Principle, Jensen's Inequality; Fano's Inequality; Data Processing Inequality.

Unit 2: Source Coding **Lectures-6**

Introduction to Lossless Coding; Block Code and its Properties, Instantaneous Code and Its Properties, Kraft-Mcmillan Equality and Compact Codes, Shannon's Source Coding Theorem, Prefix Coding, Huffman Coding and Proof of Its Optamality, Competitive Optamality of The Shannon Code, Adaptive Huffman Coding, Shannon-Fano Coding, Arithmetic Coding, Lempel-Ziv Algorithm

Unit 3: Channel Capacity and Coding **Lectures-8**

Introduction to Discrete Information Channels, Equivocation and Mutual Information, Properties of Different Information Channels, Reduction of Information Channels, Noiseless Channel, Properties of Mutual Information and Introduction to Channel Capacity, Calculation of Channel Capacity for Different Information Channels, Shannon's Channel Coding Theorem, Bandwidth-S/N Trade-Off, Channel Capacity Theorem, Discussion On Error Free Communication Over Noisy Channel, Error Free Communication Over A Binary Symmetric Channel and Introduction to Continuous Sources and Channels, Differential Entropy and Evaluation of Mutual Information for Continuous Sources and Channels, Channel Capacity of A Band-Limited Continuous Channel.

Unit 4: Linear Block and Cyclic Error-Correction Coding **Lectures-9**

Definition of Terms – Redundancy, Code Efficiency, Systematic Codes, Hamming Distance, Hamming Weight, Hamming Bound; Types of Codes – Parity Check Codes, Hamming Codes, BCH Codes, Reed-Solomon Codes, Concatenated Codes; Linear Block Codes, Generator and Parity Check Matrix, Syndrome Decoding; Cyclic Codes, Generation and Detection; Coding for Reliable Communication, Coding Gain, Bandwidth Expansion Ratio; Comparison of Coded and Un-coded systems.

Unit 6: Convolutional Code **Lectures-8**

Burst Error Detecting and Correcting Codes; Convolutional Codes; Time Domain and Frequency Domain Approaches; Code Tree, Trellis and State Diagram; Decoding of Convolutional Codes, Viterbi's Algorithm, Sequential Decoding; Transfer Function and Distance Properties of Convolutional Codes; Bound on the Bit Error Rate; Coding gain.

Unit 7: Coded Modulation **Lectures-4**

Coding for Bandwidth Constrained Channels -- Combined Coding and Modulation, Trellis Coded Modulation (TCM), Set-partitioning, Encoder and Decoder Design for TCM, Decoding of TCM Codes using the Viterbi Algorithm.

Books:

1. T. M. Cover and J. A. Thomas, 'Elements of Information Theory', 2nd Edition, Wiley India Pvt. Ltd, 2013.
2. I. Csiszar and J. Korner, 'Infromation Theory: Coding Theorems for Discrete Memoryless Systems', 2nd Edition, Cambridge University Press, 2011.
3. R. G. Gallager, 'Information Theory and Reliable Communication', JohnWiley & Sons, 1969.
4. R. E. Blahut, 'Algebraic Codes for Data Transmission', 1st Edistion, Cmabridge University Press, 2003.

Other useful references:

1. C.E. Shannon, "A Mathematical Theory of Communications", Bell System Tech. Journal, Vol. 27, July and Oct. 1998.
2. G. Forney and D. Costello, B., "Channel coding: The road to channel capacity", Proc. IEEE, vol. 95, no. 6, pp. 1150–1177, Jun. 2007.

EC145 Fuzzy Logic and Network

L-T-P: 3-0-0; Total 42 lectures

Prerequisites: i) Calculus ii) Linear Algebra iii) Numerical Analysis iv) C/Fortran/MATLAB Programing

Objective: The main objective of this course is to provide the student with the basic understanding of neural networks and fuzzy logic fundamentals, program the related algorithms and design the required and related systems.

Course Outcome: Upon successful completion of this course, students should be able to:

Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.

Appreciate the learning and adaptation capability of neural and fuzzy systems.

Implement neural networks and fuzzy systems to solve practical problems.

Topics Covered

Unit I: Introduction **3 Lectures**

Introduction to ANN; Biological Neuron and Artificial Neural Networks (ANN); Types of ANN; Introduction to Fuzzy Set and Fuzzy Systems; Probability versus Possibility

Unit II: Review of Linear Algebra and Optimization **4 Lectures**

Linear Algebra− Matrix as Linear Transformation, Gradient of a scalar function in N-Dimensional Space, Jacobian and Hessian of a scalar function; Quadratic Form, Positive Definite Matrices, Optimum of a Quadratic Function, Least Square and Recursive Least Square solution of over-determined set of equations; Optimization− Gradient Descent in N-Dimensional Space

Unit III: Least Square Methods for Estimation **3 Lectures**

Least Square Estimator (LSE), Geometric interpretation of LSE and principle of orthogonality, Recursive Least Square Estimator (RLSE)

Unit IV: Learning **3 Lectures**

Unsupervised Learning (Hebbian Learning, Competitive Learning & Boltzmann Learning); Supervised Learning (Error-Correction learning); Reinforcement Learning

Unit V: Adaline and Perceptron **7 Lectures**

Architecture of a Adaline and Perceptron; MLP Architecture; MLP the Universal Approximator; The XOR problem and the theory of Back-propagation as remedy; Rate of Learning, Training Considerations; Accelerated convergence of BP through learning-rate adaptation; Limitations of BP Learning

Unit VI: Radial Basis Function NN **6 Lectures**

Architecture of a RBF-NN; Advantages of RBF-NN, Training of RBF-NN using Back Propagation; Training of RBF-NN using Clustering and LS Parameter Estimation; Self Organizing Map

Unit VII: Introduction to Fuzzy Set and Approximate Reasoning **6 Lectures**

Introduction to Linguistic Variable, Fuzzy Set, and Membership Function; Fuzzy Set Theoretic Operators; Fuzzy IF-THEN Rule and Approximate Reasoning

Unit VIII: Fuzzy Inference Systems **6 Lectures**

Introduction to Fuzzy Inference Systems− Fuzzification, Computation of Rule Firing Strength, Aggregation, and Defuzzification; Mamdani, Singletone, and Sugeno type Fuzzy System; Rule Generation and Parameter Estimation of Sugeno type Fuzzy System; Industry application of Fuzzy Systems

Unit IX: Adaptive Neuro-Fuzzy Systems **4 Lectures**

The Neuro-Fuzzy approach towards adaptive systems; Functional equivalence of RBF-NN and Sugeno type Fuzzy System; Function Approximation and System Identification using Neuro-Fuzzy System; Pattern Classification using Neuro-Fuzzy approach

Book:

1. Neural Networks – A Comprehensive Foundation, 2nd Ed., Simon Haykin, Prentice Hall India, India, 2004.
2. Understanding Neural Networks and Fuzzy Logic, S. V. Kartalopoulas, IEEE Press and Prentice Hall India, India, 2000.
3. Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence, Prentice Hall India, India, 2009.
4. Fuzzy Logic with Engineering Applications, 3rd Ed., T. J. Ross, Wiley India Pvt. Ltd., India, 2011.
5. Neural Networks and Fuzzy Systems: A dynamical systems approach to machine intelligence, B. Kosko, Prentice Hall India, India, 1994.
6. Fuzzy Logic Intelligence Control & Information, John Yen and Reza Langari, Pearson Education Limited, India, 2007.

EC144 Optical Fiber Communication

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites**:* i) Electromagnetic Field Theory iii) RF and Microwave Engineering iii) Communication Engineering.

***Objective**:* To introduce the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber. To study about various optical sources and optical detectors and their use in the optical communication system. Finally to discuss about digital transmission and its associated parameters on system performance.

***Course Outcome**:* Upon successful completion of this course, students should be able to:

Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures. Understand the different kind of losses, signal distortion in optical wave guides and other s ignal degradation factors.
Design optimization of SM fibers, RI profile and cut-off wave length.

Learn the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers.

Learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.

Learn fiber slicing and connectors, noise effects on system performance, operational principles WDM and solutions.

Topics Covered:

UNIT 1: INTRODUCTION TO OPTICAL FIBERS Lectures-6

Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure.

UNIT - 2: SIGNAL DEGRADATION OPTICAL FIBERS Lectures-7

Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength.

UNIT - 3: FIBER OPTICAL SOURCES AND COUPLING Lectures-8

Direct and indirect Band gap materials-LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition -Rate equations - External Quantum efficiency -Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, Lencing schemes, Fibre -to- Fibre joints, Fibre splicing.

UNIT 4: FIBER OPTICAL RECEIVERS Lectures-7

PIN and APD diodes -Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise -Comparison of Photo detectors -Fundamental Receiver Operation - preamplifiers, Error Sources -Receiver Configuration -Probability of Error - Quantum Limit.

UNIT 5: DIGITAL TRANSMISSION SYSTEM Lectures-6

Point-to-Point links System considerations -Link Power budget -Rise - time budget -Noise Effects on System Performance-Operational Principles of WDM, Solitons, Erbium-doped Fibre Amplifiers..

UNIT 6: OPTICAL NETWORKS Lectures-4

Fiber optics in LAN, MAN, SAN, WAN, FDDI architecture, SONET/ SDH architecture, SONET/ SDH network elements

UNIT 7: FEW ADVANCED TOPICS OF OFC Lectures-4

Potential application and future prospects optical fibers, multimode intensity sensors and signal mode interferometric sensors

TEXT BOOKS

1. Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, Singapore, 3rd ed., 2000

2. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 1994.

REFERENCES

1. J. Gower, "Optical Communication System", Prentice Hall of India, 2001

2. G. P. Agrawal, *Fiber-Optic Communication Systems*, Fourth Edition, Wiley, 2010

EC145 EMI/ EMC

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites**:* i) Vector Calculus ii) Electromagnetic Field Theory iii) RF and Microwave Engineering

Objective: The objective of this course is for the student to develop skills for analyzing and modeling non-ideal aspects of device design as they relate to EMC issues.

Course Outcome: Upon successful completion of this course, students should be able to:

Understand legal and quality aspects of limiting commercial product emissions
Model non-ideal behavior of electronic components
Understand the specifications EMI sensors
Understand and evaluate the sources of electrostatic discharge, radiated emission and conducted emissions
Understand signal integrity issues and evaluation of crosstalk
Design for reduction of EMC interference using proper shielding and grounding
Carryout EMI/EMC measurement

Topics Covered

Unit I: Introduction to EMC and EMC Requirements for Electronic Systems

Unit II: EMC standards and Regulations for export to Europe and USA; European Community Directive on EMC and relevant Standards, Directive 2004/108/EC; Generic Standards & Product Standards; FCC regulations & other specifications

Unit III: Theory of Transmission Line and Determination of Characteristic Impedance

Unit IV: Behavior of Resistor, Capacitor, Inductor, and PCB Traces at High Frequency

Unit V: Electrostatic Discharge

Unit VI: Conducted Emissions and Susceptibility Modeling

Unit VII: EMI Sensors

Unit VIII: Radiated Emissions and Susceptibility

Unit IX: Multiconductor Transmission Line, Crosstalk, and Signal Integrity

Unit X: Electromagnetic Shielding, Grounding

Unit XI: EMI/EMC Measurement

Textbook:

1. Introduction to Electromagnetic Compatibility, 2nd Ed., C. R. Paul, John Wiley and Sons, New York, USA, 2006.
2. Advanced Signal Integrity for High-Speed Digital Designs, S. H. Hall and H. L. Heck, IEEE Press and John Wiley & Sons, New Jersey, USA, 2009.

Reference Book:

1. Electromagnetic Compatibility Handbook, K. L. Kaiser, CRC Press, Florida, USA, 2004.

2. High-Speed VLSI Interconnections, 2nd Ed., A. K. Goel, IEEE Press and John Wiley & Sons, New Jersey, USA, 2007.
3. Inductance: Loop and Partial, C. R. Paul, IEEE Press and John Wiley & Sons, New Jersey, USA, 2009.
4. Analysis of Multiconductor Transmission Lines, 2nd Ed., C. R. Paul, IEEE Press and John Wiley & Sons, New Jersey, USA, 2007.
5. Transmission Lines in Digital Systems for EMC Practitioners, C. R. Paul, IEEE Press and John Wiley & Sons, New Jersey, USA, 2011.
6. Transmission Lines in Digital and Analog Electronic Systems: Signal Integrity and Crosstalk, C. R. Paul, John Wiley and Sons, New York, USA, 2010.

Web Page: http://www.engr.uky.edu/~bsmith/ee527/ee527main.htm

EC146 Embedded System

L-T-P: 3-0-0; Total 42 Lectures

Prerequisites: **(i)** Digital Electronics (ECI 1 1)

Objectives: This course concerns with Embedded systems basic knowledge: embedded architectures: Architectures and programming of microcontrollers: embedded system applications..

Course Outcome: Upon successful completion of this course, students should be able to understand the following:

(1) Introduction to Microcontroller Organization and Architecture **(ARM.**8051)
(2) Data Representation and Memory Usage
(3) Problem Solving and Algorithm Development
(4) Assembling/Compiling and Execution
(5) Assembly and C Programming
(6) Analysis of timing and memory requirements.
(7) Embedded system applications

Course Detail

UNIT –I: Introduction to Embedded Systems

Definition of Embedded System. Embedded Systems Vs General Computing Systems. History of Embedded Systems. Classification, Major Application Areas. Purpose of Embedded Systems,Characteristics and Quality Attributes of Embedded Systems

Typical Embedded System:

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs,Commercial Off-The-Shelf Components (COTS), Memory: ROM. RAM. Memory according to thetype of Interface. Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators. Communication Interface: Onboard and External Communication Interfaces.

UNIT- II: Programming Embedded Systems in C

Introduction .What is an embedded system. Which processor should you use. Which programming language should you use. Which operating system should you use. How do you develop embedded software,

UNIT- III: Embedded Firmware:

Reset Circuit. Brown-out Protection Circuit. Oscillator Unit. Real lime Clock. Watchdog Timer,Embedded firmware Design Approaches and Development Languages.

UNIT- IV: RTOS Based Embedded System Design:

Operating System Basics, Types of Operating Systems, Tasks. Process and Threads. Multiprocessing and Multitasking, Task Scheduling.

Task Communication: Shared Memory. Message Passing. Remote Procedure Call and Sockets.Task Synchronization: Task Communication/Synchronization Issues. Task SynchronizationTechniques, Device Drivers, How to Choose an RTOS.

UNIT –V: ARM Architecture

ARM Design Philosophy, Registers, Program Status Register. Instruction Pipeline Interrupts and Vector Table. Architecture Revision, ARM Processor Families. ARM Programming Model – I: Instruction Set: Data Processing Instructions. Addressing Modes. Branch. Load. Store Instructions,PSR Instructions. Conditional Instructions.

UNIT –VI: ARM Programming Model - II:

Thumb Instruction Set: Register Usage, Other Branch Instructions. Data Processing Instructions.Single-Register and Multi Register Load-Store Instructions. Stack. Software Interrupt Instructions

UNIT –VII: ARM Programming:

Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic,Assembly Code using Instruction Scheduling, Register Allocation. Conditional Execution and Loops

Text Book:

1. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley..
2. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008.
3. ARM Systems Developer's Guides- Designing & Optimizing System Software Andrew N.
4. Sloss. Dominic Symes. Chris Wright, 2008. Elsevier

Reference Books

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

EC147 Adaptive Signal Processing

L-T-P: 3-0-0; Total 42 lectures

Prerequisites: **(i)** Digital Signal Processing **(**EC117**),** (ii) Linear Algebra and (iii) Random process

Objectives: This course concerns with processing of signals where the processing parameters are adjusted continuously to suit the time varying environmental conditions.

***Course Outcome*:** Upon successful completion of this course, students should be able to understand the following:

Modeling of random signal
Approaches for parameter estimation and it's need for real world applications
Design and analysis of optimal filters
Linear Prediction analysis of the signal and it's applications
Design and analysis of Adaptive filters and it's application for real world signal processing

Course Detail

UNIT –I

Review of Linear Algebra relevant to the course, Review of Random Processes: power spectral density, autocorrelation and auto-covariance structures of discrete time random processes, Linear shift-invariant (LSI) systems with random input signal, spectral factorization theorem, Wold's decomposition

UNIT –II

Random signal modeling: White Noise Sequence, Moving Average (MA), Autoregressive (AR), ARMA models

UNIT –III

Parameter Estimation: Necessary and sufficient statistic for parameter estimation, ***Cramer–Rao theorem***, maximum likelihood and Bayesian estimation

UNIT –IV

Optimal linear filter: Linear minimum mean square error estimator (LMMSE), Winer-Hopf equations, FIR and IIR Wiener filters both for causal and noncausal case, noise filtering.

UNIT –V

Linear Prediction of the signal: Forward and Backward prediction, Prediction error, Yule-Walker equations, Levinson-Durbin Algorithm, Lattice filer realization

UNIT –VI

Adaptive Filters: Steepest Descent method, convergence of the steepest descent methodLeast Mean Square (LMS) algorithm, convergence of the LMS algorithm, excess mean square error, Recursive Least Squares (RLS) filters; Kalman filters: signal modeling, estimation of the filter-parameters, scalar and vector Kalman filters

UNIT –VII

Spectral estimation: periodograms, modified periodograms, minimum variance, maximum entropy and parametric methods for spectral estimation.

Text Book:

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley.
2. S. Haykin, ***Adaptive Filter Theory***, PHI, 2001.

Reference Books

1. D G Manolakis, V K Ingle, S M Kogon, Statistical and Adaptive Signal Processing, Artech House.

EC148 Wireless And Mobile Communication

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites**:* i) Probability and Statistics, ii) Linear Algebra, Random Variable and Random Processes iii) Digital Communication System

***Objective**:* The course aims to provide students with an understanding of the concepts/techniques/basic principles and the most update knowledge in wireless communications.

***Course Outcome**:* Upon successful completion of this course, students should be able to understand and analyse:

1. Large-scale propagation effects
2. Small-scale propagation effects (Multipath fading)
3. Prediction of the radio cell coverage
4. Basic digital modulation techniques used in wireless communications
5. Performance of basic digital modulation techniques over wireless channels
6. Diversity techniques to mitigate the effect of multipath fading
7. Basic principles of multiple access methods
8. Basic code division multiple access (CDMA) methods

Topics Covered:

Unit 1: Introduction to Wireless Communication **Lectures-2**

Introduction to Wireless Communication, Types of Wireless Communication, Frequencies used and Ranges, Basic Challenges and Requirements, Block Schematic Diagram, Evolution of Wireless Communication-Different Generations

Unit 2: RF and microwave signal propagation in wireless channel **Lectures-5**

Propagation mechanism- Free space propagation and Friis transmission formula, reflection, refraction, diffraction and scattering; Large scale signal propagation – Path-loss, Introduction to shadowing and log-normal shadowing; Link-budget calculation**.**

Unit 3: Wireless fading channel **Lectures-10**

Multipath and small scale fading, Doppler shift, Statistical multipath channel models – Clerk's Model, Rayleigh and Rician fading channel; Narrowband and wideband fading channel, Power delay profile - average and r.m.s delay spread, coherence bandwidth and coherence time, Flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Unit 4: Diversity techniques in wireless communication **Lectures-8**

Different types of diversity techniques – Time diversity, Frequency diversity, Antenna diversity; Antenna diversity – Space diversity, polarization diversity and pattern diversity; Receiver antenna diversity – Selection combining, Maximal-Ratio-Combining (MRC) and Equal gain combining; Outage probability, average SNR, average BER/SER; Introduction to Rake receiver; Transmit diversity – Alamouti scheme

Unit 5: Basic digital modulation techniques used in wireless communications **Lectures-6**

Modulation schemes: BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM; Performance of basic digital modulation techniques over wireless channels; Equalization: linear-ZFE and adaptive, DFE

Basic principles of multiple access methods- FDMA, TDMA, CDMA, SDMA, OFDMA

Unit 6: Cellular Communications **Lectures-7**

Introduction to Cellular Communications, Cell structure, Frequency reuse, Cell splitting, Channel assignment, Handoff, interference, capacity, power control Wireless Standards: Overview of 2G and 3G cellular standards - GSM, EDGE, GPRS, WCDMA.

Module 7: Brief introduction to Satellite Communication Systems **Lectures-4**

Geostationary and non-geostationary orbits; Global beam and spot beam; Spectrum management; International satellite systems; Transponders; Multiple access techniques;

Intermodulation distortion and back-off; VSAT; link budget

Text Books

1. Andrea Goldsmith, 'Wireless Communications', 1st Edition, Cambridge University Press, 2005.
2. T. S. Rappaport, 'Wireless Digital Communications: Principles and Practice', 2nd Ed., Prentice Hall India, 2007.
3. W. C. Y. Lee, 'Wireless and cellular telecommunications', 3rd Ed., MGH, 2006.

Reference Books

1. Arogyaswami Paulraj, Rohit Nabar and Dhananjay Gore, 'Introduction to Space-Time Wireless Communications', 1st Edition, Cambridge University Press, 2003.
2. J. Proakis and M. Salehi, "Digital Communications", 5th ed., McGraw-Hill Higher Education, 2013.
3. Andreas F. Molisch, 'Wireless Communications', 2nd Edition, Wiley -IEEE Press, 2011.

RELATED LINKS
http://users.ece.gatech.edu/stuber/6604/
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http://wncg.org/ee381v/
http://users.ece.utexas.edu/~rheath/courses/mimo/index.php
http://www.nari.ee.ethz.ch/commth/teaching/mimo/lecture.html
http://www.nptel.iitm.ac.in/video.php?subjectId=117102062

EC149 Communication Networks

EC149 Communication Networks

L-T-P: 3-0-0; Total 42 lectures

Prerequisites: i) Probability Theory ii) Communication Engineering
Objective: This is a first class on the fundamentals of communication networks, their architecture, principles of operations, and performance analyses. One goal will be to give some insight into the rationale of why networks are structured the way they are today and to understand the issues facing the designers of next-generation data networks. Much of the class will focus on network algorithms and their performance.
Course Outcome: Facts about the physical arrangement of networks, types and modes of networks, data conversions and transmission medium. In-depth understanding of the detection and correction of errors, link control and link protocols of data link layer. Study of queuing theory and its application in networking Knowledge about the access method, electrical specification and implementation of different networks, types of switching. Performance analysis of communication network Understanding of the logic of link mechanisms used in networks and different layers of TCP/IP. Knowledge about next generation data networks.

Topics Covered

Unit 1: Introduction to communication networks Lectures-4

Networking Concepts and Terminology; Types of Networks; Protocols and Standards; Network Topology; Transmission Mode; OSI 7 Layer Architecture; Brief Introduction of Each Layer; Physical Layer and Transmission Media–Guided and Unguided; Digital Transmission of Data and Signals; Transmission Impairments; Data Rate Limits; Error Performance; Bandwidth Utilization– Multiplexing and Spreading;

Unit 2: Data Link Layers Lectures-3

Framing; Error Detection and Error Correction; Data Link Control – Line discipline, Flow control, Error control; ARQ Protocols; Data-Link Layer Protocols.

Unit 3: Introduction to Queuing theory Lectures-6

Delay Models; Queuing Theory Framework; Little's Theorem; M/M/1 Queuing System; Poisson Process; Analysis and Application of M/M/1 Queue; M/G/1 Queuing System; Application of M/G/1 Queuing System; Introduction to Markov System.

Unit 4: MAC Layer and ALOHA Lectures-5

Brief summary of Multiple Access Schemes; Classification of MAC Protocols; ALOHA/Slotted ALOHA, Analysis and Performance of Slotted ALOHA; Stabilized Slotted ALOHA, Carrier Sense Protocols— CSMA, CSMA/CD, Ethernet; Tree Algorithms; High-speed LANs; Token Rings, Delay and Throughput Analysis, FDDI, DQDB; MAC for Wireless LAN;

Unit 5: Switching and Networks Lectures-6

Introduction to Switch Architecture; Throughput Analysis of Input Queued Switches; High Speed Switch Scheduling; Backbone Networks; Virtual LANs; SONET / SDH – Architecture, Synchronous Transport Signals, Physical Configuration, SONET layers, Applications; Virtual Circuit Networks – Frame relay and ATM: Introduction, Frame Relay Operation, Frame Relay Layers, Congestion Control, Leaky Bucket Algorithm, Traffic Control, ATM Architecture, Layers, and Applications, ISDN; Multi-protocol Label Switching.

Unit 6: Routing Lectures-3

Broadcast Routing & Spanning Trees; Multicast Routing; Shortest Path Unicast Routing, Distributed Routing Algorithms, Optimal Routing.

Unit 7: Networking Devices and TCP / IP Protocol Lectures-7

Networking and Internetworking Devices – Repeaters, Bridges, Gateways, and Routers; Other Devices; TCP / IP Protocol suite – Overview of TCP/IP; TCP/IP Layers; Network Layer – Addressing (IPv4 and IPv6), Internet Standards; Sub-netting, DHCP, Internetworking; Transport Layer – Process-Process Delivery: UDP, TCP and SCTP; Congestion Control and Quality of Services, Integrated Services and Differentiated Services; TCP Error Control. Application layer – Domain Name System (DNS), Telnet, File Transfer Protocol (FTP), Trivial File Transfer Protocol (TFTP), Simple Mail Transfer Protocol (SMTP), WWW and HTTP architecture, Simple Network Management Protocol (SNMP), Multimedia, Digitization and Compression of Audio/Video; Streaming Stored/Live Audio/Video; Real Time Interactive Audio/Video; RTP, RTCP, Voice over IP.

Unit 8: Special Topics – A Glimpse Lectures-8

Introduction to Optical Networks; Cellular Network; Wireless Wide Area Networks – GSM, IS-95, WCDMA, GPRS etc.; Wireless LAN – IEEE 802.11a/b/g/e; Wireless PAN – Bluetooth; UWB Network; Wireless Sensor Networks and Ad-Hoc Networks; Introduction to 3GPP-LTE; Introduction to Cognitive Radio Network.

Book List

1. S. Tanenbaum, 'Computer Networks', Pearson Education, 4th Edition, 2003 / PHI.
2. William Stallings, 'Data and Computer Communication', 8th Edition, Pearson Education, 2003 / PHI.
3. R. Gallager and D. P. Bertsekas, 'Data Networks', 2nd edition, Prentice-Hall, Inc., 1991.
4. Peterson and Davie, 'Computer Networks: A Systems Approach', 5th Ed, Morgan Kaufmann Publishers, 1999.

5. Kleinrock, Leonard, 'Queueing Systems, Vol 1: Theory', Wiley J., 1975.
6. Kaveth Pahlavan, K.Prasanth Krishnamurthy, 'Principles of Wireless Networks", Pearson Education Asia, 2002.
7. Jon W. Mark, Weihua Zhuang, 'Wireless communication and Networking', Prentice Hall India, 2003.

EC150 Satellite & Radar Engineering

L-T-P: 3-0-0; Total 42 lectures

Prerequisites: i) Electromagnetic Field Theory ii) RF and Microwave Engineering iii) Digital Communication Systems

Objective: This course builds basic knowledge of satellite communication systems and different types of radar systems.

Course Outcome*:* Upon successful completion of this course, students should be able to:

Understand the basic radar concepts including the radar range equation; RCS; CW, pulsed doppler, MTI, and tracking radar; receiver noise, losses, and radar clutter; radar detection and parameter estimation

Understand the basics of satellite communications; orbiting satellites; satellite frequency bands; channel and link budget analysis; transponder; multiple access techniques

Topics Covered

Part I:

Unit I: Introduction to Satellite Systems; Orbiting Satellites; Satellite Frequency Bands

Unit II: Satellite Channel and Link Budget Analysis

Unit III: Satellite Transponder

Unit IV: Multiple Access Techniques

Part II:

Unit I: Introduction to Radar

Unit II: Radar Range Equation

Unit III: Radar Cross-Section

Unit IV: CW, Pulsed Doppler, MTI, and Tracking Radar

Unit V: Receiver Noise, Losses, and Radar Clutter

Unit VI: Matched Filter; Radar Detection and Parameter Estimation in Clutter and Noise Background

Textbook

1. Satellite Communication - R. M. Gagliardi

Reference Book

1. Satellite Communication - T. Pratt & C. W. Boston
2. Satellite Communication System Design Principles - M. Richharia
3. Introduction to Radar Systems - M. I. Skolnik (Textbook)
4. Radar Fundamentals - G. J. Wheeler
5. Radar Engineering - D. G. Rink

EC151 Software Defined and Cognitive Radios

L-T-P: 3-0-0; Total 42 lectures

Prerequisites*:* i) Linear Algebra ii) Fourier Analysis iii) Digital Signal Processing iv) Estimation Theory iv) Digital and Wireless Communication v) Communication Networks.

Objective: This course targets to discuss the cognitive radio, software defined radio, and adaptive radio concepts from several aspects.

***Course** Outcome:* Upon successful completion of this course, students should be able to understand and analyze:

Application of SDR in advanced communication systems
Challenges and issues regarding the implementation of SDR
SDR and cognitive radio architectures
Spectrum efficiency and soft spectrum usage
Applications of cognitive radio (specifically for public safety)
Cognitive features in the upcoming wireless standards (LTE, WiMAX, etc)
Blind receiver design
Cognitive OFDM(A)
Sampling and ADC/DAC issues in CR and SDR
Multi-rate processing, sampling rate adjustments. Auto-rate detection and adjustments etc.

Topics Covered:

Unit 1- Introduction to Cognitive Radio, Adaptive Radio, and SDR **Lectures-4**

Definitions; Motivation and Requirements; Relations with the evolution of wireless systems; Cross-Layer Design; Cognitive Process; Software Adaptable Network; Applications; Recourse Requirements; Challenges; Standards; Spectrum – Licensed, Unlicensed, Shared Unlicensed, Opportunistic Unlicensed; Current Spectral Usage and Issues; Regulations; XG (Soft Spectrum Usage, Related to Spectrum Only), and Relations with Cognitive Radio – Spectral Awareness, Spectrum Adaptation, Dynamic Frequency Selection, Spectrum Sharing (secondary users in licensed spectrum), Priority Allocation, Adaptive Bandwidth Control, Policies; Adaptation and Optimization – Link Adaptation, Incremental Redundancy, Jointly Adaptive Source and Channel Coding, Water Pouring and Adaptive Scheduling.

Unit 2- Cognitive Radio Architecture **Lectures-4**

Introduction; SDR Technology Underlies Cognitive Radio; Quality of Information (QoI) Metric; Functions, Components and Design Rules of CR Architecture; The Cognition Cycle; The Inference Hierarchy; Building the CRA on SDR Architectures.

Unit 3- Software Defined Radio Architectures for Cognitive Radios **Lectures-6**

SDR and Cognitive Radio Relationship; SDR Architectures; Software Tunable Analog Radio Components; Antenna Systems – MIMO Systems, Smart Antennas and Beam-forming; Reconfigurable Digital Radio Technologies; Basic Digital Radio Components; Hardware limitations; Processing, Programmability (Flexibility) Vs Power Consumption; Digital signal processing role in SDR; FPGA/DSP and Mixed Programming Platforms.

Unit 4- Spectrum Sensing and Awareness for Cognitive Radio Applications **Lectures-7**

Introduction; Challenges; Spectrum Sensing Methods for Cognitive Radio – Matched Filtering, Waveform-Based Sensing, Cyclostationarity-Based Sensing, Energy Detector-Based Sensing, Radio Identification, Other Sensing Methods; Cooperative Sensing; External Sensing; Statistical Approaches and Prediction; Sensing Frequency; Hardware Requirements and Approaches; Multi-dimensional Spectrum Awareness; Spectrum Sensing in Current Wireless Standards; Spectral awareness; Wireless Channel Awareness; Network Awareness; Location Awareness; Environment Awareness; Power Efficiency, Energy/Battery Awareness, Device capability awareness, RF Awareness.

Unit 5- Dynamic Spectrum Sharing in Cognitive Radio **Lectures-7**

Introduction to spectrum Sharing – Centralized Spectrum Sharing and Distributed Spectrum Sharing; Cooperative and Non-cooperative Spectrum Sharing; Overlay/Underlay Spectrum Sharing; Spectrum Sharing Challenges; Spectrum Mobility Challenges; Game Theoretical Models for Dynamic Spectrum Sharing – Motivation, Game Models, Distributed Dynamic Spectrum Sharing, Game Theoretical Optimality Analysis.

Unit 6- Cross-layer optimization (Adaptation) **Lectures-6**

PHY, MAC, Network, Cognitive Radio, Cross-Layer Design and Adaptation, Cognitive Engine and Cross-Layer Architecture Design, Cross-Layer Optimization, Challenges for Cross-Layer Optimization, Source/Channel Joint Coding, Joint Routing and Link Adaptation, Routing/Power Adaptation, Efficiency Measures and Metrics, Network and System Aspects

Unit 7- Cognitive Features in Wireless Communication **Lectures-8**

Current Cellular Cognitive Features – Power control, Hand-off, Channel Allocation, Cellular Network Design, Link Adaptation, Incremental Redundancy, Interference Avoidance, Detection, and Cancellation; Femto Cells and Relation to Cognitive Radio; 2.5G/3G/4G Cognitive Features – Multi-carrier system adaptation (OFDM(A) adaptive features), Adaptive CP, Adaptive Number of Carriers, Sub-band Adaptive Modulation, Pre-compensation, Adaptive PAPR Reduction, Link Adaptation; UWB and Cognitive Radio;

BOOKS & REFERENCES

We will not be using a specific text book for the course. We will take the help of following database for reading references- http://wcsp.eng.usf.edu/cognitive_radio_links.html

EC152 Voice and Video Processing

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites**: (i)* Digital Signal Processing (EC117)

***Objectives**:* The first part of this course concerns with the production and perception of speech signal, the need of speech signal processing, processing speech signal in temporal and spectral domains for extraction of different information and application of speech signal processing. The second part of this course concerns with the human visual system, the need of video processing, coding of video signal and applications of video processing.

***Course Outcome**:* After successful completion of this course, students should be able to understand the following:

Information sources in speech signal
Short-term processing and it's need for speech signal processing.
Cesptrum analysis and it's need for speech signal processing.
Linear Prediction (LP) analysis and it's need for speech signal processing.
Sinusoidal analysis and it's need for speech signal processing.
Speaker and speech recognition systems.
Human visual system and image perception
Analysis and representation of signals and systems in two dimension
Different methods for video transformation
Different coding standards and it's need for video processing
Transmission of video signal over internet and wireless network

Course Detail

Voice Processing:

Unit-I: Introduction: speech production and perception, information sources in speech, nature of speech, models for speech analysis and perception; Short-term processing: time, frequency and time-frequency analysis; Short-term Fourier transform (STFT): overview of Fourier representation, non-stationary signals, development of STFT, transform and filter-bank views of STFT;

Unit-II: Cesptrum analysis: mel-cepstrum, delta, and delta-delta, homomorphic signal processing, real and complex cepstrum, Applications of Cepstral analysis

Unit-III: Linear Prediction (LP) analysis: Basis and development, Levinson-Durbin's method, normalized error, LP spectrum, LP cepstrum, LP residual, Applications of LP analysis; Sinusoidal analysis: Basis and development, phase unwrapping, sinusoidal analysis and synthesis of speech

Unit-IV: Applications of voice processing: Speaker recognition system and speech recognition system

Video Processing:

Unit-V: Human visual system and image perception; monochrome and colour vision models; standard video formats; image digitization, display and storage; 2-D signals and systems

Unit-VI: Image transforms: 2D DFT, DCT, KLT, Harr transform and discrete wavelet transform;

Unit-VII: Video Coding: Entropy coding, transform coding, subband coding, image compression standards, lossy and lossless compression

Unit-VII: Video compression, motion compensation, Error-Control in Video Communications, Streaming Video over the Internet and Wireless Network

Texts/References:
Voice Processing:
Text book

1. L.R. Rabiner and R.W. Schafer, Digital Processing of Speech Signals Pearson Education, Delhi, India, 2004

Reference books

1. J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis Discrete-Time Processing of Speech Signals, Wiley-IEEE Press, NY, USA, 1999.
2. T. F. Quatieri, "Discrete time processing of speech signals", Pearson Education, 2005.
3. L. R. Rabiner, B. H. Jhuang and B. Yegnanarayana, "Fundamentals of speech recognition", Pearson Education, 2009.

Video processing:
Text book:

1.Yao Wang, Jörn Ostermann, and Ya-Qin Zhang, "Video Processing and Communications," Prentice Hall Signal Processing Series, 2002

Reference books

1.R. C. Gonzalez and R. E. Woods: Digital Image Processing, Pearson Education, 2001
2. A. K. Jain, Fundamentals of Digital Image processing, Pearson Education, 1989.

EC153 CMOS and VLSI design

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites*:** Basicsof VLSI Technology, MOS devices and IC Fabrication MOS circuit concepts, MOS performance characteristics

Objective:This course is intended to provide students fundamentals of CMOS logic, MOS amplifiers, BiCMOS inverters, frequency response, CMOS analog circuit design, VLSI design methodology, fundamentals of low power CMOS design and testing and verification of design. This course also dealt with the design of circuits which includes such as switched-capacitor filters, analog-to-digital and digital-to-analog converters.

Course Outcome: After completing of the course, students should able to

Analyze MOS models

To learn concept second order effects in CMOS

Use CMOS circuit concepts in basic analog components, such as single-stage and operational amplifiers and data converters.

Understand CMOS technology in specific layout rules in the placement and routing of transistors and interconnect

Verify the functionality, timing, power, and parasitic effects in CMOS technology.

Topics Covered

Unit1 (Introduction CMOS circuits) :(4 Lectures)

Basic MOS models; second order effects; CMOS logic and Design rules and layout; Latchup

Unit2 (MOS Amplifiers): (4 Lectures)

Transfer characteristics; Basic MNOS/CMOS gain stage; Cascade and Cascode circuits, and Frequency response; Stability and Noise issues in amplifiers

Unit3 (Analog Circuits Design): (12 Lectures)

Basic current mirrors- Cascode current mirrors, Active current mirror; Operational amplifiers-two stage MOS op-amps; Switched Capacitor Circuits and introduction to Switched Capacitor circuits-Sampling switches; Switched Capacitor Filters-basic operation and analysis

Unit4 (BiCMOS Logic Circuits):(4 Lectures)

Introduction-BJT Structure & operation; Basic BiCMOS Circuit behavior; Switching Delay in BiCMOS Logic circuits; BiCMOS Applications

Unit5 (VLSI System Design methodology): (6 Lectures)

Structure Design, Strategy; Hierarchy, Regularity; Modularity; Locality; System on Chip Design options- Programmable logic and structures, Programmable interconnect, programmable gate arrays, Sea of gate and gate array design, standard cell design, full custom mask design

Unit6 (Low Power VLSI Design): (5 Lectures)

Basis introduction- Importance of low power CMOS design; sources of power consumption in CMOS-short circuit power dissipation, static power dissipation; Power consumption-supply voltage level; Physical Capacitance; switching frequency; Techniques for power reduction

Unit7 (Testing and Verification): (4 Lectures)

Practical aspects in VLSI design; Performance parameters; Optimization of CMOS Inverter; Noise margin; Floorplan; Testability- Fault types and models.

Unit8 (Data converters): (3 Lectures)

Introduction to Ideal D/A and A/D converters-quantization noise, performance limitations; Higher order sigma-delta A/D converters

Text books-

1. Gray, Meyer, Lewis, Hurst, "Analysis and design of Analog IC's", 4th Edition, Willey International, 2002
2. Nandita Dasgupata, Amitava Dasgupta, "Semiconductor Devices- Modelling and Technology", Prentice Hall of India pvt. Ltd, 2004

Reference books-

1. Behzad Razavi, "Principles of data conversion system design", S.Chand and Company Ltd, 2000
2. Grebene, "Bipolar and MOS Analog Integrated circuit design", John Wiley &Sons Inc, 2003
3. Phillip E. Allen Douglas R. Holberg, "CMOS Analog Circuit Design", 2nd Edition, Oxford University Press, 2003
4. CMOS: Circuit Design, Layout and Simulation- Baker, Li and Boyce, PHI

EC154 Broadband Access Network

L-T-P: 3-0-0; Total 42 lectures

***Prerequisites**:* i) Probability Theory ii) Communication Engineering iii) Computer Communication Network

***Objective**:* This course provides a broad and comprehensive study of the technologies enabling broadband services and networking. High-speed network access technologies, core-network architectures, and the broadband service environment are the focus of this course. The broadband access technologies of Digital Subscriber Line (DSL), cable modem service, optical fiber-based access, and the high-speed wireless technologies of WiFi and WiMAX are examined and differentiated. The core-network technologies of MPLS, RSVP, DiffServe, as well as the services-converging IP Multimedia Sub-system (IMS) are discussed and studied as enabling technologies for broadband services. An overview is provided of key broadband services: VoIP, IPTV, streaming video and Video on Demand. The course concludes with a discussion of the opportunities and threats posed to service providers and the communications industry by the emerging disruptive technologies of broadband networking.

***Course Outcome**:*Upon successful completion of this course, students should be able to:

Understand the importance of broadband networking services and technologies.

Describe and compare the different broadband network access techniques of Digital Subscriber Line (DSL), cable modem service, optical fiber based access, and broadband wireless access techniques of WiFi and WiMAX networks.

List and provide a high-level discussion on the important broadband core network technologies of MPLS and IP multicast and discuss IP QoS control mechanisms including RSVP and DiffServe.

Identify the relationship between broadband networking and the IP Multimedia Sub-system (IMS) and discuss the operation of IMS.

Discuss the important broadband services of VoIP, IPTV, streaming video, and VoD.

Examine the opportunities and threats presented to communications service providers with the introduction of the disruptive technologies of broadband networking.

Topics Covered:

Unit 1- Introduction to Broadband Access Network and Enabling Technologies Lectures- 8

Introduction to Broadband Access Network; The Anatomy of An Access Network – Broadband Copper Access Network using ADSL2+/VDSL2 Technology; Fiber-to-the-home/Building (FTTH/B) Access Network – Point-to-point FTTH, PON-FTTH, WDM-PON-FTTH; Hybrid Fiber-Coax DOCSIS Protocol;

Enabling Technique for Broadband Access Network: Fiber in the Access Network – Fiber-DSL, Hybrid Fiber-Coax, Fiber-Wireless, Fiber-to-the-home; Basic Optical Access Network Components; FTTH Network Topologies; Multiple Access Techniques for a PON; Radio Over Fiber; Free-Space Optical Communication.

Unit 2- Copper Broadband Access Networks Lectures- 7

Digital Subscriber Line (ADSL, HDSL, RADSL, VDSL, G.lite); Access Network Architecture (DSLAM, ATM); Modulation technologies (DMT). Cable Modem Service; Head-end and regional network architecture (Cable Modem Termination System – CMTS, Hybrid Fiber Coax networks – HFC); CableLabs initiatives (DOCSIS. PacketCable, CableHome)

Unit 3- Optical Fiber based Access Networks Lectures- 7

Optical Fiber-based Networks; Passive Optical Network (PON) Architecture (Optical Line Termination, Optical Network Terminals); Standards (BPON, GPON, EPON); Dynamic Bandwidth Allocation for Ethernet PONs (EPON); QoS in EPONs; MultiChannel EPONs; Long-Reach Optical Access (LR-PON).

Unit 4- Wireless Access Networks Lectures- 7

Fixed and Mobile WiMAX and LTE; Architecture; Standards; Services; Modulation and Coding Techniques; Multiple Access Techniques; Diversity Techniques; WiMax Networks – Point-to-Multipoint WiMax Networks; WiMax Mesh Mode; Mobility in WiMax Networks.

Unit 5- Optical-Wireless Access Networks **Lectures- 5**

Radio-over-Fiber Networks, Networking Concepts and Techniques; Integration of EPON and WiMax; Microwave-over-Fiber Architectures; Hybrid Architectures; Multistage EPON and WiMax Integration.

Unit 6- Broadband Network Technologies **Lectures- 4**

IP QoS Control Mechanisms; Resource Reservation Protocol (RSVP); Differentiated Services (DiffServ) Multi-Protocol Label Switching (MPLS), IP Multimedia Sub-System (IMS)

Unit 7- Broadband Services **Lectures- 4**

Services Enabled by Broadband: VoIP, IPTV, Streaming Video, VoD; VoIP – Network Architecture; Protocol Architecture for VoIP; Session Initiation Protocol (SIP); H.323; SGCP; MGCP; IPDC.

Book List

1. J. Bellamy, 'Digital Telephony', 3rd Edition, Wiley India, 2000.
2. B. A. Forouzan, 'Data Communications and Networking', 4th Edition, Tata McGraw-Hill, 2006.
3. W. Stalling, 'Data and Computer Communications', 8th Edition, Pearson India Inc., 2007.
4. R. Ramaswami and K. Sivarajan, 'Optical Networks: A Practical Perspective', 3rd Edition, Morgan Kauffman, 2010.
5. Heiskala and J. Terry, 'OFDM Wireless LANs: A Theoretical and Practical Guide', 1st Edition, Sams Publishing, 2001.
6. A. Bachmutsky, M. Katz, and F. Fitzek, 'WiMAX Evolution: Emerging Technologies and Applications', 1st Edition, Wiley, 2009.
7. S. Parkvall, J. Skold, P. Beming, '3G Evolution: HSPA and LTE for Mobile Broadband', 2nd Edition, Academic Press, 2008.

EC155 Micro-Electro-Mechanical System

L-T-P: 3-0-0; Total 42 lectures

Prerequisites: i) General Physics ii) General Chemistry and iii) Kinematics and Dynamics of Mechanical Systems

Objective: This course is intended to make students familiar with recent developments and process technology used to fabricate MEMS devices, MEMS, and smart devices with a wide variety of MEMS application areas.

Course Outcome: Upon successful completion of this course, students should be able to

Integrate the knowledge of semiconductors and solid mechanics required to fabricate MEMS devices.

Understand the various Micro fabrication techniques.

Different materials used for MEMS

Understand the various applications of MEMS to disciplines beyond Electrical and Mechanical discipline

Topics Covered

Unit 1 (Introduction): (4 Lectures)

Introduction to MEMS and Microsystems; Materials and Substrates for MEMS; Sensors- Sensors characterization and classifications; Micro actuators; Applications of MEMS, Micromachining; Micro Electro Mechanical Systems

Unit 2 (Material Properties): (7 Lectures)

MEMS materials- structural and sacrificial materials, properties of silicon, mechanical, electrical and thermal properties of materials; Basic modeling of elements in electrical and mechanical systems

Unit3 (MEMS Fabrication): (5 Lectures)

Microfabrication and Micromachining-Integrated Circuit Processes, Bulk Micromachining; Isotropic Etching and Anisotropic Etching; Wafer Bonding; High Aspect-Ratio Processes (LIGA)

Unit4 (Mechanical Sensors): (8 Lectures)

Classification of physical sensors- Integrated, Intelligent, or Smart sensors; Sensor Principles- Stress and Strain, Hooke's Law; Stress and Strain of Beam Structures, Cantilever, Pressure sensors- Piezoresistance Effect, Piezoelectricity; Piezoresistive Sensor ;Capacitive sensors; Inductive sensors; MEMS inertial sensors

Unit 5 (Magnetic Sensors): (4 Lectures)

Magnetic material for MEMS; magnetic sensing and detection; Mannetoresistive sensors; Hall Effect, magnetodiode, Megnetotransitors; MEMS magnetic sensors, RF MEMS.

Unit6 (Microactuators): (4 Lectures)

Electromagnetic and Thermal microactuation; Microvalves; Micropumps; Micromotors-Microactuator systems

Unit7 (Surface Micromachining): (6 Lectures)

Surface micromachining requirements; Polysilicon surface micromachining; other compatible materials,-Silicon Dioxide, Silicon Nitride, Piezoelectric materials; Surface Micro machined Systems: Micro motors, Gear trains, Mechanisms

Unit8 (Application Areas): (4 Lectures)

Mechanical miniature devices; 3-D electromagnetic actuators and sensors; RF/Electronics devices; Optical/Photonic devices

Book List

1. Stephen D. Senturia, "Microsystem Design" by, Kluwer Academic Publishers, 2001.
2. Marc Madou, Analysis and Design Principles of MEMS Devices by Minhang Bao, ELSEVIER.
3. M. J. Usher, “Sensors and Transducers”, McMillian Hampshire.
4. N. P. Mahalik, “MEMS” Tata McGraq Hill
5. Fundamentals of Microfabrication by, CRC Press, 1997.
6. Gregory Kovacs, Micromachined Transducers Sourcebook WCB McGraw-Hill, Boston, 1998.
7 .S. M. Sze, Semiconductor Sensors, John Wiley & Sons Publications.

EC156 Communication System

L-T-P: 3-0-0; Total 42 lectures

Prerequisites: i) Elements of Electronics Engg.

Objective: This course is intended to make students familiar with different modulation techniques used in communication and with the different type communication system.

Course Outcome: After completion of this Lab, students should be able to:

Determine the spectral content of periodic and non-periodic signals.

Generate analog modulated waves and demodulate the and also able to analyze the time domain and frequency domain representation of analog modulated wave.

Evaluate the performance levels (Signal-to-Noise Ratio) of AM, FM and PM systems in the presence of additive white noise.

Generate and analyse the Analog Pulse Modulation/Demodulation and evaluate their performance in presence of noise.

Topics Covered

Unit 1 Review of frequency band Fourier Transform and Fourier Series.

Unit 2 Amplitude Modulation System

Need for modulation, normal AM, Generation and demodulation - envelop and synchronous detection; Modulation index; DSBSC: Generation and demodulation, Effect of phase and frequency offset on demodulation; SSB: Generation using filter and phasing method, detection, Frequency division multiplexing systems using SSB.

Unit3 Angle Modulation System

Concept of frequency and phase modulation, frequency deviation and modulation index, FM spectra, Carson's Rule, Narrowband FM, Generation of Wideband, FM-Armstrong method, Direct FM generation; Demodulation of FM.

Unit4 Sampling and Discrete time modulation

Sampling Theorem – Low pass and Band pass; Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM)- their generation and detection, Phase time division multiplying.

Unit 5 Digital Communication

PCM, Quantization noise, Bandwidth, Advantages over analog communication, PCM system, Differential PCM, Delta Modulation, Digital Modulation – ASK, FSK, PSK, DPSK, Digital Multiplexing.

Unit6 Optical Communication System

Types of optical fibers- step index and graded index, multimode and single mode; Attenuation and Dispersion in fibers; Optical transmitters- LEDs and Laser Diode; Optical Receiver- PIN and APDs, Fiber optic links.

Unit7 Introduction to Satellite and Mobile communication System

Text Books:

1. B.P. Lathi and Zhi Ding, 'Modern Digital and Analog Communication Systems', 4th Edition, Oxford University Press, 2009.
2. S. Haykin, 'Communication Systems', 4th Edition, John Wiley & Sons, 2001.

References:

1. J G Proakis & M Salehi, 'Communications Systems Engineering', 2nd edition, Prentice-Hall, 2005.
2. G. Kennedy and B. Davis, 'Electronic Communication System', 4th Edition, Tata McGraw-Hill Education, 1999.

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EE101 Elements of Electrical Engineering

L-T-P-Cr: 3-1-0-4

Objectives: The course is a foundation courses and first course for B. Tech students, where they are required to learn basics of DC and AC circuit analysis, different circuit laws and fundamentals of Electrical machines.

Prerequisites: Mathematics and Physics of 12^{th} level.

Outcome: Ability to analyses DC and Ac Circuit, AC circuit phasor representation, Magnetic circuit for electrical machines, fundamentals of single phase Transformer and rotating machines

Syllabus:

Unit 1. Introduction: D.C. circuits steady state analysis with independent and dependent sources using Loop and node voltage method, Series and parallel circuits, star delta conversion, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer Theorem. **10** Lecture

Unit 2. A.C. circuits: Common signals and there waveform, RMS and Average value, form factor and peak factor of sinusoidal wave, Impedance of series and parallel circuits, Phasor diagram, Power, Power factor, Power Triangle, Resonance and Q-factor, Superposition, Thevenin's and Norton's Maximum Power transfer theorem for A.C. circuits. **10** Lecture

Unit 3. A.C. circuits 3-phase: Star delta, line and phase relation, Power relations, Analysis of balanced and unbalanced 3-phase circuits. **4** Lecture

Unit 4. Magnetic circuits: Introduction, Series & Parallel magnetic circuits, B-H Curve under A.C. excitation, Eddy current and hysteresis losses. **3** Lecture

Unit 5. Single Phase Transformer – Types, construction, operating principle, EMF equation, Turn ratio, Equivalent circuit, losses and efficiency. **5** Lecture

Unit 6. Introduction to DC Machine and three phase Induction Motor and starters for Induction Motor. 10 Lecture

Suggested Readings:

2. Fitzgerald, et.al, Basic Electrical Engineering, Tata McGraw Hill
3. Ashfaq Hussain, Fundamentals of Electrical Engineering, Dhanpat Rai & Co.
4. R. Prasad, Fundamentals of Electrical Engineering, PHI Publication

EE102 Elements of Electrical Engineering Lab

L-T-P-Cr: 0-0-3-1

Objective: To verify characteristics of various electrical parameters, material properties, various theorems, to start and run of various electrical machines taught in Elements of Electrical Engineering course work through experiments.

List of the Experiments

1. To obtain B-H curve of a given magnetic material.
2. Verification of Kirchhoff's law.
3. Verification of Superposition theorem.
4. Verification of Thevenin's and Norton's theorem.
5. To study of R-L-C series and parallel circuit.
6. Study of resonance in series R-L-C circuit.
7. Measurement of power and power factor in a single-phase ac circuit using one watt method.

8. Power measurement in three-phase star connected circuit with balanced and unbalanced load using two-wattmeter method.
9. Measurement of energy by single-phase energy meter.
10. Starting and reversing of a dc shunt motor.
11. Study of 3-phase starters.
12. To start and run a 3-phase induction motor.
13. To find out the turns ratio of a single-phase transformer.
14. To perform open and short circuit test of single-phase transformer.
15. Study of V-I characteristics of different lamps.

Note: Minimum ten experiments are required to be performed.

EE103 Electrical Machine – I

L-T-P-Cr: 3-0-0-3

Objective: To have the basic knowledge of construction , operating principle, characteristics and application of dc generator, dc motor, single phase transformer, auto transformer, three phase transformer and three phase induction machine.
Pre-requisite: Basic Electrical Engineering

Outcome: To understand working and construction of electrical machines and their performance, to be able to analysis their behavior in parallel operation and under different load conditions.

Syllabus:

Unit 1. **DC Generator:** Constructional feature and types of D.C. Machines, Types of armature winding, Action of commutator, Principle of D.C. generator, Induced EMF, Armature reaction, Commutation, Compensating Winding and Inter Poles, External & internal Characteristics of D.C. Generator, Critical Resistance , Critical Speed. **8** Lecture **DC Motor:** Principle of D.C. Motors, Back EMF, Torque and Speed of D.C. Motors, Losses and Efficiency, Characteristics, Starting and Speed Control of Various types of D.C. Motors.

6 Lecture

Unit 2. **Single Phase Transformer:** Basic Principle, Types and Construction of single phase transformer, EMF equation, Equivalent Circuits, Phasor Diagram, Losses and efficiency Testing, Voltage Regulation, per unit system, Losses and Efficiency, Parallel Operation of Single Phase Transformer. **10** Lecture

Unit 3. **Auto Transformer:** Working Principle, Efficiency, Saving of Conductor, Advantages and Disadvantages of Auto Transformer. **2** Lecture

Unit 4. **Three Phase Transformer:** Introduction**,** Types, Phasor Group, Parallel Operation of three Phase Transformers, Cooling of Transformer. **5** Lecture

Unit 5. **Three Phase Induction Motors:** Construction, Types and principle of operation of three phase induction motors, Production of rotating field, Slip, Equivalent Circuit and Phasor Diagram, Mechanical Power Developed, Maximum Torque, Torque-Slip Characteristics, Losses and Efficiency. Starting, Testing and Speed Control of Induction Motor. **11 Hours**

Suggested Readings:

1. Samarjit Ghosh, Electrical Machine, Pearson Education Pvt. Ltd.
2. P. S. Bimbra, Electrical Machines, Khanna Publication
3. NagarathI. J. and Kothari D. P , Electrical Machines , TMH

EE104 Electrical Machine – I Lab

L-T-P-Cr: 0-0-3-1

Experimentation on Electrical Machines - I

1. Starting of dc motors/ study of 3 point & four point starters.
2. Speed control of DC motor.
3. Magnetization characteristic of DC generator.
4. External characteristic of DC generator.
5. Load test on DC motors.
6. Separation of losses.
7. Polarity, voltage ratio and load test on transformer.
8. Open circuit and short circuit test on 1- ϕ transformer.
9. Sumpner's test on transformer.
10. Separation of iron losses

EE105A Network Analysis and Synthesis[7]

L-T-P-Cr: 3-1-0-4

Objective: This course will cover Electrical circuit transient response and steady state response with different type of excitation, two port network representation, High pass and low pass filters and Passive and active circuit Synthesis.

Further Network analysis with application of graph theory has been included in the course to explain generalised approach of analysis..

Pre requisites: knowledge of KCL, KVL, Network theorems, differential equations, Laplace transforms, matrix operation

Outcome: Develop skill to analyze transient behavior of passive circuit elements and how it effects in real time. Circuit representation in two port and multiport form, and how complex circuits parameters can be determined without going to passive/ active circuit connections by simple test. How to realize a circuit from transfer function. Basics of using Different types of filters realization by passive and active circuit elements.

Syllabus:

Unit 1: Introduction continuous signal their classification, Transient response of RC, RL and RLC circuit to various excitation signals such as step, ramp, impulse and sinusoidal signals

5 **- Lecture**

Unit 2: Network Functions for one port & two-port networks, poles and zeroes of network functions. Restrictions on poles and zeroes locations for driving point functions and transfer functions. Time domain behaviour of electrical network from the pole- zeroes plot.

5 **- Lecture**

Unit 3: **Two Port Network:** Relationship of two port variables, short circuit admittance parameters, open circuit impendence parameters, transmission parameters, hybrid parameters, relationship between parameters sets, interconnections of two port networks. 5**- Lecture**

Unit 4: Network graph theory: Terminologies used in the graph theory, incidence matrix, cut-set matrix, loop-matrix, loop analysis using graph theory, cut set analysis using graph theory.

5**- Lecture**

Unit 5: Filter fundamentals: Derivation of expression for propagation constant, attenuation constant, phase shift constant, cut-off frequency, characteristics impedance etc. for constant K and m-derived, high-pass, low-pass, band-pass and band-stop L-C filters.

5 **- Lecture**

[7] EE105A New syllabus with effect from Session 2015-16 instead of EE105, as per direction of 16th Senate.

Unit 6: Positive real function: Definition, necessary and sufficient conditions, properties Synthesis of L-C, R-C and R-L Networks. 5**- Lecture**

Unit 7: **Introduction to Active Filters:** Op Amp and its application in realizing active Network, Open loop response and closed loop response, Input and output Impedance.

Dynamic OP Amp Limitations: Open Loop response and Closed Loop response, Input and Output Impedance, Transient Response. Effect of Finite GBP on Integrator Circuit. Effect of finite GBP on Filters **5 - Lectures**

Unit 8: **Operational Trans-conductance Amplifier (OTA)** and its application in realization of Positive and negative grounded impedance and floating impedence, OTA-C Oscillators and filters.

Operational Trans-conductance Impedance Amplifier (OTA) and its application in Realization of impedances, NIC, NII and GIE, Oscillators and filters. **7 - Lectures**

Note: **Unit 7 and 8 will be taught by ECE department and faculty is required to set one/ two question from this unit.**

Suggested Readings:

1. Desoer and Kuh: Basic circuit theory, Mc Graw Hill
2. D Roy Choudhary: Network and systems, New Age International
3. Van Valkenburge: Network Analysis, PHI
4. F. F. Kuh: Network Analysis and Synthesis, John Wiley & Sons.
5. Haytkemrlly and Durbin, Engineering Circuit Analysis, Tata Mc Graw hill
6. Sergis Franco: Design with Operational Amplifiers and Analog Circuits; Tata McGraw Hill
7. Govind Daryanani: Principals of Active Network Synthesis and Design; Wiley 1976
8. Tahira Parveen: A text Book of Operational Trans-conductance Amplifiers and Analog Integrated Circuits: LK International Publishing House Pvt Ltd, 2010

EE105 Network Analysis and Synthesis[8]

L-T-P-Cr: 3-1-0-4

Objective: This course will cover Electrical circuit transient response and steady state response with different type of excitation, two port network representation, High pass and low pass filters and Passive and active circuit Synthesis.

Further Network analysis with application of graph theory has been included in the course to explain generalised approach of analysis..

Pre requisites: knowledge of KCL, KVL, Network theorems, differential equations, Laplace transforms, matrix operation

Outcome: Develop skill to analyze transient behavior of passive circuit elements and how it effects in real time. Circuit representation in two port and multiport form, and how complex circuits parameters can be determined without going to passive/ active circuit connections by simple test. How to realize a circuit from transfer function. Basics of using Different types of filters realization by passive and active circuit elements.

Syllabus:

Unit 1: Introduction continuous signal their classification, Transient response of RC, RL and RLC circuit to various excitation signals such as step, ramp, impulse and sinusoidal signals

7- Lecture

[8] EE105 Syllabus effective till Session 2014-15 only

Unit 2: Network Functions for one port & two-port networks, poles and zeroes of network functions. Restrictions on poles and zeroes locations for driving point functions and transfer functions. Time domain behaviour of electrical network from the pole- zeroes plot.

5-Lecture

Unit 3: Relationship of two port variables, short circuit admittance parameters, open circuit impendence parameters, transmission parameters, hybrid parameters, relationship between parameters sets, interconnections of two port networks. **8- Lecture**

Unit 4: Network graph theory: Terminologies used in the graph theory, incidence matrix, cut-set matrix, loop-matrix, loop analysis using graph theory, cut set analysis using graph theory.

8- Lecture

Unit 5: Filter fundamentals: Derivation of expression for propagation constant, attenuation constant, phase shift constant, cut-off frequency, characteristics impedance etc. for constant K and m-derived, high-pass, low-pass, band-pass and band-stop L-C filters. Introduction to Active Filters

7- Lecture

Unit 6: Positive real function: Definition, necessary and sufficient conditions, properties Synthesis of L-C, R-C and R-L Networks. Introduction to Synthesis using Active Elements **7- Lecture**

Suggested Readings:

1. Desoer and Kuh, Basic circuit theory, Mc Graw Hill
2. D Roy Choudhary, Network and systems, New Age International
3. Van Valkenburge, Network Analysis, PHI
4. FF Kuh, Network Analysis and Synthesis, John Wiley & Sons.
5. Haytkemrlly and Durbin, Engineering Circuit Analysis, Tata Mc Graw hill

EE106 Network Analysis and Synthesis Lab[9]

L-T-P-Cr: 0-0-3-1

List of Experiments

1. Verification of maximum power transfer theorem.
2. Impedance Parameters measurement.
3. Admittance Parameters Measurement.
4. ABCD Parameters measurement.
5. Impedance Parameters measurement of series connected network.
6. Admittance Parameters measurement of parallel connected network.
7. ABCD Parameters measurement of cascade connected network.
8. Frequency response of Low-pass filters using RC network.
   Frequency response of Low-pass filter using LC network.
9. Frequency response of High-pass filters using RC network.
   Frequency response of High-pass filter using LC network.
10. Transient response of RLC series circuit.
11. Transient response of RLC parallel circuit.

[9] EE105 Syllabus effective till Session 2014-15 only

EE110 Electrical Machine –II

L-T-P-Cr: 3-1-0-4

Objective: To have the basic knowledge of construction , operating principle, characteristics and application of **Synchronous Generator**, **Synchronous Motor**, **Single Phase Induction Motors**, AC series motor, hysteresis motor, reluctance motor, Single Phase Synchronous Motors, Two Phase AC Servo Motor, Permanent Magnet DC Motor.

Pre-requisite: Knowledge of Basic Electrical Engineering and Electrical Machine I

Outcome: To understand working and performance of Synchronous machine, to be able to analysis their behavior under different load conditions. To understand working principals of Fractional Horse power rotating machine.

Syllabus:

Unit 1. **Synchronous Generator**: Principle, Construction and types of synchronous machines, Methods of Excitation, Armature Windings, EMF Equation of Alternator, Armature Reaction, Testing (OC and SC test), Voltage Regulation, Phasor Diagram. **9** Lecture

Unit 2. **Two reaction Theory**-Modified Phasor Diagram, Power Angle Characteristics, Parallel Operation, Effect of Change of Fuel supply and excitation on Alternator connected to infinite bus, Cooling of Synchronous Generator. **9** Lecture

Unit 3. **Synchronous Motor:** Principle of operation, Equivalent circuit, Effect of Varying field current, V-curves, Inverted V-curves, Phasor Diagram, Staring of synchronous motors, Hunting, Applications. **8** Lecture

Unit 4. **Fractional Horse Power Motor:** Introduction single phase Motor, Working Principle, Double Revolving field theory, Equivalent circuit, Starting Method and Types of Single Phase Induction Motors, Applications. **8** Lecture

Unit 5. **Special Motors:** Single Phase Synchronous Motors, hysteresis motor, reluctance motor, Two Phase AC Servo Motor, Single Phase Series (Universal) Motor, Stepper Motor, Permanent Magnet DC Motor, etc, Applications. **8** Lecture

Suggested Readings:

1. Fitzgerald A. E. & Kingsley, Electrical Machinery, TMH
2. P. S. Bimbra, Electrical Machines ,Khanna Publication
3. P. S. Bimbra , Generalized Theory of Electrical Machines, Khanna Publication
4. Smarjit Ghosh, Electrical Machine, Pearson Education Pvt. Ltd.
5. Nagarath I. J. and Kothari D. P., Electrical Machines, TMH

EE111 Electrical Machine –II Lab

L-T-P-Cr: 0-0-3-1

Experimentation on Electrical Machines-II

1. Parallel operation of 3-ϕ transformers.
2. Starting of 3-phase induction motors/ study of star-delta starter and slip ring motor starter.
3. Load test on induction motors.
4. No load and block rotor test.
5. Load test on slip ring induction motor with varying rotor resistance
6. Voltage Regulation of synchronous generator by synchronous impedance method.
7. Synchronization of alternators.
8. V-curves of synchronous motor.
9. Slip test to measure steady state reactance.

EE112 Electrical Measurement and Instruments

L-T-P-Cr: 3-0-0-3

Objective: To learn working of basic measuring instruments and different types of measuring bridges

Prerequisite: Basic electrical engineering

Outcome: To understand analysis and working Principal of measuring instrument for measuring Voltage, current, power**,** resistance and other electrical parameters.

Syllabus:

Unit 1. **Introduction to Standards of Measurement**, Errors and their evaluation. Calibration, accuracy precision Sensitivity, resolution, noise etc**.** **3** Lecture

Measurements of voltage, current, power and energy: Moving iron, moving coil, thermal, induction and rectifier type **8** Lecture

Measurements of power factor and frequency: Dynamometer and moving iron single and three phase power factor meters, Resonance, moving coil and moving iron frequency meters **2** Lecture

Range extension of voltmeter, ammeter, wattmeter and energy meter: Voltmeter multipliers, ammeter shunt, current and potential transformers **5 Hours**

Unit 2. **Galvanometer:** D'Arsonval, vibration and ballistic galvanometers **5** Lecture

Bridges: D.C. bridges: Kelvin double bridge, Wheat stone bridge and Carey-Foster bridge A.C. bridges: Maxwell Bridge, Hay and Owen bridges, Anderson Bridge, Wien Bridge, Schering Bridge and Heaviside-Campbell bridge **7** Lecture

Unit 3. **Potentiometer's Principle, standardization and application:** D.C. Potentiometers: Crompton and Vernier potentiometers A.C. Potentiometers: Coordinate type and Polar type **5** Lecture

Unit 4. **Magnetic measurements:** Measurement of magnetic flux by ballistic galvanometer and fluxmeter Determination of B-H curve and hysteresis loop Separation of iron loss into hysteresis and eddy current losses Measurement of iron loss and its separation on Lloyad-Fisher squares **5** Lecture

Unit 5. **Digital measurements:** Digital voltmeter and multimeter. Universal counter and its uses for measurements of frequency, ratio of two frequencies, time period and pulse width. **5** Lecture

Suggested Readings

1. E O Doeblin , Measurement System , Application & Design, TMH
2. A K Sawhney, Course in Electrical & Electronic Measurement & Instrumentation, Dhanpat Rai & Sons.
3. Rajendra Prasad, Electronic Measurements and Instrumentation Khanna Publishers
4. M.B. Stout, Basic Electrical Measurements, Prentice Hall

EE113 Electrical Measurement and Instruments Lab

L-T-P-Cr:0-0-3-1

List of the Experiment:

Exp1- Testing of 3-ϕ AC Energy meter
Exp2- Measurement of self-inductance & quality factor using Anderson Bridge.
Exp3- Basic Voltmeter design.
Exp-4 Testing of single phase Wattmeter.
Exp-5 Measurement of low resistance using Kelvin Double Bridge.
Exp-6 Measurement of small resistance by means of D.C. potentiometer.
Exp-7 Measurement and control of temperature using RTD.
Exp-8 Measurement of Linear Displacement using LVDT.
Exp-9 Measurement of capacitance and loss factor using sharing bridge.
Exp-10 Calibration of Ammeter & Voltmeter.

Exp-11 Calibration of Wattmeter.

EE114 Control System

L-T-P-Cr: 3-1-0-4

Objectives: To understand the methods of representation of systems and to desire their transfer function models. To provide adequate knowledge in the time response of systems and steady state error analysis. Mathematical modelling of different Physical systems, To understand the concept of stability of control system and stability analysis of Linear System using Time domain and Frequency domain techniques. To develop base for linear system design using Time domain and Frequency domain techniques

Pre-requisite: Laplace Transforms, Complex Analysis, Differential Equation, Matrix

Outcome: By the end of the course, students should be able to do the following:

- Mathematical modelling of different Physical systems
- Draw the pole-zero diagram and the root loci, which are the change in location of the poles as parameters are of a system are varied.
- Analyze stability of Linear system.
- Understand the meaning of proportional control, integral control, and derivative control, lag compensation, and lead compensation, and how to use them to achieve desired stability, steady-state error, and frequency response.
- Designing linear system using different techniques

Syllabus:

Unit 1. **Introduction:** Linear, nonlinear, time varying and linear time invariant system, servomechanism, historical development of automatic control and introduction to digital computer control, mathematical models of physical systems, differential equations of physical systems, transfer functions, block diagram algebra and signal flow graphs **10** Lecture

Unit 2. **Feed Back Characteristics of Control Systems:** Feedback and non-feedback systems, advantages and disadvantages of negative feedback, regenerative feedback. Control Systems and Components: DC and AC servomotors, synchros, tacho generator and stepper motors, ADC and DAC etc. **6** Lecture

Unit 3. **Time Response Analysis, Design Specifications and Performance Indices:** Standard test signals, time response of first-order systems, time response of second-order systems, steady-state error and error constants, effect of adding a zero to a system, P, PI and PID control actions and their effect, design specifications of second-order systems and performance indices. **8** Lecture

Unit 4. **Concepts of Stability and Algebraic Criteria:** The concept of stability, necessary and sufficient conditions for stability, Routh's stability criterion and relative stability analysis. Root locus technique: root locus concept, construction of root loci, root contours, systems with transportation lag, sensitivity of the roots of the characteristic equation, analysis and design of control systems with MATLAB. **8** Lecture

Unit 5. **Frequency Response Analysis:** Correlation between time and frequency response, polar plots, Bode plots, and all pass and minimum-phase systems. Stability in frequency domain: mathematical preliminaries, Nyquist stability criterion, definition of gain margin and phase margin, assessment of relative stability using Nyquist and Bode Plots, closed-loop frequency response. **10** Lecture

Suggested Readings:

1. Kuo, B. C, Automatic Control Systems. Prentice Hall of India.
2. Ogata. K, Modern Control Engineering, Prentice Hall of India
3. Nagrath I. J. and Gopal M, Control Systems Engineering, New Age International. Publishers

4. James Melsa, Donald Schultz, Linear Control Systems, Mcgraw-Hill, 1992.
5. Norman S. Nise, Control Systems Engineering, John Wiley and Sons, 2011.
6. B. S. Manke, Control system Engineering, Khanna Publication

EE115 Control System Lab

L-T-P-Cr: 0-0-3-1

List of Experiment:-

1. To verify time response of first order circuit.
2. To verify time response of second order circuit.
3. To study Synchro-transmitter and Synchro-receiver.
4. Programmable Logic Controller (PLC) programming of inverter gate , OR gate and AND gate .
5. Programmable Logic Controller (PLC) programming of EXOR gate , NAND gate , NOR gate
6. To study of Speed Measurement sensor.
7. To study of Temperature measurement and control Sensor
8. To study of Speed control of D.C. servomotor.
9. To study of Speed control of A.C. servomotor.
10. To study of Speed control of Stepper Motor.
11. To study of AC Servo motor position control.
12. To study of DC motor position control.

EE116 Power Electronics

L-T-P-Cr: 3-1-0-4

Objective: to develop understanding of different kinds of power electronic circuits, their applications and the devices being used as switches in these circuits.

Prerequisite: semiconductor Devices, circuit Analysis, Electrical Machines.

Outcome: Student will be able to understand working principle and application of different power electronic devices and circuits like converter, chopper, inverter etc

Syllabus:

Unit 1. **Introduction:** Characteristics and switching behavior of Power Diode, SCR, UJT, TRIAC, DIAC, GTO, MOSFET, IGBT, MCT and power BJT, two-transistor analogy of SCR, firing circuits of SCR and TRIAC, SCR gate characteristics, SCR ratings. Protection of SCR against over current, over voltage, high dV/dt, high dI/dt, thermal protection methods of commutation, series and parallel operation of SCR . 4 Lecture

Unit 2. **AC to DC Converter:** Classification of rectifiers, phase controlled rectifiers, single phase half wave controlled, fully controlled and half controlled rectifiers and their performance parameters, .three phase half wave, full wave and half controlled rectifiers and their performance parameters, effect of source impedance on the performance of single phase and three phase controlled rectifiers, single-phase and three phase dual converter. 8 Lecture

Unit 3. **D.C. to D.C. Converter:** Classification of choppers, principle of operation, steady state analysis of class- A chopper, step up chopper, switching mode regulators, Buck, Boost, Buck-Boost, Cuk regulators, current commutated and voltage commutated chopper. 8 Lecture

Unit 4. **DC drives:** Basic characteristics of dc motors operating modes, using controlled rectifiers, chopper controlled dc drives 4**-** Lecture

Unit 5. **A.C. to A.C. Converter:** Classification, principle of operation of step up and step down cyclo-converter, single phase to single phase cyclo-converter with resistive and inductive load, three phase to single phase cyclo-converter, half wave and full wave, cosine wave crossing technique. three phase to three phase cyclo-converter. output voltage equation of cyclo-converter. 8 Lecture

Unit 6. **D.C. to A.C. Converter:** Classification, basic series and improved series inverter, parallel inverter, single phase voltage source inverter, steady state analysis, half bridge and full bridge inverter, modified McMurray and modified Mc Murray Bedford inverter, voltage control in single phase inverters, PWM inverter, reduction of harmonics, current source inverter, three phase bridge inverter. 8 Lecture

Unit 7. **AC Drives:** 1-phase drives and 3-phase drives speed control using invertor and cyclo-converter **2-** Lecture

Suggested Readings:

1. Ned Mohan, Tore M, Power Electronic, Converters, Applications and Design, Undeland and William P. Robbins, John Wiley & Sons
2. M.H. Rashid, Power Electronics: Circuits, devices and applications, PHI.
3. Robert W. Erickson and Dragon Maksimovic, Fundamental of Power Electronics, , Springer International Edition, 2nd ed. 2001.
4. Modern Power Electronics, Evolution, Technology and Applications, Edited by B.K. Bose, Jaico Publishers
5. Joseph Vithayathil, Power Electronics Principles and Applications, Tata McGraw Hill Education, 2010
6. M. Ramamoorthy, An Introduction to Thyristors and their applications, , East-West Press.
7. B W Williams, Power Electronics Devices, Drives and Applications, ELBS publication
8. P S Bhimbhra, Power Electronics, Khanna Publication

EE117 Power Electronics Lab

L-T-P-Cr: 0-0-3-1

Objectives: to observe and analyse the working of different kinds of power electronic circuits, to verify the v-i characteristic of devices being used as switch, application of power electronics in induction motor speed control.

List of experiments

1. Study of V-I characteristics of a given SCR.
2. Application of UJT as a relaxation oscillator
3. Study of half wave gate controlled rectifiers using one SCR
4. Study of half wave SCR controlled Rectifier with R, R-L and R-L-C load
5. Study of full wave SCR controlled Rectifier with R, R-L and R-L-C load
6. Effect of freewheeling-diode (FWD) on SCR convertor performance with inductive load
7. Study of AC voltage controller with lamp load
8. Study of VWF controller
9. Study of V-I characteristics of Triac.
10. Study of SCR based Cycloconverter

Note: minimum ten experiments are required to be performed.

EE118 Power System – I

L-T-P-Cr: 3-1-0-4

Objective: To learn the basic of power system distribution and transmission

Pre-requisite: Elements of Basic Electrical Engineering

Outcome: Student will be able to understand different type of phenomena occurred in Distribution and transmission system

Syllabus:

Unit 1. **Distribution:** Effect of system voltage on transmission efficiency, Single phase AC, 3 phase AC System. Choice of Conductor's Size, choice of voltage, Radial and ring Feeders; Calculation of voltage drop in AC. Radial and ring system. 6 Lecture

Unit 2. **Electrical Design:** Calculation of Inductance of conductor due to internal and external flux, Inductance of Single Phase system; Skin and proximity effects/ G.M.R. of solid conductor: G.M.R. of standard conductor; Mutual G.M.D. Inductance of opposite conductor lines, Inductance of 3-phase lines single circuit and double circuit, symmetrical spacing and unsymmetrical spacing. Inductance of bundled conductor system, Calculation of capacitance of single phase and 3-phase system, symmetrical and unsymmetrical and unsymmetrical spacing, single circuit and double circuit bundled conductor system, effect of earth on capacitance of line. 10 Lecture

Unit 3. **Mechanical Design:** Types of supports cross arms and conductors. Calculation of sag and tension, cases of unequal height of supports. Stringing chart, earth clearance of live conductors, vibration, dampers. Types of insulator, Potential distribution over a string of suspension insulator, Methods of equalizing potential 8 Lecture

Unit 4. **Performance of Lines:** Short medium and long lines, A.B.C.D constants: regulations nominal T and Pi, equivalent T and Pi representation, surge impedance, surge impedance loading of line, universal power circle diagram. Lossless line. Corona, corona loss, line design based on corona 10 Lecture

Unit 5. **Underground cables:** Types, insulating materials, stress in insulation and capacitance inter seath and capacitance grading, P.F. in cables capacitance of 3-core cables. Instantaneous and long time breakdown strength, dielectric losses, Ionization, deterioration, Heat production, Sheath current, Thermal characteristics. 8 Lecture

Suggested Readings:

1. C.L. Wadhwa Electrical Power System
2. I J Nagrath & Kothari, Modern power System , TMH.
3. Stevenson , Elements of power System Analysis, McGraw Hill
4. Soni, Gupta & Bhattnagar A Course in Electrical Power, Dhanpat Rai & Sons
5. A R Bergen & V Vittal, Power System Analysis, Pearson Education

EE119 Power System –II

L-T-P-Cr: 3 - 1 -0-4

Objective- To learn operation of power plant, economy of power system

Pre-requisite-Power System-1

Outcome: Student will be able to understand process of power generation, power flow, behaviour of power system under different fault condition and stability of power system

Syllabus:

Unit 1. **Power Plants:** Hydro power Station: Site selection, Layout, Calculation of available Power, Classification, Salient features, Pumped hydro plants.

Thermal Power Station: Site selection, layout, calculation of coal requirements, cooling water/ tower, efficiency, co-ordination of hydro and thermal power stations. Nuclear power plant **8 Hours**

Unit 2. **Economy of Power System:** Load Curves, Load duration Curves, Diversity Factor, Base and Peak Load Stations, Cost allocation of Power station – Fixed cost, Operating Cost, Two Par Tariff and Evaluation. **4 Hours**

Unit 3. **Load Flow Analysis:** Different types of buses, Power flow equation, Classification buses, Objective of load flow, problem formulation, Formation Y-bus matrix, Calculation of voltage by Gauss and Gauss-Siedel Method, Covergence problem, Flow chart of load flow analysis for all kinds of buses. **8 Hours**

Unit 4. **Symmetrical three phase faults on synchronous machines:** Short Circuit current and reactance of Synchronous machines, Internal Voltage of Loaded Machines under transient conditions. **4 Hours**

Unit 5. **Symmetrical Components:** Synthesis of unsymmetrical phases from their symmetrical components, operators. The Symmetrical components of unsymmetrical phase, phase shift in transformer bank, power in terms of symmetrical components; unsymmetrical series impedances; Sequence impedances and sequence networks; sequence networks of unbalanced generators; Sequence impedance of circuit elements positive and negative sequence networks; Zero sequence network. **6 Hours**

Unit 6. **Unsymmetrical Faults;** Single line to ground fault, line to line fault, double line to ground fault on unloaded generator and power systems, Interpretation of inter guidance sequence networks. **6 Hours**

Unit 7. **Power System Stability:** Steady State power limit of cylindrical rotor and salient pole machines without saturation, Maximum power transmitted to a transmitting network, series capacitor. Transient stability Power Angle curve, Inertia clearance angle, equal swing equation, equal area criterion and its application. **6 Hours**

Suggested Readings:

1. Stevention, Elements of Power System Analysis; 3rd Edition McGraw Hill
2. C.L. Wadhwa, Electrical Power System, Wiley Eastern
3. Nagrath & Kothari, Modern Power System Analysis, Tata McGraw Hill
4. Soni, Gupta and Bhattnagar, A Course of Electrical Power; Dhanpat Rai & Sons
5. P Kundu, Power System Stability and Control, TMH

EE121 Power System Protection

L-T-P-Cr: 3 - 1 -0-4

Objective:

- To introduce the students to various faults and other abnormal operating conditions in various parts of the power system and their impact on power system.
- To understand the characteristics and functions of different relays and their role for power system protection.
- To understand the phenomena of current interruption and the problems associated with circuit interruption by various switchgears.

Prerequisite:

- Knowledge of Generation, Transmission and distribution of electrical Power

- Symmetrical components and fault calculations

Outcome: Student will be able to understand working and application of different type of relay, Circuit breaker and different types of protection scheme

Syllabus:

Unit 1. **Introduction:**Need for protective systems, Nature and causes of faults, Types of faults, Effects of faults, Relay terminology – definitions – and essential qualities of protection, Classification of protective relays, Components of protection system, Classification of Protective Scheme, CTs and PTs and their applications in protection schemes. 4 Lecture

Unit 2. **Relay Construction and Operating Principles** **3** Lecture

Electromechanical relays: Attracted armature relays, Induction relays and Thermal relays.

Unit 3. **Different Protection Schemes** **2+3+2+4=11** Lecture

Over current protection: Directional and Non-directional.

Distance protection: Principle, Impedance, Reactance, MHO, Quadrilateral relays.

Differential relays: Simple differential protection, Percentage or Biased differential protection. Introduction to Static and Numerical relays.

Unit 4. **Transformer and Bus-Zone Protection:** Types of faults on transformers, Percentage differential protection, Causes of false differential currents, Three-phase transformer protection and Differential current protection of bus-zone. 4 Lecture

Unit 5. **Rotating Machinery Protection:** Stator protection (Percentage differential protection, Protection against stator inter-turn faults, stator overheating protection), Rotor protection (Field ground protection, Loss of excitation, Protection against rotor overheating) 4 Lecture

Unit 6. **Feeder protection**: Over current, differential and distance protection of feeders. Choice between impedance, reactance and MHO relays. Elementary idea about carrier-aided and Pilot wire protection of transmission lines. 6 Lecture

Unit 7. **Circuit Breaker- Theory of Circuit Interruption:** Physics of arc phenomena and arc interruption, Restriking voltage, Recovery voltage, RRRV, Resistance switching, Current chopping, Interruption of capacitive current, 4 Hours

Circuit Breakers: Operating Principles and constructional details of different types of circuit breakers – air break, air blast, oil, SF6 and vacuum circuit breakers, comparative merits of different circuit breakers. 6 Hours

Suggested Readings:

1. Paul M Anderson, Power System Protection, Wiely
2. Badri Ram and D N Vishwakarma, Power System Protection and Switchgear, 2nd edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. B. Bhalja, R. P. Maheshwari and N. G. Chothani, Protection and Switchgear, Oxford University Press, New Delhi.
4. Stanley H. Horowitz and Arun G. Phadke, Power System Relaying, 3rd edition, John Wiley and Sons, Ltd.
5. by Y. G. Paithankar and S. R. Bhide, Fundamentals of Power System Protection, Prentice-Hall of lndiaPvt. Ltd, New Delhi.
6. by B. A. Oza, N. K. Nair, R. P. Mehta and V. H. Makwana, Power System Protection and Switchgear, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
7. Sunil S. Rao, Switchgear Protection and Power Systems, 12th edition, Khanna Publishers, New Delhi.

EE122 Power System Protection Lab

L-T-P-Cr: 0-0-3-1

1. Over-Current Relay

To study the operating characteristic of an induction type Over-Current relay.
Determine characteristics of the relay for two plug settings and two time settings for each.

2. Directional Relay

To study the operating characteristic of Directional Over-Current relay.

3. Under-Voltage Relay

To study the operating characteristic of an induction type Under-Voltage relay.
Determine characteristics of the relay for two plug settings and two time settings for each.

4. Percentage biased Differential Relay protecting a Transformer

Determine the operating characteristic of transformer percentage-biased differential relay for at least two bias settings.

5. To study the magnetic inrush current in a transformer.
6. Digital distance relay

Study on distance protection scheme with a Digital Relay

7. Study on CT characteristics and burden calculation.
8. Study on PT characteristics and burden calculation.
9. Study of miniature circuit breaker.

EE123 Microprocessor and Its Application

L-T-P-Cr: 3 - 1 -0-4

Objectives: In depth study of Microprocessor 8085 and 8086 architecture, their Instruction sets, addressing mode and interfacing. Use of assembler directives and programming in assembly language using Assembler MASM/ TASM and C.

Pre requisite: Digital electronics

Outcome: After study of this course it is expected that students will be able to develop interface for real time industrial process and write programmers for different applications, Further it is expected that students will be able to do of their own for higher processors and microcontrollers.

Syllabus:

Unit 1. Introduction to 8085 CPU Architecture, Pin configuration, Addressing Modes Registers, Memory and Memory Addressing Instructions Set. **7** Lecture

Unit 2. Timing Diagram: Instruction Cycle, Execute Cycle, Fetch cycle, Machine Cycle, State, Memory Read Cycle, Memory Write Cycle, I/O Read Cycle, I/O Write Cycle **3** Lecture

Unit 3. Assembly language Programming using Simulators for different arithmetical and logical operations Simple Programming. **4** Lecture Data transfer scheme, Interrupts, 8255, 8253 and 8257 chips, Pin diagram, Control word, Operating modes **5** Lecture

Unit 4. Interfacing of Analog Multiplexer, ADC, DAC Sample & Hold. **3** Lecture

Unit 5. Introduction to 8086 CPU, Architecture, Pin diagram, Operating Modes, BIU & Execution unit, registers. **4** Lecture

Unit 6. Addressing Modes, Interrupts, Typical configuration of 8086 system, Bus Cycle, Instructions, Classification of 8086 instructions, Binary address of 8086 Registers 8 **Lecture**

Unit 7. Programming using MASM/ TASM and C **7** Lecture

Course delivery through Assembler and Integrated development Environment in class room needs to be undertaken for different application programs using assembly language and C.

The Tutor is required to take up a full real-time project and development of hardware requirements interface and software be taken up.

Suggested Readings:-

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085/ 8086 A, Wiley Easter Ltd.
2. B. Ram, Fundamentals of Microprocessors & Microcontrollers, Dhanpat Rai & Sons.
3. D.V. Hall, Microprocessors & Interfacing, TMH
4. B. Ram, Advanced Microprocessor, TMH
5. B. B. Brey ,The Intel Microprocessors Architecture, Programming & Interfacing, PHI
6. Michael Andrews, Programming Microprocessor Interfaces for control & Instrumentation, PHI, Engle Wood Clifs, New Jersey.

EE124 Microprocessor and its Application Lab

L-T-P-Cr: 0-0-3-1

Objectives:

1. To understand Instruction sets of 8085 μP and use them
2. Using microprocessor Kit and 8085/ 8086 simulation Program
3. Manually decoding assembly language program and hex file generation using Assembler
4. Assembler directives and Using MASM/ TASM and 8086/ 8051 simulation Program
5. Running/ testing assembled program on 8085/ 8086 Kit

List of Experiments (Based on 8085 through μP Kit)

1. Addressing Modes for Memory and register data transfer
   - (i) Register addressing: Place a 8 bit data in register A and register B
   - (ii) Immediate mode: load 8 bit data in a register, or 16 bit data in register pair where 8bit data or 16 bit data is next to the instruction
   - (iii) Direct addressing: load accumulator from memory directly
   - (iv) Indirect addressing: copy data from memory to register and register to memory.
2. Arithmetic Operations familiarization
   - (i) Addition of two 8 bit hexadecimal numbers
   - (ii) Addition of two 8 bit decimal numbers
   - (iii) Addition of two 8 bit number, where result may be of 9 bits
   - (iv) Subtraction of two 8 bit hexadecimal numbers
3. Find largest and smallest between two 8 bit numbers

   Find largest and smallest number from a series of N numbers
4. Sort a series of 8 bit numbers in ascending/ descending order

5. Find 2's complement of an 8 bit number

Find 1's complement of a 16 bit number

Find 2's complement of a 16 bit number

6. Addition of two 16 bit numbers where result may be greater than 16 bits and extend the program to add two numbers (each of multi bytes) numbers.
7. Subtraction of two 16 bit numbers where result may be greater than 16 bits and extend the program to add two numbers (each of multi bytes) numbers.
8. Using PPI 8255 I/O ports to control sequence of ON/ OFF of LED'S
9. ALP for interfacing ADC 0809 and find conversion time.
10. ALP for interfacing of DAC 0808 for different wave form generation.
11. ALP for Stepper motor control

List of Experiments (Based on 8086 using Assembler and through μP Kit)

1. Introduction to assembler, simulator and Assembler Directives
2. Sample ALP Structure using dot directives
3. HELLO.ASM - Illustrates DOS programming with simplified segment directives.
4. Addition of two 16bit numbers assumed sum will not generate carry
5. Addition of two multiword (four) each of 16bits operands the result may be have carry hence additional 16bits for carry
6. Find sum of a series of number each of 16bit size result may be of 32bit due to carry at each addition
7. Find largest number from array of string
8. Find the smallest number (16bit) from an array whose length in count
9. copy string word from one location of memory to other location
10. division of 16bit number with 8bit divisor and division of 32bit number with 16 bit divisor,
11. Program to arrange an array in ascending order, length of array is 'count' determined by length directive. The number of the ascending order is replaced by 'ffffh' and numbers in ascending order saved at 'ascend'

Note:

EE125 Microprocessor and Microcontrollers

L-T-P-Cr: 3 – 1 – 0-4

Objectives: In depth study of Microprocessor 8086 and 8051 architecture, their Instruction sets, addressing mode and interfacing. Use of assembler directives and programming in assembly language using Assembler MASM/ TASM and C.

Pre requisite: Digital electronics

Outcome: After study of this course it is expected that students will be able to develop interface for real time industrial process and write programmers for different applications, Further it is expected that students will be able to do of their own for higher processors and microcontrollers.

Syllabus:

Unit 1. Brief introduction to 8085 CPU Architecture, Pin configuration, Addressing Modes Registers, Memory Addressing Instructions Set. 5 Lecture

Unit 2. THE 8086 ARCHITECTURE: Pin diagram of 8086 and description of various signals. Architecture block diagram of 8086 & description of sub-blocks such as EU & BIU & of various registers; Description of address computations & memory segmentation; Program relocation; addressing modes; Instruction formats. 8 Lecture

Unit 3. INSTRUCTION SET OF 8086: Instruction execution timing, Assembler instruction format; Data transfer instructions, Arithmetic instructions, Branch instructions, Looping instructions, NOP & HLT instructions, Flag manipulation instructions, Logical instructions, Shift & Rotate instructions, Directives & Operators, simple example such as copying a block of data, finding maximum from an array of numbers, using look up table technique etc. 10 Lecture

Unit 4. Microcontrollers– Type, processor architecture memory type, hardware features, 8051 Processor architecture 3 Lecture

Unit 5. Addressing modes, 8051 Instruction Set – Data movement Instruction, arithmetic instruction, Logic instruction, Branch group Instruction **9** Lecture

Unit 6. 8051 software and programming memory interfacing and address decoding, programming Input/ Output port/ timer/ ADC/DAC, Serial data communication controller and interrupts controller for different application with respect to instrumentation & control. 10 Lecture

Suggested Readings:

1. Brey , The Intel Microprocessors 8086- Pentium processor, PHI
2. Badri Ram, Advanced Microprocessors and Interfacing, TMH
3. Triekel & Singh, The 8088 & 8086 Microprocessors-Programming, Interfacing, Hardware & Applications: PHI.
4. D. B. Hall , Microprocessor and Interfacing, McGraw Hill
5. M. A. Mazidi & J. G. Mazidi,The 8051 Microcontroller & Embedded System, Pearson Education.

Reference Books:

1. Yu-Chang Liu & Glenn, A Gibson, Microcomputer systems: the 8086/8088 Family: architecture, Programming & Design, PHI.
2. Microsoft MASM Reference Manual – Published by Microsoft Corporation (Soft copy of Document available with MASM Software)
3. Assembler Inside & Out; Harley Hahn Pub. Osborn MgGraw Hill, Burkley USA.
4. Venugopal, 80xx Microprocessor Programming, B P B Publication
5. Ramesh S. Gaonkar, Microprocessor Architecture, Programming & Applications with 8085/ 8086 A, Wiley Eastern Ltd.
6. Programming Microprocessor Interfaces for control & instrumentation; Michael Andrews, Prentice Hall Inc., Engle Wood Clifs, New Jersey.
7. Predko, Programming and Customizing the 8051 Microcontroller, TMH.
8. John B. Peatman, Design with PIC Microcontrollers, Pearson.
9. John Catsoulis, Designing Embedded Hardware, SHROFF PUB. & DISTR. ND.
10. John. B. Pitman Design with Micro-controllers, Mc-Graw Hill

EE126 Microprocessor and Microcontrollers Lab

L-T-P-Cr: 0-0-3-1

Objectives:

1. To understand Instruction sets of 8086 μP and use them
2. Using microprocessor Kit and 8086 simulation Program
3. Manually decoding assembly language program and hex file generation using Assembler
4. Assembler directives and Using MASM/ TASM and 8086/ 8051 simulation Program
5. Running/ testing assembled program on 8086/ 8051 Kit

List of Experiments (Based on 8086 using Assembler and through μP Kit)

1. Introduction to assembler, simulator and Assembler Directives
2. Sample ALP Structure using dot directives
3. HELLO.ASM - Illustrates DOS programming with simplified segment directives.
4. Addition of two 16bit numbers assumed sum will not generate carry
5. Addition of two multiword (four) each of 16bits operands the result may be have carry hence additional 16bits for carry
6. Find sum of a series of number each of 16bit size result may be of 32bit due to carry at each addition
7. Find largest number from array of string
8. Find the smallest number (16bit) from an array whose length in count
9. copy string word from one location of memory to other location
10. Division of 16bit number with 8bit divisor and division of 32bit number with 16 bit divisor,
11. Program to arrange an array in ascending order, length of array is 'count' determined by length directive. The number of the ascending order is replaced by 'ffffh' and numbers in ascending order saved at 'ascend'

List of Experiments (Based on 8051 using Assembler and through μC Kit)

Objectives:

1. To explain Instruction sets of 8081 μC and use them
2. Assembler directives for assembler.
3. Using 8081 simulation Program for writing Assembly language
4. Using 8081 simulation Program for development program using C language
5. Decoding assembly language program and hex file generation using Assembler
6. Running/ testing assembled program on 8051 Kit

List of Experiments

Important Instruction for 8x51/31 ALP:

Important Assembler Directives:

Add two bytes data with different addressing modes and save the result in data memory.

Add two unsigned BCD number 125d and 98d in immediate mode and save the result in data memory after decimal adjustment.

Subtract two bytes with immediate data and save the result in data memory.

Multi byte Addition of data from memory and save the result in data memory.

Multi byte Subtraction of data from memory and save the result in data memory.

(a) Find the largest number from a Series in data memory and save the largest number in data memory.

(b) Find smaller number from series and save at the lowest location in memory

(a) Find sum of a series of HEX data in memory and save the sum (sum may be greater than 8 bits) in memory.

(b) Find sum of a series of bcd data in memory and save the sum (sum may be greater than 8 bits) in memory.

Multiply two eight bits data and save the result in memory.

Divide two eight bits data and save the result in memory.

Convert binary number of 8bits to decimal, save 100th, 10th and 1's decimal digit in memory. Binary number may range from 00H to FFH.

Write a program to toggle all bits of Port1 by output 66H and BBH continually with a time delay in between. Calculate the delay time period with 12MHz clock frequency.

Write a program to create square wave of 50% duty cycle on BIT 2 OF PORT2 (P2.2). Calculate the delay time period with 12MHz clock frequency.

Write a program to a square waveform of 50% duty cycle on P1.4 bit Use TIMER0 to generate the time delay

Write a program input at P1.0 logic low to increment accumulator by 10 till a carry is generated, thereafter call a delay and again wait for such input at P1.0, Design a hardware to input at low at P1.0

Serial Communication and Timer SFR details

Serial Communication Baud Rate and Timer1 Auto Reload Values

Write a subroutine to initialise 8051 serial port to operate in Mode 1 to receive data at Baud rate of 9600 using Timer 1 in Mode 2 i.e. auto reload mode. Data format used is one start bit followed by 8 data bit and a stop bit.

Write a subroutine to initialise 8051 serial port to operate in Mode 1 for transmit data at Baud rate of 9600 using Timer 1 in Mode 2 i.e. auto reload mode. Data format used is one start bit followed by 8 xxxdata bit and a stop bit.

EE151 Utilization of Electrical Energy

L-T-P-Cr: 3 - 0 -0-3

Objective: This subject assumes importance in view of the fact that a engineers has to work in a wide spectrum of activities wherein he has to make collections from alternative schemes from technical and economic considerations; i.e. to plan and design using basic principles and handbooks, to select equipment, processes and components in different situations.

The curriculum has been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements

Prerequisite: Electrical Machines. Elements of Electrical Engineering, Engineering Mechanics.

Outcome: The course provides a concise form of the essential features on utilization aspects of electric energy. Some common aspects like electric heating, welding and electric traction systems have been chosen under the curriculum so as to acquaint the students on the advantages, working principle, various forms, design procedures, etc. of these utilities. The chapter on electrical energy auditing supplements the course.

Syllabus

Unit 1. **Electric Drives**: 5 Lecture

Advantages of electric drives. Characteristics of different mechanical loads. Types of motors used in electric drive. Electric braking and Mechanical braking. Methods of power transfer by direct coupling using devices like belt drive, gears, pulley drives etc.

Specifications of commonly used motors e.g. squirrel cage, slip ring induction motors, AC series motors, FKW motors. Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.

Unit 2. **Illumination:** **9** Lecture

Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light. Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux.

Laws of illumination – simple numerical. Different types of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour lamp, fluorescent lamp, metal halide lamp, neon lamp.

Design of interior lighting, Illumination schemes; indoor and outdoor. Illumination levels

Main requirements of proper lighting; absence of glare, contrast and shadow

General ideas about street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc.

Unit 3. **Electric Heating** **6** Lecture

Advantages of electrical heating, Heating methods:

Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit.

Induction heating; principle of core type and coreless induction furnace

Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace

Dielectric heating, applications in various industrial fields

Simple design problems of resistance heating element

Unit 4. **Electric Welding:** **5** Lecture

Advantages of electric welding and welding methods.

Principles of resistance welding, types – spot, projection seam and butt welding and welding equipment used.

Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method of and their applications. Power supply required. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminium and copper.

Introduction to TIG, MIG Welding

Unit 5. **Heat Ventilation and Air Conditioning (HVAC):** **4** Lecture

Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants. Description of Electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler.

Unit 6. **Electric Traction:** **12** Lecture

Advantages of electric traction, different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves.

Different accessories for track electrification; such as overhead capacitor wire, conductor rail system, current collector-pentagraph.

Factors affecting scheduled speed

Electrical block diagram of an electric locomotive with description of various equipment and accessories, Types of motors used for electric traction. Starting and braking of traction motors, Introduction to EMU and metro railways

Suggested Readings:

1. E O Taylor, Utilization of Electrical Energy, University Press
2. Wadhwa, C. L.; Utilization of Electric Power; New Age Publication
3. Pratab, H.; Modern Electric Traction, Dhanpat Rai & Sons.
4. Cotton.H, Principles of Illumination, Chapman & Hall.

EE152 Electrical Wiring Drawing, Estimation and Costing

L-T-P-Cr: 3 - 0 -0-3

Objective: To learn installation of wiring system and lighting accessories, protective devises uses in Residential and commercial buildings for proper functioning of electrical system

Prerequisite: Basic Electrical Engineering

Outcome: Student will be able to design electrical wiring system

Syllabus:

Unit 1. **Introduction:** Wires, wire Splicing and Termination, Types and Installation of Wiring Systems, Lighting Accessories. Electrical Symbols. 03 Lecture

Unit 2. **Protective Devises:** Introduction, Protective devices used in Residential, Commercial and Industrial buildings for protection of wiring system, Fuse, MCM, MCCB, ELCB/RCCB and other Circuit Breakers. 02 Lecture

Unit 3. **Internal Wiring System:** Design and Drawing of Internal wiring system for various types of Residential, Commercial and Industrial buildings, Electrical layout, Different types of circuits, Light circuit, Power circuit, Sub-main wiring, Main wiring, Single Line diagram. Load Calculation. 08 Lecture **Illumination:** Introduction, Nature of light, Different types of Lamps used in Residential, Commercial and Industrial buildings. Lighting schemes, Methods of Lighting Calculations (Watt per sqm method, Lumen or Light flux method, point to point or Inverse Square Law method). 04 Lecture

Unit 4. **External Wiring System:** Introduction, Different types of Under Ground (UG) Cables, Cable Laying, Electrical Control Panels, Feeder Pillar, External Electrical Distribution System, Single Line Diagram, Load Calculations, General Specifications of Generating Set, Transformer, Circuit Breakers. Street Lighting. 07 Lecture

Unit 5. **Earthing and Lighting Arrestor:** Introduction, Different types of earthing system, Plate earting, Pipe Earthing, Lighting Arrestor. 02 Lecture

Unit 6. **Communication System:** Introduction, Different types of communication system used in Residential and Commercial buildings/areas. Layout of Telephone/ Intercom/ T.V. System. Introduction to LAN (Local Area Networking), Layout, HUB, Switches, Introduction to Server, On-line & Off-line UPS. 04 Lecture

Unit 7. **Estimating and Costing;** Introduction, Estimating and Costing of Internal and External Wiring System (a) based upon actual measurement and prevailing market rate and rate analysis (b) based upon Government Schedule of rates. 12 Lecture

Suggested Reading:

1. M G say, Electrical Engineers Reference Book, George Newnes Limited, Tower House, Southampton street strand, w.c.2
2. Uppal, Electrical Wiring, Estimating and costing, Khanna publishers

EE153 Special Electrical Machine

L-T-P-Cr: 3 - 0 -0-3

Objective: To have the in depth knowledge of special Electrical Machines and their applications

Pre-requisite: Knowledge of Basic Electrical Engineering, Electrical Machine I and Electrical Machine-II

Outcome: Student will be able to understand operation and application and performance of different types of special electrical machines.

Syllabus

Unit 1. **Special Electrical Machines**: Hysteresis motors – constructional features, Principle of operations, Performance, Characteristic and Application. **6** Lecture

Unit 2. **Stepper Motors**: Types constructional feature, Principle of operation & switching operation, Performance, Characteristic & Applications. **6** Lecture

Unit 3. **Universal Motor**: Constructional feature, working principle, Phasor diagram, Performance and Application. **6** Lecture

Unit 4. **Repulsion motor**-Constructional feature, Principle of operation, starting performance and Applications. **6** Lecture

Unit 5. **Double cage induction motor**: Constructional feature, Principle of operation, Equivalent circuits, torque speed characteristics and application. **6** Lecture
Brushless D.C. machines: Constructional feature, Principle of operation, Characteristic & Applications **6** Lecture

Unit 6. **Switched Reluctance motor** : Constructional feature, Principle of operation, Characteristic & Applications **6** Lecture

Suggested Readings:

1. P. S. Bimbra, **Generalized Theory of** Electrical Machines, Khanna Publication

EE154 Electrical Machine Design

L-T-P-Cr: 3 - 0 -0-3

Objective: To learn design of different type of electrical machine

Pre-requisite: DC Machines and Transformers, Synchronous and Induction Machines

Outcome: Students will be able to design different type of electrical machines

Syllabus:

Unit 1. Introduction: Major considerations in Electrical Machine Design-Electrical Engg. Materials-Space factor-Choice of specific Electrical and Magnetic loadings- Thermal considerations – Heat flow –Temperature rise-Rating of machines-Standard specification 6 Lecture

Unit 2. DC Machines: Output Equations- Main dimensions- Magnetic circuit calculations Carter's co-efficient- Net length of iron- Real and apparent flux density –Selection of number of poles-Design of armature-Design of commutator and brushes - Performance prediction using design values. 8 Lecture

Unit 3. Transformer: Output equations-Main dimensions-KVA output for single and three phase transformers-Window space factor Overall dimensions -Operating characteristics-Regulation-No Load current-Temperature rise in transformers- Design of tank-Methods of cooling of transformers 8 Lecture

Unit 4. Induction Motors: Output equation of induction motor –Main dimensions-Length of induction motor- Main dimensions –Length of air gap-Rules for selecting rotor slots of squirrel cage machines-Design of rotor bars and slots- Design of end rings-Design of wound rotor-Magnetic leakage calculations-Leakage reactance of polyphase machines-Magnetizing current- Short circuit current-Circle diagram- Operating characteristics 10 Lecture

Unit 5. Synchronous Machines: Output equations-Choice of loadings –Design of salient pole machines-Short circuit ratio-Shape of pole face-Armature design-Armature parameters-Equation of ear gap length – Design of rotor-Design of damper winding-Determination of full load field MMF-Design of field winding-Design of turbo alternators-Rotor design 10 Lecture

Suggested Readings

1. Sawhney, A.K., "A course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 1996.
2. Albert E. Clayton and Hancock,N.N, "The performance and Design of Direct Current Machines", Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi, 1990
3. Say, M.G., "Alternating Current Machines", ELBS & Pitman, London, 5th edition, 1992.
4. Ion Boldea & Syed A Nasar, Induction Machines Design handbook, CRC Pressf
5. Rai, H.M., "Principles of Electrical Machine Design", Sathyaprakashan , New Delhi, 4th Edition, 1995.
6. Shanmugasundaram A., "Electrical Machine Design Data Book", Wiley Eastern Ltd, 1989.
7. M. Ramamurthy – Computer aided Design of Electrical Equipment, East_West Press Pvt. Ltd. Madras, 1988.

COMPUTER AIDED MACHINE DESIGN LAB

L-T-P-Cr: 0-0-2-0

1. Study of AutoCAD machine
2. Design of D.C. Machine through computer
3. Design of single and three phase transformer through computer
4. Design of single phase Induction motor through computer
5. Design of synchronous machine through computer
6. Study of circuit breaker operation
7. Testing of different types of relays
8. Effect of airgap variation on induction machines performance
9. Electrical machines cross sectional view using AUTOCAD
10. Study of protective equipment & layout of 230/110KV substation
11. Introduction to ANSYS package

EE155 Industrial Drives and Control

L-T-P- Cr: 3 – 0 – 0-3

Objective: To learn basic of DC and AC motor Drive

Pre-requisite: Power Electronics, Electrical Drives

Outcome: Student will be able to understand operation ,application and control of dc and ac motor drive using power electronics devices like diode, thyristor etc

Syllabus:

Unit 1. **Introduction:** Electrical Drives & their Advantages, parts of Electrical Drives, D.C. & A.C. Drives. **3** Lecture

Unit 2. **Dynamics of Electrical Drives:** Torque equations, Multiquadrent Operation, Load torques & their types, Calculation of Time and Energy – loss in transient operation, Steady state stability, load equalization. **5 Lecture**

Unit 3. **Selection of Motor & Its power rating:** types of motors & their enclosures, thermal model of motor for heating & cooling, classes of motor duty, Rate of Motor. **5** Lecture

Unit 4. **Control of Electrical Drives:** Introduction, Modes of operation, speed control & Drive classifications closed loop control of drives, speed & current sensing, manual, semi-automatic & automatic control, magnetic & static control, power circuit & control circuit and their development, inter locking & sequential operation. **15** Lecture

Unit 5. **D.C. Motor Drives:** Performance characteristics of D.C. Motors and their modifications, starting and design of starting circuits, Braking, Speed control, Converter – controlled DC drives, and chopper controlled D.C. drives. **8** Lecture

Unit 6. **Brushless D.C. machines:** Constructional feature, Principle of operation, Characteristic & Applications and open loop and closed loop Control. **6** Lecture

Unit 7. **Induction Motor Drives:** Performance characteristics of three phase induction motors and their modifications. **6** Lecture

Suggested Readings:

1. G. K. Dubey, Fundamentals of Electric Drives, Narosa Publishing House, Second Edition.
2. G.K. Dubey, Power Semiconductor Controlled Drives, PH-New JersyI
3. V. Subrahmaniyam, Electric Drives Concepts and Applications, TMH
4. Ned Mohan, Tore M. Vndeland & William P. Robins Power Electronics: Convertors Application & Design, John Wiley & Sons
5. K. Malarvizhi, Solid State Drives, Scitech Publication Pvt Ltd.
6. S.K. Pillai, A first course in Electric Drives, Wiley Eastern
7. B. K. Bose, Modern Power Electronics and AC Drives, PHI

EE156 Power Plant Engineering

L-T-P-Cr:3-0-0-3

Objective: This subject gives student wide knowledge about different types of generating plants and their operation.

Prerequisite: Electrical Machines. Elements of Electrical Engineering, Engineering Mechanics.

Outcome: Students will get detailed knowledge about different power plants.

Syllabus

Unit 1. **Introduction**: Conventional & Non-Conventional Sources of Energy and their availability in India. Different Types of Power Plants, Choice of Type of Power Generation, Power Plants in India. 5 Lecture

Unit 2. **Thermal Power Generation:** Operating Principle, Site selection, Coal to Electricity, General Layout of Thermal Power Plant, Brief description of different parts/systems and their functions, Advantages and Limitations. **7** Lecture

Unit 3. **HYDRO POWER GENERATION :** Hydrology – Hydrographs, Flow Duration Curve, Mass Curve; Principle of working, Classification, Site selection; Different components & their functions; Types of Dams; Types, Characteristics & Selection of Hydro-Turbines; Specific Speed of Hydro-Turbines; Power Output Equation; Turbine Governing; Draft Tube; Bearings; Water Hammer & Surge Tank, Cavitation, General arrangement and Operation of Hydro-electric Power Plant, Mini & Micro Hydro Power Plants, Pumped Storage Power Plants; Advantages of Hydro-electric Power Plants; Hydro Power in India & future trends. **8** Lecture

Unit 4. **DIESEL & NUCLEAR POWER GENERATION :** Applications **of** Diesel Engine, Advantages & disadvantages ,Types of Diesel Plants, General Layout, Combustion in CI Engines, Performance Characteristics, Supercharging, Layout of a Diesel Engine Power plant, Principle of Nuclear Energy, Nuclear Power Plant Components & their Functions; Nuclear Fuels, Radioactivity, Nuclear Reaction & Classification. **8** Lecture

Unit 5. **GAS POWER GENERATION :** Operating Principle; Classification – Open Cycle, Closed Cycle, Combined Cycle; Fuels for Gas Turbine Power Plants; Different Components and their functions; Gas Turbine Characteristics, Cycle Efficiency, Operational Aspects, Advantages and Limitations. **8** Lecture **ENERGY STORAGE:** Pumped hydro, Compressed Air Energy Storage(CAES), Flywheel energy storage, Electrochemical Energy Storage, Thermal Energy Storage, Magnetic Energy Storage, Chemical Energy Storage, Hydrogen Energy storage. **6** Lecture

Suggested Readings:

1. P. K. Nag, Power Plant Engineering, II Edition, TMH.
2. G. D. Rai, An Introduction to Power Plant Technology, Khanna Publishers
3. Rajput,A Text Book of Power Plant Engineering, Laxmi Publications
4. P. C. Sharma, Power Plant Engineering, Pub S. K. Kataria & Sons
5. Arora and S. Domkundwar. A Course in Power Plant Engineering, Dhanpat Rai, 1988
6. Elanchezhian, Power plant Engg , I.K. International Pub
7. Ramalingam, Power plant Engineering, Scietech Publishers

EE157 Modern Control Theory

L-T-P-Cr: 3 - 0 -0-3

Objective: To learn modern control technique of linear and non-linear system and the recent Advances of control system

Perquisite: Laplace Transforms, Complex Analysis, Differential Equation, Matrix, Linear Control Theory

Outcome: Student will be able to design and analyse control system of linear and non-linear system

Syllabus

Unit 1. **Introduction to Design:** The design problem, preliminary considerations of classical design, realization of basic compensators, cascade compensation in time domain cascade compensation in frequency domain, tuning of PID Controllers

Unit 2. **State Space Techniques:** Concept of state and state variables, various types of state models, state transition matrix and its evaluation, solution of state equations, concepts of controllability and observability, design of control system using pole placement, observer design.

Unit 3. **Sampled Data Systems and Digital Control:** Difference between continuous, discrete and digital signals, sampling theorem, z-transform and inverse z-transformation, applications in the modeling of sampled data control system, signal reconstruction using ZOH and higher order hold circuits, design of digital controllers using bilinear transforms, ZOH equivalence and pole-zero mapping techniques, stability studies for sampled data systems.

Unit 4. **Non-Linear Systems**: Introduction to various types of non-linearities and their transfer characteristics, concept of phase-plane and describing function methods, limit cycle, concept of stability and various methods for study of stability of non-linear systems, Lyapunov's theorem for stability

Unit 5. **Recent Advances in Control Systems:** Advanced topics relevant to control systems theory and practice

Suggested Readings:

1. Li Qiu and Kemin Zhou, Introduction to Feedback Control, Penguin Books Ltd,2010.
2. K. Ogata, Modern Control Engineering, Prentice-Hall, 5th edition,2010.
3. Nagrath & Gopal, Control Systems Engineering, New Age International, 2009.
4. Kuo B.C., Digital Control System, Oxford University Press, 2nd edition, 2012
5. M. Sami Fadali and Antonio Visioli, Digital Control Engineering, Academic Press Inc, 2nd Revised edition, 2012.
6. D' Azzo & Houpis, Linear Control System Analysis & Design, CRC Press,5th edition, 2003.

EE158 Power System Dynamics & Reliability

L-T-P-Cr:3-0-0-3

Objectives:

- To discuss importance of system Dynamics in power system operation and control.
- To present historical development of PSD.
- To Study Transient Energy functions and its applications for on-line detection of loss of Synchronism.
- To study the basic aspects of reliability and
- To study different methods of reliability analysis.

Prerequisite: Power System Analysis, Electrical Machines

Outcome: Student will be able to analyze power system stability for synchronous machine connected in power system.

Syllabus: **(To be detailed)**

Unit 1.	Introduction to power system stability problem, solution of swing equation.	3 Lecture
Unit 2.	Equal area criterion for stability.	2 Lecture
Unit 3.	Dynamic models of synchronous machines.	4 Lecture
Unit 4.	Excitation system and its modeling.	2 Lecture
Unit 5.	Modeling of Turbines, Governors, Loads	5 Lecture
Unit 6.	Modeling and stability study of single machine infinite bus system.	3 Lecture
Unit 7.	Mathematical modeling of multi-machine system.	2 Lecture

Unit 8. Dynamic and transient stability analysis of single machine and multi-machine system. 3 Lecture

Unit 9. Power system stabilizer design. Techniques for the improvement of stability. 2 Lecture

Unit 10. Voltage stability 3 Lecture

Unit 11. Reliability concepts, exponential distributions, meantime to failure, series and parallel system. MARKOV process, recursive technique. Generator system reliability analysis 3 Lecture

Unit 12. Probability models for generators unit and loads, reliability analysis of isolated and interconnected system, generator system cost analysis, corporate model, energy transfer and off peak loading. 3 Lecture

Unit 13. Transmission system reliability model analysis. Introduction to system modes of failure, the loss of load approach, frequency & duration approach 3 Lecture

Suggested Readings:

1. Prabha Kundur, Power system stability and control – TMH
2. P W Sauer, M A Pai – Power System Dynamics and Stability - Prentice Hall
3. Eodrenyi, J., Reliability modelling in Electric Power System John Wiley, 1980
4. P. M. Anderson and A. A. Fouad, Power system control and stability – Galgotia Publications.
5. J Machowski, J W Bialek, J R Bumby, Power System Dynamics (Stability and Control,) Wiley. 1. Sullivan, R.L., Power System Planning, Heber Hill, 1987.
6. Roy Billington, Power System Reliability Evaluation, Gordan & Breach Scain Publishers, 1990.

EE159 Computer Aided Power System Design

L-T-P-Cr:3-0-0-3

Objectives:

- To update the knowledge in the emerging and upcoming topics in power system analysis.
- To make the students conversant with the different software used for computer aided power system analysis i.e., the students should be able to write algorithms and implement computer programs to find out Y-bus matrix, 2) Solve power flow 3) Solve Economic load dispatch problems in power flow studies 4) Unit commitment problem 5) Implement Artificial intelligence (AI) in power system studies

Prerequisite: Power system, Programming Knowledge.

Outcome: After completion of this subject students should be capable of implement programs for different power system operations and analysis techniques.

Syllabus:

Unit 1. **Network Modelling for Power Flow**: System graph, loop, cutest and incidence matrices, y-bus formation, sparsity and optimal ordering, power flow analysis, Newton Raphson method. 6 Lecture

Unit 2. **Power Flow**: Decoupled and fast decoupled method, dc load flow, formulation of AC-DC load flow. 6 Lecture

Unit 3. **Power System Security**: Factors affecting security, State transition diagram, contingency analysis using network sensitivity method. 5 Lecture

Unit 4. **Introduction to optimization** and classical optimization techniques Linear Programming: Standard form, geometry of LPP, Simplex Method pf solving LPP, revised simplex method, duality, decomposition principle, and transportation problem. 6 Lecture

Unit 5. **Non-Linear Problem (NLP):** One dimensional methods, Elimination methods, Interpolation methods. Non-Linear Programming (NLP): Unconstrained optimization techniques-Direct search and Descent methods, constrained optimization techniques, direct and indirect methods.

5 Lecture

Unit 6. **Genetic Algorithm:** Introduction to genetic Algorithm, working principle, coding of variables, fitness function. GA operators; Similarities and differences between GAs and traditional methods; Unconstrained and constrained optimization using GA, real coded GAs, Advanced GAs, global optimization using GA. 6 Lecture

Unit 7. **Applications to Power system:** Economic Load Dispatch in thermal and Hydro-thermal system using GA and classical optimization techniques, Unit commitment problem, reactive power optimization. Optimal power flow, LPP and NLP techniques to optimal flow problems.

6 Lecture

Suggested Readings:

1. D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, Tata McGraw Hill Publishing Co. Ltd.
2. Hadi Saadat, Power System Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.
3. George L. Kusic, Computer Aided Power System Analysis. Prentice Hall of India (P) Ltd., New Delhi.
4. J. Arrilaga, C. P. Arnold, B. J. Harker, Computer Modelling of Electric Power System, John Wiley & Sons.
5. K. Mahailnavis, D. P. Kothari, S. I. Ahson, Computer Aided Power System Analysis & Control, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1988.
6. G. T. Heydt, Computer Analysis Methods for Power Systems, Macmillan Publishing Company.
7. L. P. Singh, Advanced Power System Analysis and Dynamics, New Age International Publishers.

EE160 Power System Design

L-T-P-Cr: 3 - 0 -0-3

Objective-To learn design of transmission line, distribution line and sub station,

Pre-requisite: Power System-I

Outcome: Student will be able to design of ac & dc transmission line, distribution line and sub station

Syllabus:

Unit 1. **Transmission Line Design:** Electrical design of transmission line Design philosophy, voltage level selection and choice of conductors, spacing of conductor and corona, insulators and SIL, design problem. Mechanical design of transmission line: Considerations, loading on conductors, span, sag and tension clearance, stringing, problems. Transmission line tower design: Location of tower, earth wires, reduction of tower footing resistance, design of tower, examples. EHV transmission line design: Considerations, selection, spacing of conductors, corona and radio interference, shunt and series compensation, tuned power lines, insulation coordination and different types of EHV towers, EHV systems in India **8 Lecture**

Unit 2. **AC and DC Low Tension Distribution Design:** Types of distribution systems: arrangements, selection and size of feeders using Kelvin's law, design of cables in distribution systems considering ampere capacity, voltage drop during starting and running load, primary distribution design, secondary distribution design. HV distribution design concept, load balancing Distribution substation,

Calculation of distributor size and its examples, calculation of voltage drops and size of distributor in ring system. Voltage regulation and lamp flicker. 8 Lecture

Unit 3. **Substation Design:** Determination of voltage regulation and losses in power system, shifting of distribution transformer centre, Substation layout, sizes and locations of sub stations, Substation equipments specifications ratings and its operation from design view point, Cathodic Protection, Gas Insulated Substation (GIS). **8 Lecture**

Unit 4. **Power System Earthing – Power Station and Sub Station Earthing:** Objectives, definitions, tolerable limits of body currents, soil resistivity, measurement of soil resistivity, earth resistance, measurement of earth resistance, tolerable step and touch voltage, actual step and touch voltage, design of earthing grid, impulse behaviour of earthing system **6 Lecture**

Unit 5. **HVDC Transmission:** Merits and demerits of HVDC transmission, one line diagram, types of DC link, necessary equipment, operation and control, applications, recent advances, HVDC in India. **6 Lecture**

Unit 6. **Design of Power Station:** Introduction, selection of sizes and location of generating stations, interconnections issues with wind and Solar PV. **6 Lecture**

Suggested Readings:

1. M. V. Deshpande, Electrical Power System Design, TMH publication
2. B. R. Gupta, Electrical Power System Design, S. CHAND
3. Satnam & Gupta, Substation Design, Dhanpat Rai and Co.
4. A. S. Pabla, Electrical Power System Planning, TMH publication

EE161 Microprocessor and Microcontrollers

L-T-P-Cr: 3 – 1 – 0-4

Syllabus: of the Elective Course offered is same as of EE 125 Microprocessor and Microcontrollers, However Lab EE126 will be conducted as Audit course, and credit will not be added for SGPA/ CGPA calculation.

EE162 Microcontroller and its Applications

L-T-P-Cr: 3 - 0 -0-3

Objectives: In depth study of Microcontrollers architecture, their Instruction sets, addressing mode and interfacing. Use of assembler directives and programming in assembly language and C.

Prerequisite: (i) Digital Electronics (ii) Microprocessor

Outcome: Student will be able to apply microcontroller in different types of electrical, electronic and mechanical systems

Syllabus:

Unit 1. Microcontrollers– Introduction to different types of Microcontrollers, Hardware features, architecture and memory type, 2 Lecture

Unit 2. Detailed study of 8051 Processor architecture and Memory organization, External memory Interfacing 6 Lecture

Unit 3. Addressing modes of 8051and Instruction Set – Data movement Instruction, arithmetic instruction, Logic instruction, Branch group Instruction and Bit manipulation Instructions.

10 Lecture

Unit 4. 8051 software and programming memory interfacing and address decoding, programming Input/ Output port/ timer/ ADC/DAC, interrupts controller and Serial data communication controller for different application with respect to instrumentation & control.

10 Lecture

Unit 5. Embedded System Hardware, Embedded system software, Introduction to embedded development tools like cross assembler, simulator, HLL Cross compiler & in circuit emulator for system development 6 Lecture

Unit 6. Discussion on at least on one full project for selection of microcontroller, interfacing hardware circuit software development for real-time application. The project may be divided as assignment to different groups to design hardware, software and prepare documentation.

8 Lecture

Course delivery through Microcontroller Assembler and Integrated development Environment in class room needs to be undertaken for different application programs using assembly language and C.

The Tutor is required to take up a full real-time project and development of hardware requirements interface and software be taken up.

Suggested Readings

1. M. A. Mazidi & J. G. Mazid , The 8051 Microcontroller & Embedded Systemi, Pearson Education
2. V Udayashankara and M. S. Mallikarjunaswamy, 8051 Microcontroller Hardware, software and applications by, TMH Publication
3. M. Senthil Kumar, M Saravanan, J Jeevanthan, Microprocessors and Microcontrollers, Oxford Publication
4. David E. Simon, An Embedded Software Primer, Pearson Education
5. Myke Predko, Programming & Customizing 8051 Microcontroller, TMH
6. John. B. Pitman, Design with Micro-controllers, Mc-GrawHill

EE163 Digital Control Systems

L-T-P-Cr: 3-0-0-3

Objective: To learn digital control technique of linear system and the recent advances of control system

Perquisite: Laplace Transforms, Z transform, Differential Equation, Matrix, Linear Control Theory

Outcome: Student will be able to design and analyse digital control system

Syllabus:

Unit 1. **Introduction** Basic Elements of discrete data control systems, advantages of discrete data control systems, examples. Review of z-Transforms, Applications of z-Transforms to Difference equations and ladder Network problem, Signal between sampling instants using sub multiple sampling method, Modified z- Transforms. 4+2:6 Lecture

Unit 2. **Signal conversion & processing**: Digital signals & coding, data conversion & quantization, sample and hold devices, Mathematical modelling of the sampling process; Data reconstruction and filtering of sampled signals: Zero order hold, first order Hold and polygonal hold.

4+2=6 Lecture

Unit 3. **Transfer functions, Block diagrams, and signal flow graphs**: Introduction, Pulse Transfer function, and z-Transfer function, Discrete Data System with cascaded elements separated by a sampler and not separated by a sampler. Closed loop systems, characteristic equation in discrete domain, causality and physically realizable systems; The Sampled signal flow graph, Modified z-transfer function, Multirate discrete data systems (slow rate and fast rate), closed loop multirate sampled systems. 6+1=7 Lecture

Unit 4. **Comparison of time response of continuous data and discrete data**, Steady state error analysis of digital control systems, correlation between time response and root locations in s-plane and z-plane, Root loci for digital control systems, Effects of adding poles and zeros to open loop transfer function, discrete data systems: Stability tests of discrete data systems: Bilinear transformation method, extension of RH criterion, Jury's Stability Test.

6+1=7 Lecture

Unit 5. **Frequency – Domain Analysis:** Polar plot of GH (z), Nyquist stability criterion, Bode plot, Gain Margin and Phase margin, Nicholas chart, Band width considerations, sensitivity analysis.

3+1=4 Lecture

Unit 6. **Review of state space techniques** to continuous data systems, state equations of discrete data systems with sample and hold devices, state diagrams of digital systems, Decomposition of discrete data transfer function, state variable analysis of response between sampling instants, Controllability, Observability of LTI discrete data systems.

4+1=5 Lecture

Unit 7. **Design of digital control systems** with digital controllers through bilinear transformation. Digital PID controller, Design for dead beat response, pole placement design by incomplete feedback or output feedback. 4+1=5 Lecture

Suggested Readings:

1. Kuo, Digital control systems (Second Edition), Oxford University Press
2. Ogatta Discrete Time control systems, 2nd ed. (PHI)
3. M. Gopal, Digital Control Engineering, (New Age Publ.)
4. Nagrath & Gopal Control System Engineering, (Wiley Eastern)
5. John Dorsey, Continuous & Discrete Control Systems (MGH)

EE164 Advance Control Systems

L-T-P-Cr: 3 - 0 -0-3

Objective: This subject deals with state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

Prerequisite: Laplace Transforms, Complex Analysis, Differential Equation, Matrix, Linear Control Theory

Outcome: Student will be able to design and analyse advance control system

Syllabus:

Unit 1. **STATE SPACE ANALYSIS:** State Space Representation, Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form. 6 Lecture

Unit 2. **CONTROLLABILITY AND OBSERVABILITY:** Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle

of Duality, Controllability and observability form Jordan canonical form and other canonical forms. 4 Lecture

Unit 3. **Non Linear System Analysis:** Introduction, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems. 6 Lecture

Unit 4. **PHASE-PLANE ANALYSIS:** Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems. 7 Lecture

Unit 5. **STABILITY ANALYSIS:** Stability in the sense of Lyapunov., Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems. 6 Lecture

Unit 6. **MODAL CONTROL:** Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer 6 Lecture

Unit 7. **CALCULUS OF VARIATIONS:** Minimization of functionals of single function, Constrained minimization. Minimum principle. Control variable inequality constraints. Control and state variable inequality constraints. Euler Lagrangine Equation. 6 Lecture

Unit 8. **OPTIMAL CONTROL:** Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Output regulator problem. Tracking problem, Continuous-Time Linear Regulators. 6 Lecture

Suggested Readings:

1. M. Gopal, Modern Control System Theory , New Age International Publishers, 2nd edition, 1996
2. Sankar Sastri, Non Linear System Analysis, Dover Publication
3. Stainslaw H. Zak , Systems and Control, Oxford Press, 2003
4. K. Ogata , Modern Control Engineering , Prentice Hall of India, 3rd edition, 1998
5. I. J. Nagarath and M.Gopal, Control Systems Engineering, New Age International (P) Ltd.
6. M. Gopal, Digital Control and State Variable Methods, Tata Mc Graw-Hill Companies, 1997.

EE165 Modern Power System Operation and Control

L-T-P-Cr: 3 - 0 -0-3

Objective:-The Course "Advanced Power System Operation and Control " is introduced to make students familiar with the control and the operation aspects of the power System, Two types of control namely Voltage and frequency control and the methods of enhancing Power Quality and the capability of the power system along with the economic aspects have been incorporated in this course

Prerequisite: Electrical Power System – I, Electrical Machine - 1 Electrical Machine - II

Outcome: Students will be able to understand operation and control of active power, reactive Power and voltage control of power system

Syllabus:

Unit 1. Power flow analysis: formation of Y-bus for n-bus system, solution by Gauss-seidel method, Power flow solution by Newton Raphson method, fast decoupled power flow solution.

Unit 2. Power system economic operation: distribution of loads between units within a plant, Transmission loss as a function of plant generation, Distribution of load between plants, considering

transmission losses, Penalty factor, unit commitment, dynamic programming solution to unit commitment problem.

Unit 3. Power system control: load frequency control of isolated system, speed governing system and its linearized model, generator load model, complete block diagram of load frequency control, steady state analysis, Analysis of integral control, Area Control error, Automatic Generation control of a single area.

Unit 4. Load frequency control of interconnected system: block diagram representation of a two-area system with a load frequency control, Dynamic response, Area control error, tie-line bias control.

Unit 5. Reactive power compensation: objectives of load compensation, p.f. correction, voltage regulation, load balancing. Compensated transmission line – sub synchronous resonance, shunt compensation, series compensation, unified power flow control.

Unit 6. Voltage Control: Method of voltage control, excitation control, shunt compensator and reactors, Tap changing transformers, booster transformer, synchronous condenser.

Suggested Reading:

1. Nagrath & Kothari, Modern Power System Analysis, Tata McGraw Hill.
2. HadiSaadat, Power System Analysis, Tata McGraw Hill.
3. P. Kundur, Power System Stability and Control, Tata McGraw Hill Book Company, New York 1984.
4. O.I. Elgerd, Electric Energy System Theory, Tata Mc. Graw Hill Book Company.

EE166 H.V.D.C. Transmission

L-T-P-Cr: 3-0-0-3

Objective: This subject deals with the importance of HVDC transmission, analysis of HVDC converters, Faults and protections, Harmonics and Filters. It also deals with Reactive power control and Power factor improvements of the system.

Prerequisite: Power System-1, Power Electronics

Outcome: Students will be able to understand operation, components, advantages and disadvantages of HVDC System

Syllabus:

Unit 1. **Basic Concepts:** Comparison of AC and DC Transmission**,** Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission.

Unit 2. **Analysis Of HVDC Converters:** Choice of Converter configuration – analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters – Cases of two 3 phase converters in star –star mode – their performance.

Unit 3. **Converter & HVDC System Control:** Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

Unit 4. **Reactive Power Control In HVDC:** Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies-sources of reactive power-AC Filters – shunt capacitors-synchronous condensers.

Unit 5. **Power Flow Analysis in AC/ DC Systems:** Modelling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – P.U. System for d.c. quantities-solution of AC-DC Power flow-Simultaneous method-Sequential method.

Unit 6. **Converter Fault & Protection:** Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

Unit 7. **Harmonics:** Generation of Harmonics –Characteristics harmonics, calculation of AC Harmonics, Non- Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics

Unit 8. **Filters:** Types of AC filters, Design of Single tuned filters –Design of High pass filters.

Suggested Readings

1. K.R. Padiyar, HVDC Power Transmission Systems: Technology and system Interactions, New Age International (P) Limited, and Publishers.
2. S. Rao, EHVAC and HVDC Transmission Engineering, Practice.
3. Ariandam Ghosh and G Ledwich, Power Quality Enhancement using Custom Power Devices, Penguin Books.
4. J. Arrillaga, HVDC Transmission.
5. E. W. Kimbark, Direct Current Transmission, John Wiley & Sons.
6. E. Uhlmann, Power Transmission by Direct Current – B.S. Publications

EE167 Flexible AC Transmission Systems (FACTS)

L-T-P-Cr: 3 - 0 -0-3

Objective: Good understanding of various kinds of FACTS devices. Understanding of significance and practical application of FACTS.

Prerequisite: Power Electronics, Power System-1

Outcome: Students will be able to understand application of Facts devices to power control

Syllabus

Unit 1. **Introduction:** Opportunities for FACTS, Basic types of facts controllers, brief description &definition of FACTS controllers' **1-lecture**

Unit 2. **Voltage source converters:** basic concepts, **1-lecture**

Unit 3. **Static shunt compensators:** (SVC and STATCON) objectives of shunt compensation, static VAR compensators, Comparison between STATECON & SVC **7-lecture**

Unit 4. **Statics series compensators:** TSSC, TCSC and SSSC, Objective of series compensation, variable impedance type series compensation, variable impedance type series comparators, switching convertor type series comparators **11-lecture**

Unit 5. Static voltage and phase angle regulators: TCVR & TCPAR objectives of voltage and phase angle Regulators, Approaches to thyristor-controlled voltage and phase angle regulators (TCVRS and TCPARS) **9-lecture**

Unit 6. **Combined compensators:** UPFC&IPFC: introduction the UPFC, the IPFC, generalized and multifunctional, FACTS controllers 1**2-lecture**

Suggested Readings:

1. R M Mathur and Rajvib K Verma, Thyristor based FACTS Controllers for Electrical Transmission, Wiley IEEE Press

2. N G Hingorani and L Gyugyi , Understanding FACTS, IEEE Press
3. J Arrillaga, N R Watson and S Chen, Power System Quality Assessment, Wiley India
4. C Sankaran, Power Quality, CRC Press
5. Ariandam Ghosh and G Ledwich, Power Quality Enhancement using Custom Power Devices, Penguin Books.

EE168 PLC and SCADA

L-T-P-Cr: 3 - 0 -0-3

Objectives: Know general PLC issues, To be able to write simple ladder logic programs, Understand the operation of a PLC, Programming of PLCs, Working with SCADA software, Implementation of Distributed Control Scheme, Communications with Master and salves

Prerequisite: Microcontrollers & interfacing, Power system, Power Electronics

Outcome: Students will be able to understand SCADA and PLC System

Syllabus:

Unit 1. **INTRODUCTION TO AUTOMATION:** Brief Description of a Control System, Pneumatic Controller, PID Controller, PLC Controller, History & Need of Industrial Automation, Application of Industrial Automation, Basic Components of Automation, Hardware Classification of Automation 4 Lecture

Unit 2. **GETTING FAMILIAR WITH PLC:** Type of PLC, Hardware & Architecture of PLC, Application and Advantage of PLCs, Sourcing and Sinking concept, Programming Language of a PLC. Introduction to field Device(Input / Output), Data files in PLC Programming, Brief Description of a Logic Gates, Simulator analysis of a PLC Programming, Communication with PLC, Wiring different field device to PLC, Uploading, Downloading & Monitoring programs. Introduction to SFC, Introduction to Instruction List, Introduction to Ladder Logic 8 Lecture

Unit 3. **ADVANCE PROGRAMMING IN PLC:** Introduction to jump and label instruction, Introduction to SBR and JSR instruction, Forcing of I/O, Monitoring/Modifying Data table values, Hands on experience on real time applications, Fault finding/troubleshooting and documentation. Interfacing proximity sensor with PLC, Interfacing with Relay, Control circuit designing with feedback concept. 8 Lecture

Unit 4. **LADDER LOGIC PROGRAMMING:** Comparison b/w Gates, Relay Logic& ladder logic, Description of using Memory bit in a programming, Mathematical Concept ADD, SUB, MUL, DIV and etc. Logical Concept AND, ANI, OR, ORI, EXOR, NOT etc, Special Function, MOV, SET, RST, CMP, INC, DEC, Programming based on Timer and Counter 8 Lecture

Unit 5. **GETTING FAMILIAR WITH SCADA:** Introduction to SCADA Software, Creating new SCADA Project, GUI Designing, Tag Substitutions, Dynamic Process Mimic, Real Time Trend, Historical Trend, How to create Alarms & Event, Recipe Management. 8 Lecture Introduction to graphic Properties like Sizing, Blinking, Filling, Analog Entry, Movement of Objects, Visibility etc., Net DDE Communication, Application of scripts, Communication with PLC. 5 Lecture

Unit 6. **WORKING WITH DIFFERENT SCADA TOOLS:** Introduction to other SCADA, Communication through DDE/OPC/DIRECT driver, various other related properties 3 Lecture

Project work is mandatory after the completion of the training program.

Suggested Readings:

Reference: http://nptel.iitm.ac.in

EE169 SCADA and Energy Management Systems

L-T-P-Cr: 3 - 0 -0-3

Objectives: The course provides an introduction to the role of Computers and Communication in Electrical Power Engineering. Energy Management Systems (EMS) and Supervisory Control and Data Acquisition (SCADA) are strongly linked and associated with each other.

EMS deals with the computer operation, optimization and control of power systems. Power System operation, optimization ad control, which are the studies carried in an EMS are presented in detail.

SCADA deals with the communication protocols and control of power systems using EMS. Open Systems, protocols for power system protection and relaying under IEC6180 will also be covered in this course.

This course provides an introductory course material for power system automation and recent advances in technological aspects of computers and communications in networking.

Prerequisite: Computer Methods in Power System Applications, Computer Applications to Power Systems

Outcome: Energy management and emissions control have become important topics in recent years. An increased awareness of the importance of energy conservation coupled with new international standards and regulations have left many organizations scrambling to find a simple, cost-effective way to monitor and control their energy consumption.

Balancing load and generation is no small feat, particularly in combination with the ever changing constraints of the power grid. Transmission owner/operators and wholesale power market operators, as well as regulated balancing authorities must achieve this feat 24/7 with unparalleled reliability

Syllabus:

Unit 1. **General Theory:** Purpose and necessity, general structure, data acquisition, transmission and monitoring, general power system hierarchical structure, overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels, cables, telephone lines, power line carrier, microwaves, fiber- optical channels and satellites.

Unit 2. **Supervisory and Control Functions:** Data acquisitions, status indications, measured values, energy values, monitoring alarm and event application processing. Control function: ON/OFF control of lines, transformers, capacitors and applications in process industry, valve, opening, closing etc. Regulatory functions: set points and feed-back loops, time tagged data, disturbance data collection and analysis, calculation and report preparation.

Unit 3. **MAN- Machine Communication:** Operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, report and printing facilities.

Unit 4. **Data bases - SCADA, EMS and network data bases:** SCADA system structure - local system, communication system and central system, Configuration- non-redundant single processor, redundant dual processor, multi control centers, system configuration. Performance considerations: real time operation system requirements, modularization of software programming languages.

Unit 5. **Energy Management Center** Functions performed at a centralized management center, production control and load management, economic dispatch, distributed centers and power pool management.

Suggested Readings:

1. Torsten Cegrell, Power System Control Technology, Prentice Hall International, 1986
2. Stuart A. Boyer, SCADA: Supervisory Control And Data Acquisition, The Instrumentation, Systems and Automation Society, 4th edition, 2009.
3. Krishna Kant, Computer-Based Industrial Control, PHI Learning,2nd edition, 2013.

4. Bela G. Liptak, Instrument Engineers Handbook, Volume 3: Process Software and Digital Networks, CRC Press, 4th edition, 2011.
5. Behrouz Forouzan, Data Communications and Networking, McGraw-Hill,5th edition, 2012.
6. **Reference:** http://nptel.iitm.ac.in

EE170 Advance Instrumentation

L-T-P-Cr: 3 - 0 -0-3

Objective: To learn use of transducers for electrical and physical quantity measurement and interfacing

Prerequisite: Electrical Measurement and Instrumentation

Outcome: Student will be able to analyze different waveform ,accuracy and errors in measurement, application of transducer and data acquisition system

Syllabus:

Unit 1. **Analysis of errors in measurement:** Classification of errors, statistical analysis, probability of errors and Limiting errors 2 Lecture

Unit 2. **Analysis of Waveforms:** Wave analysers, Distortion measurement, harmonic analysers and spectrum analyser 3 Lecture

Unit 3. **Special purpose CROs:** Dual trace CRO, dual beam CRO, Storage (analogue and digital) CRO and sampling CRO 2 Lecture

Unit 4. **Electronic counter:** Universal counter, its components, its mode of operations and errors in measurement 2 Lecture

Unit 5. **Transducers:** Classification of transducers, primary sensing elements, displacement transducers, LVDT, digital displacement transducer, photoelectric transducers, piezoelectric transducers, strain gauges, thermoelectric transducers, Hall effect transducer, tachogenerator and synchros 8 Lecture

Unit 6. **Measurement of non-electrical quantities:** Measurements of displacement, velocity, acceleration, force, pressure, flow rate of liquid, level of liquid, temperature, strain, stress and magnetic field. 9 Lecture

Unit 7. **Data acquisition system:** Signal conditioning, excitation system, S/H circuit, multiplexing, telemetry, d.c. telemetry, position telemetry, a.c. telemetry, pulse telemetry, radio telemetry, signal recovery, data processing, display and recording 9 Lecture

Unit 8. **Biomedical measurements:** Sources of bioelectric potentials, electrodes, biochemical transducer selector ocardiogram and electrocardiograph, measurement of blood pressure pacemakers, and X-ray instrumentation. 7 Lecture **Suggested**

Readings:

1. Rajendra Prasad, Electronic Measurements and Instrumentation, Khanna Publisher (2012)
2. W.D. Cooper and A.D. Helfrick, Electronic Instrumentation and Measurement Techniques Prentice Hall of India.
3. L. Cromwell, F.J. Weibell and E.A. Preiffer, Biomedical Instrumentation and Measurement, Prentice Hall of India.

EE171 Process Control

L-T-P-Cr: 3 - 0 -0-3

Objective:

I. To study the basic characteristics of first order and higher order processes.
II. To get adequate knowledge about the characteristics of various controller modes and methods of tuning of controller
III. To study about various complex control schemes.
IV. To study about the construction, characteristics and application of control valves.
V. To study the five selected unit operations and a case study of distillation column control

Prerequisite: Control Systems

Outcome: To provide basic knowledge of controllers, find control elements and the processes.
Syllabus:

Unit 1. **INTRODUCTION:** Need for process control – mathematical model of first order level, pressure and thermal processes – higher order process – interacting and non-interacting systems – continuous and batch processes – self-regulation – servo and regulator operations. 9 Lecture

Unit 2. **CONTROL ACTIONS AND CONTROLLERS:** Basic control actions – characteristics of on-off, proportional, single-speed floating, integral and derivative control modes – P+I, P+D and P+I+D control modes – pneumatic and electronic controllers to realize various control actions. 9 Lecture

Unit 3. **OPTIMUM CONTROLLER SETTINGS:** Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – Tuning –Process reaction curve method – Ziegler Nichols method – Damped oscillation method. 9 Lecture

Unit 4. **MULTILOOP CONTROL:** Feed-forward control – ratio control- cascade control – inferential control – split-range control – introduction to multivariable control – examples from distillation column and boiler systems. 7 Lecture

Unit 5. **FINAL CONTROL ELEMENT:** I/P converter – pneumatic and electric actuators – valve positioner – control valves – characteristics of control valves – inherent and installed characteristics – valve body – commercial valve bodies – control valve sizing – cavitation and flashing – selection criteria. 7 Lecture

Unit 6. **Microprocessors and Microcontroller**s, their applications in process control, Hierarchical system, Control of Fuzzy system 3 Lecture

SUGGESTED READINGS:

1. Stephanopoulis, G, Chemical Process Control, Prentice Hall of India, New Delhi, 1990.
2. Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993.
3. Coughanour and Koppel, Process system Analysis and Control
4. T.A. Lee, G.L. Adams and W.M.G ains, Computer Process Control (Modelling and Optimization)
5. K.J.M. Douglasre , Process Dynamic and Control – Vol-I (Analysis of Dynamic Systems)
6. Pollard A.Process Control, Heinemann educational books, London, 1971.
7. Harriott. P., Process Control, Tata McGraw-Hill Publishing Co., New Delhi, 1991.
8. F.G. Shinskay, Process Control System –
9. Cecil and Smith, Digital Computer Process Control –

EE172 Process Control & Instrumentation

L-T-P-Cr: 3 - 0 -0-3

Objective: Automatic Process Control is being used in almost all the industry verticals today. This introductory course covers basics of process control and the instrumentation used for it. The process control part begins with the introductory concepts, and mathematical modeling and its use for control purposes. Subsequently, the dynamic behavior of chemical processes will be discussed.

This course goes deeper into the design of feedback controllers. A special emphasis will be placed on the controller tuning and stability analysis. Several advanced control systems will also be covered under the process control part.

The instrumentation part will elaborate the valve characteristics along with the working principle, specifications, and design and selection aspects of various measuring sensors. A number of practical process examples will be used to illustrate the control theory.

Prerequisite: process control**,** Electrical Measurement and Instrumentation

Outcome: Students will be able to understand process control and use of instrumentation in process control

Syllabus:

Unit 1. Introduction to Process Control. 4 Lecture

Unit 2. Mathematical Modeling 3 Lecture

a. Development of mathematical models.
b. Modeling considerations for control purposes.

Unit 3. Dynamic Behavior of Chemical Processes 8 Lecture

a. Computer simulation and the linearization of nonlinear systems.
b. Brief of Laplace transforms.
c. Transfer functions and the input output models.
d. Dynamics and analysis of first, second and higher order systems.

Unit 4. Feedback Control Schemes 14 Lecture

a. Concept of feedback control.
b. Dynamics and analysis of feedback-controlled processes.
c. Stability analysis.
d. Controller design.
e. Frequency response analysis and its applications.

Unit 5. Advanced Control Schemes 4 Lecture

a. Feedback control of systems with dead time or inverse response.
b. Control systems with multiple loops.
c. Feed forward and ratio control.

Unit 6. Instrumentation 10 Lecture

a. Final control elements.
b. Measuring devices for flow, temperature, pressure and level.

Suggested Readings:

1. Stephanopoulos, G. "Chemical process control: an introduction to theory and practice," .(1984) Prentice-Hall, New Delhi.
2. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A. (2003). "Process dynamics and control," Wiley, New York.
3. Smith, C.A. and Corripio, A.B. (1997). "Principles and practice of automatic process control," Wiley, New York.
4. Johnson, C.D. (2006). "Process control instrumentation technology," Prentice-Hall, New Delhi.

5. http://nptel.iitm.ac.in

EE173 Performance Specifications & Control System Design

Syllabus: L-T-P-Cr : 3-0-0-3

Objective:

Prerequisite: Control Systems

Outcome: To provide basic knowledge of controllers, find control elements and the processes.

Syllabus

Unit 1. Performance Specifications: Tracking system; natural response, relative stability. Forced response; steady state error, initial and final values. Power-of=time error performance; Type number. Performance indices and optimal system. System sensitivity; effect of changes in parameters, sensitivity to disturbance signals.

Unit 2. Root locus approach: Design of phase lead compensator, phase lag compensator and Lead-lag compensator.

Unit 3. Bode plot approach; Design of phase lead compensator, phase lag compensator and Lead-lag compensator.

Unit 4. PID controller: Root locus approach, frequency response approach.

Unit 5. State space design: state feedback and pole placement, tracking problem, observer design.

Suggested Books:

1. Stefani and others, Design of feedback control system, Oxford.
2. B.S. Manke, Control System Design, Khanna Publishers

Department of Mechanical Engineering

ME101 Engineering Graphics

L-T-P-Cr: 1-0-3-2

1. Practice Set 1: Title – Engineering Lettering & Dimensioning Practice:
2. Practice Set 2: Title – Engineering Curves: Ellipse, Parabola, Hyperbola and Cycloid, Involutes, Archimedean spiral
3. Practice Set 3: Title – Scales: Diagonal Scale, Vernier Scale, Scale of Chord.
4. Practice Set 4: Title – Projection of Points and Straight Lines:
5. Practice Set 5: Title – Projection of Planes and Solids:
6. Practice Set 6: Title – Section of Solids and Surface Development:
7. Practice Set 7: Title – Intersection of Surfaces:
8. Practice Set 8: Title – Orthographic Views
9. Practice Set 9: Title – Isometric Projections & Views
10. Practice Set 10: Title – Elementary Engineering Graphics with AutoCAD.

Suggested Readings:

1. Dhananjay A Jolhe, Engineering Drawing with an Introduction to auto CAD-.TMH
2. K. Venugopal & V. Prabhu Raja, Engineering Drawing – New Age International
3. N. D. Bhatt & V. M. Panchal, Engineering Drawing – Charotar Publishing House Pvt Ltd
1. T. Jeyapoovam, Engineering Drawing & Graphics using AutoCAD, Vikash Pub
2. P. S. Gill, Engineering Drawing (Geometrical Drawing) –
3. Agrawal & Agrawal, Engineering Drawing – TMH

ME102 Workshop Practice

L-T-P-Cr: 0-0-3-1

1. Study of tools used in Black Smithy Shop and making of (i) Eye nail (ii) Ring
2. Study of tools used in Carpentry Shop & making of (i) Half lap joint (ii) Dovetail joint & (iii) File handle.
3. Study of tools used in Fitting Shop and making of (i) Matching gauge (ii) Chipping & filing.
4. Study of different parts of Lathe machine and making of Taper Stud.
5. Study of tools used in Foundry Shop and making of (i) Stuffing gland box (ii) Vee block
6. Welding, Soldering & devices of Electric arc welding.

Suggested Readings:

1. Workshop technology -Hazra Chaudhary
2. Workshop technology- Raghubansi
3. Manual on workshop Practice- Kannaiah
4. Workshop manual- Kannaiah
5. Workshop Practice- Swarn Singh

ME103 Strength of Materials

L-T-P-Cr: 3-1-0-4

Pre-requisite: Basic knowledge of mechanics.

Objective: It provides a complete treatment of the fundamental principles of mechanical behaviour, analysis and performance of deformable solids.

Outcome: Students are able to understand the behaviour of materials under various loading conditions which is fruitful to design a mechanical component.

Module 1: Fundamental concepts of external and internal forces, stress, strain, st vanant's principles. Hook's law, Tension and compression test of Ductile and brittle materials elongation of a bar, principle of superposition, composite bar, statically indeterminate systems, Thermal stresses, Poisson ratio, Elastic Constants & their relations. Lectures 12

Module 2: Torsion of a circular shaft, Power transmission hollow shaft, design of a circular member in torsion, shaft in series and parallel, closed coil helical spring. Lectures 05

Module 3: Two dimensional stress analysis, plane stress, stress components on a general plane at a point, Mohr's circle of stress. Lectures 04

Module 4: Shear force and bending moment diagram of the transverse section of the beam. Stresses due to bending in beams. Shear stress in beams. Shear stress variation in different sections. Lectures 09

Module 5: Deflection of beams, deflection by Double Integration, Macaulay's method, Moment area method and energy method. Lectures 06

Module 6: Stresses in thin cylindrical shell, Elastic strain energy and its application, strain energy of a bar under different kinds of loading, strain energy for various state of stress. Lectures 06

Suggested Readings:

1. Elementary Mechanics of Solid – Singh & Jha.
2. Solid Mechanics – Kazimi.
3. Strength of material – G H Rider.
4. Strength of materials – S. S. Ratan.
5. MOS – Timoshinko & Gere.
6. MOS – Popov.

ME106 Strength of Materials Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. Tensile test of mild steel specimen on universal Testing machine.
2. Compression test of a given specimen on universal Testing machine.
3. Torsion test of given specimen on torsion testing machine.
4. Impact tests (Izod and Charpy tests).
5. Spring test on spring testing machine.
6. Double shear test on U.T.M.

7. Brinell hardness test.
8. Rockwell hardness test.
9. Fatigue test on rotating cantilever type Fatigue Testing Machine.

ME104 Manufacturing Process

L-T-P-Cr: 3-1-0-4

Pre-requisite: NIL

Objective: To know the basic manufacturing processes and fabrication techniques such as metal casting, manufacturing of plastic components, bulk deformation, powder metallurgy and welding.

Outcome: Students are able to assess product design for most suitable manufacturing processes and can apply modern technologies to the manufacture of products and manufacturing strategies in various industries.

Module 1: Casting Processes: Principles of pattern making, allowances in patterns and core boxes, sand mould casting, constituents and properties of moulding sand and their tests, types of sand moulds, method and principles of gating, rise ring, use of cores and chills, cleaning of casting, defects in casting and their remedies, sand mould machines, melting and casting practices relating to cast iron, steel, aluminium and its alloys. Cupola, crucible and electric furnaces, metal mould casting, gravity casting, die casting, centrifugal casting, non-metallic mould casting-shell mould casting. Investment casting, plaster of paris mould casting. Lectures 10

Module 2: Manufacturing of Plastic Components: Types and characteristics of plastics, Future of plastic and its application. Working principles and typical applications of - Injection moulding, compression moulding and extrusion moulding. Welding of plastics. Lectures 05

Module 3: Bulk Deformation Processes: Hot working and cold working of metals, their comparison and limitation, Hot working process, forging, roll forging, rolling piercing, extrusion, cold working processes – rolling, spinning, roll forming, cold heating, swaging, thread rolling, tube and wire drawing, coining, embossing, tube rolling. Lectures 06

Module 4: Powder Metallurgy: Principles, method of producing power, pressing, sintering and finishing operation – applications Lectures 06

Module 5: Welding: Classification of welding processes, Gas welding, oxy-acetylene welding, electric arc welding, TIG and MIG welding, submerged arc welding, resistance welding and atomic - hydrogen welding. New welding techniques - Plasma arc welding, ultrasonic welding, electro-slag welding, electron beam welding, laser beam welding, plastic welding, friction welding, thermit welding, welding of cast iron, aluminium and its alloys, copper and its alloys. Weld defects. Testing of weld destructive & non-destructive tests. Flange cutting. Lectures 10

Module 6: Brazing and Soldering: Soldering process. Brazing process. Comparison of the processes and their application. Lectures 05

Suggested Readings:

1. P.N. Rao, *Manufacturing Technology: Foundry, Forming and Welding*, 3rd Edition, Tata McGraw-Hill Publishing Limited.

2. S. Kalpakjian and S.R. Schmid, *Manufacturing Engineering and Technology*, Pearson Education.
3. A. Ghosh and A.K. Mallik, *Manufacturing Science,* 2nd edition, Affiliated East West Press, New Delhi.

Reference Books:

1. Roy. A. Lindberg, Processes and Materials of Manufacture, 4th edition, Allyn and Bacon.
2. E. Paul DeGarmo, J.T. Black, Ronald A. Kohser, Anderson, Materials and Processes in Manufacturing, 8th edition, Wiley, 1997.

ME105 Manufacturing Process Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. Study of Lathe Machine and Job Preparation on it.
2. Study of Milling Machine and Job Preparation on it.
3. Study of Different Drilling and Grinding Machines.
4. Study of Different Forming Tools and Power Presses.
5. Brazing, Soldering, and Mechanical Joints.
6. Arc welding of Butt joint.
7. Gas welding of Butt joint.
8. Study of different foundry tools and making a green sand mould of half bearing block/casting of bearing block.
9. Study and Job Preparation on CNC machines.

ME107 Thermodynamics

L-T-P-Cr: 3-1-0-4

Pre-requisite: NIL

Objective: To know basic principles of thermal process and cycles.

Outcome: Students will get basic knowledge of fundamental laws of thermodynamics, power plant, engines etc.

Module 1: Basic Concepts: Thermodynamic system and their properties, thermodynamic equilibrium, quasi-static and non-quasi-static process, froth law and temperature equilibrium concepts.
Lectures 06

Module 2**:** Frist law of thermodynamics: Concepts of heat work, first law applied to closed and open system internal energy and enthalpy, flow work, laws perfect gas, specific heat, first low applied to flow and non-flow processer. Lectures 07

Module 3: Second law of thermodynamics: Concepts of heat engine, Refrigerator, kelvin-Plank's and Claussius' statements, and their equivalence, entropy calculation of entropy change for processes,

reversibility, entropy principles, Inequality of Claussius, Available and unavailable energy.
Lectures 08

Module 4: Properties of pure substances: Properties of steam and process with steam. Use of steam tables and Mollier charts. Helmholtz and Gibb's function, Maxwell's relations
Lectures 08

Module 5: Ideal cycles: Air standard cycle, Otto, Diesel, Dual and Brayton cycles, comparison of Otto, Diesel and Dual cycles. Lectures 07

Module 6: Vapour cycles: Carnot and Rankine cycle, regenarative and reheat cycles.
Lectures 06

Suggested Readings:

1. Engineering Thermodynamics – P K Nag, TMH
2. Fundamental of Thermodynamics – Vanwylen, Wiley india
3. Thermodynamics – Cengel, TMH
4. Engineering Thermodynamics – Dugan & Jones, PHI
5. Thermodynamics – Block & Hartley, Pearson
6. Thermal Science and Engineering – D.S Kumar , Katarion & Son,

ME109 Applied Thermodynamics

L-T-P-Cr: 3-1-0-4

Pre-requisite: Thermodynamics

Objectives: In this course thermodynamics used in practice will be presented.

Outcome: This course will enable one to be acquainted with the equipment related to energy conversion e.g. generation of heat power producing devices etc.

Module 1: Basic Concepts, Properties of steam, measurement of dryness fraction, use of steam tables and Mollier chart. Lectures 05

Module 2: Fuels and combustion, combustion equations, fuel analysis, Estimation of air/fuel ratio, Enthalpy of formation, Adiabatic flame temperature. Lectures 06

Module 3: Steam generators, IBR norms, Efficiency improvement, Boiler draught, Boiler trial and operation. Lectures 10

Module 4: Vapour power cycles, binary vapour cycles, reheat and regeneration. Lectures 05

Module 5: Steam engines, missing quantity & compounding of engines, velocity triangle.
Lectures 06

Module 6: Steam turbines, Types, compounding, Design of simple steam turbine, Steam condensers, velocity triangle, vacuum efficiency. Lectures 10

Suggested Readings:

1. Thermal Engineering – D. S. Kumar.

2. Power Plant Engg. - P K Nag, Mcgraw Hill
3. Power Plant Engg. - E. L. Vakil, Mcgraw Hill

ME110 Applied Thermodynamics Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. To find the efficiency of Horizontal steam Engine
2. To evaluate Boiler performance
3. To find the efficiency of Steam turbine
4. To find the efficiency of Steam condenser
5. Performance on steam turbine test rig
6. Flue gas analysis

ME111 Fluid Mechanics And Machinery

L-T-P-Cr: 3-1-0-4

Pre-requisite: NIL
Objective: To understand the mechanics involved in fluid flow and machinery used for obtaining hydraulic power.
Outcome: Students can get knowledge of kinematics and dynamics of different fluid flows, fluid machines and pumps.

Module 1: Properties of fluids, Kinematics of fluid flows: Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, Compressible and incompressible flows, stream function and velocity potential. Lectures 08

Module 2: Dynamics of fluid flow: Eulers equation of motion along a streamline and its integration, Bernoulli's equation and its applications – Pilot tube, orifice meter, Venturimeter, momentum equation and its application to pipe bends. Lectures 08

Module 3: Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham's π-theorem, important dimensionless numbers and their significance, geometric kinematic and dynamic similarity, model studies. Lectures 06

Module 4: Laminar and Turbulent flow: Equation of motion for laminar flow through pipes, Stoke's law, Transition from laminar to turbulent flow, types of turbulent flow. Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation. Lectures 08

Module 5: Classification of Fluid machines, Euler's fundamental equation, Hydraulic turbines – Pelton wheel, Frances Turbine, Kaplan Turbine - Constructional details, Velocity triangles, Power and efficiency Calculations, Degree of reaction and Draft tube used in reaction turbines, cavitation. Lectures 06

Module 6: Pumps: Centrifugal pumps - Classification of centrifugal pumps, Vector diagram, work done by impeller, Efficiency of centrifugal pump, specific speed. Reciprocating pumps – Theory, slip and coefficient of discharge indicator diagrams, work saved by fitting air vessels. Lectures 06

Suggested Readings:

1. Introduction to Fluid Mechanics & Fluid Machines - S. K Som and G Biswas.

2. Hydraulics & Fluid Machines - P. N. Modi & S. H Seth.
3. A Text Book of Hydraulic Machines - R. K. Rajput.
4. A Text Book of Fluid Mechanics and Hydraulic Machines – R. K. Bansal

ME112 Fluid Mechanics And Machinery Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. To calibrate the Venturimeter
2. To find out the forces induced by water jet on flat plate and curved plate
3. To plot the characteristic curves of Francis turbine
4. To plot the characteristic curves of Pelton wheel
5. To plot the characteristic curves of Centrifugal pump
6. To plot the characteristic curves of Reciprocating pump
7. Verification of Bernoullies equation
8. To determine the friction loss in Pipe
9. To find C_c , C_v and C_d

ME113 Kinematics of Machinery

L-T-P-Cr: 3-1-0-4

Pre-requisite: Basic concepts of mechanics.
Objective: To understand the kinematics of mechanisms and machines.
Outcome: Students are able to understand about the various mechanisms and their inversions, working of gears, gear trains, governors and cams.

Module 1: Basic Kinematic Concepts: Link, Pair, Chain, Mechanisms, Inversions. Lectures 06

Module 2: Velocity and Acceleration in Mechanisms: Relative velocity method and instantaneous centre method, Velocity and Acceleration diagrams, Coriolis component of acceleration. Lectures 08

Module 3: Mechanisms with Lower pairs: Pantograph, Straight line mechanisms, Steering gear mechanism, Davis steering gear, Ackerman steering gear, Universal Joint. Lectures 07

Module 4: Gears: Classification, basic terminology, fundamental law of gearing, profile of gear – involute and cycloidal, arc of contact and path of contact of involute gears, minimum number of teeth to avoid interference. Gear trains – simple, compound and epi-cyclic. Lectures 07

Module 5: Governors: Watt, Porter, Proel and Hartnell governors, performance parameters, effort and power, controlling force, coefficient of Insensitiveness. Lectures 07

Module 6: Cams: Classification of cams and followers, different motions of the follower. Cam profiles for radial and offset followers, cams with specified contours - tangent cam with reciprocating roller follower, circular arc cam with flat faced follower. Lectures 07

Suggested Readings:

1. T. Bevan, *The Theory of machines,* Pearson Education, India, 1948
2. S.S. Rattan, *Theory of Machines,* TMH, New Delhi, 2nd edition
3. R.S. Khurmi and J.K. Gupta, *Theory of Machines,* EPH, New Delhi, 13th ed.
4. S. Singh, *Theory of Machines*, Pearson Education, Singapore, 2nd edition

ME115 Dynamics Of Machinery

L-T-P-Cr: 3-1-0-4

Pre-requisite: Elementary Knowledge of Engineering Mechanics

Objective: To understand the dynamics of various mechanisms and machines.

Outcome: One is able to know about the dynamic force analysis on mechanisms and machines, various methods of balancing of revolving and reciprocating parts in locomotives, effects of gyroscopic couple and some transmission devices such as belt drive, clutches, brakes etc. Mechanical vibration is a very interesting topic and student can understand the importance of vibration in mechanical engineering.

Module 1: Force Analysis: Dynamic analysis of slider-crank mechanism, Engine force analysis, dynamically equivalent two-mass system, Turning moment diagrams for single cylinder double acting steam engine and single cylinder four stroke engine, Fluctuation of energy, Flywheels.

Lectures 06

Module 2: Balancing of Revolving masses: Static and dynamic balancing, Transference of a force from one plane to another, Balancing of several masses revolving in the same plane and different planes.

Lectures 05

Module 3: Balancing of Reciprocating masses: Primary and secondary unbalance in reciprocating engine mechanism, partial balancing of locomotives. Effects of partial balancing in two cylinder locomotives, balancing of multi-cylinder in-line, radial and V- type engines, direct and reverse cranks methods. Lectures 10

Module 3: Gyroscope: Principles of gyroscope, gyroscopic couple, effects of gyroscopic couple upon the stability of naval ships, aeroplanes and, two wheeled and four wheeled vehicles.

Lectures 04

Module 4: Friction Devices: Belt drive, plate and cone clutches, shoe brakes, band and block brakes, Antifriction bearings-ball and roller bearings. Lectures 07

Module 6: Mechanical vibrations: Basic concepts of degree of freedom, free undamped and damped vibrations of single degree of freedom systems, force vibration with viscous damping, rotating and reciprocating unbalance, vibration isolation and transmissibility, whirling of shaft, free torsional vibrations of single rotor, two rotor and three rotor systems, Torsionally equivalent shaft.

Lectures 10

Suggested Readings:

1. T. Bevan, *The Theory of machines,* Pearson Education, India, 1948
2. S.S. Rattan, *Theory of Machines,* TMH, New Delhi, 2nd edition
3. R.S. Khurmi and J.K. Gupta, *Theory of Machines,* EPH, New Delhi, 13th ed.
4. W.T. Thompson, *Theory of Vibration with applications,* Prentice-Hall, Inc., 5th edition, 1998

ME116 Dynamics Of Machinery Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. Analysis of pressure distribution in hydrodynamic lubrication of journal bearing.
2. Motion analysis of different CAM and follower pairs.
3. Static and dynamic balancing of revolving masses.

4. Free and forced vibration of single and two degree of freedom systems.
5. Analysis of Gyroscope effects.
6. Determination of critical speed of whirling of shafts.

ME117 Heat Transfer

L-T-P-Cr: 3-1-0-4

Pre-requisite: Elementary knowledge of Thermodynamics and Fluid Mechanics.

Objective: Familiarize students the concepts of conduction and radiation, heat transfer, the use of empirical correlations for forced and free convection, to evaluate radiation view factors.

Outcome: Students are able to understand basic heat transfer problem, formulations and their solution techniques.

Module 1: Introduction: Basic concepts and modes of heat transfer. Lectures 03

Module 2: Conduction: General three dimensional Heat conduction equations in Cartesian, cylindrical and spherical co-ordinates, One dimensional steady state conduction through composite walls, cylinders and spheres, critical radius of insulation, Extended surfaces of uniform cross section, fin efficiency and effectiveness. Lectures 12

Module 3: Transient Conduction: One dimensional transient conduction, Lumped system analysis, use of heisler chart. Lectures 06

Module 4: Convection: Boundary layers, Basic equations, Forced Convection - External and internal flows, correlations Natural convection, Applications of Dimensional analysis.
Lectures 10

Module 5: Heat Exchangers: Types, LMTD, Effectiveness, NTU, single and multi-pass, Heat Pipe.
Lectures 05

Module 6: Radiation Heat Transfer: Fundamental Concepts, Basic laws, Properties of Surfaces, View factors, radiation shields. Lectures 06

Suggested Readings:

1. Heat and Mass Transfer – Cengel.
2. Heat and Mass Transfer – P. K. Nag.
3. Heat and Mass Transfer Data Book – C. P. Kothandaraman.
4. Heat and Mass Transfer - Incorpera dewit.
5. Heat Transfer - J. P. Halman.
6. Heat and Mass Transfer - Rathore.
7. Heat Transfer - Bejan.
8. Heat Transfer - S P Sukhatme.

ME118 Heat Transfer Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. Heat transfer from Pin Fin
2. Natural Convection from a vertical rod
3. Heat Transfer in a Concentric tube Heat Exchanger

4. Performance of a Heat Pipe
5. Temperature measurement with the help of an Optical Pyrometer
6. Unsteady heat transfer (Lumped system analysis)
7. Measurement of Emissivity of a surface
8. Thermal conductivity of insulating powder

ME119 Machine Design - I

L-T-P-Cr: 2-1-3-4

Pre-requisite: Strength of Materials.

Objective: To Learn fundamentals of machine design methodology and mathematical calculations to design basic mechanical loading elements and various joints connecting them.

Outcome: Students can understand the design procedure along with various failure theories which govern designing of machine elements. They are also able to design simple loading structures, joints, and springs under both static and dynamic loading.

Module 1: Introduction: design process, design consideration, standards and codes, factor of safety. Materials: engineering materials, stress-strain diagram, properties of iron, aluminium, copper and their alloy. Static failure: static strength, stress concentration, failure theories, introduction to fracture mechanics. Fatigue failure: variable stress, endurance limit and fatigue strength, endurance limit modifying factors, stress concentration and notch sensitivity, combined variable and steady load. Lectures 08

Module 2: Beam: combined normal and shear stress, deflection. Column and strut: short, intermediate, and long compression members, slenderness ratio, buckling under different end constraint, eccentric loading. Shaft: stresses in shaft, combined stresses, critical speed. Lectures 06

Module 3: Springs: types of springs, specification and end connections of helical springs, stresses, deflection and energy storage in helical springs, buckling of compression spring, fatigue loading consideration in helical spring design, design of helical torsional springs, design of leaf spring. Lectures 07

Module 4: Riveted joints: riveting method, types of riveted head and joints, strength of riveted joints, boiler joints, structural joints. Welded joints: welding process and methods, types of welded joints, stresses due to axial, torsional, and bending load, strength of welded joints, fatigue loading. Lectures 08

Module 5: Screwed joints: threads standard and definitions, types of threaded fasteners, stresses in threads, preloading in fasteners, eccentric loading, fatigue loading. Keys: type of keys, design of sunk key. Lectures 06

Module 6: Coupling: types of rigid and flexible coupling, design of sleeve coupling, design of bushed-pin flexible coupling. Cotter and knuckle joints: types of cotter joints, design of socket and spigot joint, design of knuckle joint. Assembly: stresses in press and shrink fit. Lectures 07

Suggested Readings:

1. V. B. Bhandari. Design of machine element. Tata McGraw-Hill.
2. J. Keith Nisbett, Richard G. Budynas , Shigley's Mechanical Engineering Design. Tata McGraw-Hill.
3. R. S. Khurmi, J. K. Gupta. A textbook of machine design. Eurasia Publishing House (Pvt.) Ltd.

4. Robert L. Norton. Machine design: an integrated approach. Pearson Education.
5. Design data book. P.S.G. College Technology.

ME120 Mechanical Engineering Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. To determine the BHP, Brake specific fuel consumption and Brake Thermal Efficiency of the Ruston oil Engine.
2. To determine the Sp. Fuel consumption, IHP,BHP, Mech. Efficiency and Brake Thermal efficiency under varying load and to draw the performance curves and Heat Balancing Sheet by Morse Test and also to find IHP for individual cylinder.
3. To study the working of a 4-Stroke 10 H.P. single cylinder, Horizontal Diesel Engine and to draw the Heat Balance Sheet.
4. To study the Valve mechanism of I.C. Engine and to draw Valve timing diagram of a four cylinder vertical Petrol engine and a single cylinder vertical Diesel engine.
5. To study Heat Transfer from a Pin-Fin Apparatus.
6. To determine the Heat Transfer Coefficient in Unsteady Heat Transfer.
7. To determine the Surface Heat Transfer Coefficient for a Vertical cylinder losing heat by Natural Convection.
8. To determine the flame emissivity and the flame temperature using Optical Pyrometer.
9. To determine the Overall Heat Transfer Coefficient for a Tube-in-tube Heat Exchanger.
10. To determine the COP of the Hilton Thermo-electric Heat Pump.
11. Analysis of Pressure distribution in Hydrodynamic lubrication of Journal Bearing.
12. Motion analysis of different CAM and Follower pairs.
13. To study forced vibration of an equivalent spring-mass system.
14. To study the torsional vibration (undamped) of single motor shaft system.
15. To determine the Coefficient of discharge of water using Venturimeter and to perform Calibration test by using ideal Venturimeter.
16. Calibration test of Pressure gage using Bourdon-tube pressure gage.
17. To find out the Stiffness of the metal piece by Impact Testing Machine.
18. Torsion test on metals and pipes.
19. Brinell's Hardness Test on metal piece.
20. Vicker's Hardness Test on metal piece.
21. Tension test and Compression test on metal piece by using Universal Testing Machine.

Note: Out of 21 experiments, at least 14 experiments should be performed and report should be submitted.

ME121 Internal Combustion Engines

L-T-P-Cr: 3-1-0-4

Pre-requisite: Basic thermodynamics, Thermal engineering, Conservation of energy, Conservation of momentum, basics of Heat transfer, Air standards cycle, Power cycle.

Objective: The course provides detailed understanding of internal combustion engines and the factors responsible for the design/ performance.

Outcomes: Fundamental understanding of internal combustion engines and its operation, engine design and performance, operating parameters, combustion cycles, comparison between spark ignition and compression ignition engines, thermodynamic analysis of spark ignition engines, different types of diesel combustion systems, engine tribology, lubrication systems and lubricant requirements, tail pipe emissions, after-treatment devices and awareness of new/upcoming engine technologies.

Module 1: Classification of IC engines, analysis of engine cycles, two stroke and four stroke engines – petrol and diesel engines. Construction details. Valve Timing diagram. Engine performance parameters, Engine brake torque and power, Indicated power, P-V diagram, Mean effective pressure, Specific fuel consumption, Air/fuel ratio, volumetric efficiency, pumping loss.

Lectures 06

Module 2: Carburation: Simple carburetor, Air-fuel mixture requirements –essential parts Of modern carburetor. Types of carburetor. Fuel injection systems – classification, fuel injection pump – nozzle, MPFI, firing order – ignition timing and spark advance. Fuels – important qualities of fuels – rating of fuels. Combustion in SI engine – flame propagation – factors influencing combustion – knock ion SI engines, Design of combustion chambers of SI and CI engines.

Lectures 08

Module 3: Lubrication: lubrication systems, types, properties of lubricants, additives for lubricants, Heat rejection and cooling – Theory of engine heat transfer, Types of cooling systems – Air and liquid systems. Lectures 07

Module 4: Testing of IC engines: Dynamometers, Fuel and Air consumption measurements. Exhaust and coolant temperature, Emission and Noise. Causes for emission and its control – Engine power – engine efficiencies – performance characteristics – variables affecting performance characteristics, Heat balance. Lectures 07

Module 5: Exhaust emissions from IC engines, Mechanism of formation of unbound hydrocarbon, carbon monoxide, oxides of nitrogen, concept of exhaust recirculation. After treatment devices: catalytic converters. Lectures 06

Module 6: Pollution due to emissions from IC engines and Alternative Fuels, Alternate Fuels – Alcohols, CNG, Bio-diesel, Relative Merits and Demerits of these Fuels. Supercharging of IC engines. Lectures 08

Text/Reference Books:

1. Engineering Fundamentals of the Internal Combustion Engine by Willard W. Pulkrabek Prentice Hall, 1st edition, 1997.
2. Internal Combustion Engine Fundamentals by John B. Heywood McGraw-Hill Higher Education, 1988.
3. Internal Combustion Engines: Applied Thermo sciences", by Colin R. Ferguson and Allan T. Kirkpatrick, Second Edition, John Wiley & Sons, 2001

4. The Internal Combustion Engine in Theory and Practice", by Charles F. Taylor, Second Edition, the M.I.T. Press, 1994
5. Ganesan. V., 'Internal Combustion Engines', Tata Mc Graw Hill, New Delhi, 1998.
6. Colin, Ferguson. R., 'Internal Combustion Engines', John Wiley and Sons, 1989. Karunya University.
7. Edward. F. Obert., 'Internal Combustion Engines', Inter-Science Publishers, 1971.

Internal Combustion Engines – Mathur and Sharma, Dhanpat Rai and Sons.

ME122 Internal Combustion Engine Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. Valve timing diagram of a four stroke engine, Port timing diagram of a two-stroke engine.
2. Performance test on a multi-cylinder diesel engine fitted with hydraulic/electric dynamometer.
3. Friction power of diesel engine by Willan's line or fuel rate extrapolation method.
4. Mechanical efficiency using Retardation test.
5. Heat balance test on multi cylinder diesel engine.
6. Variable speed performance test of a multi-cylinder /single-cylinder petrol engine / diesel engine and prepare the curve (i) BP, FP Vs Speed (ii) Volumetric efficiency & indicated specific fuel consumption vs. Speed.
7. Effect of A/F ratio on the performance of Diesel/ Petrol Engine.
8. Indicated horse power (IHP) on multi-cylinder diesel engine / petrol engine by Morse test.
9. Performance characteristics of a multi-cylinder petrol engine – Morse test.
10. Measurement of exhaust emissions from SI engines (CO, CO_2, HC and NOx).

ME123 Machine Design - II

L-T-P-Cr: 2-1-3-4

Pre-requisite: Strength of Materials and Machine Design-I.
Objective: To learn mathematical calculations and design methodology of fundamental mechanical elements which are components of different machines.
Outcome: Students are able to design basic mechanical elements including various practical considerations. They also understand design procedure of a principle machine – I.C. engine.

Module 1: Clutches and brakes: types of clutches and breaks, design of clutches under uniform wear and uniform pressure condition, centrifugal clutch, shoe brakes, internal expanding brakes, band type brakes, disk brakes, thermal and energy consideration. . Lectures 07

Module 2: Gears: types of gear, nomenclature of spur and helical gear, law of gearing, gear train, interference and undercutting, force analysis of spur and helical gear, Lewis bending equation, design factors consideration for spur and helical gears, gear tooth failure. Lectures 07

Module 3: Sliding contact bearing: types of sliding bearing, properties of lubricants, types of lubrication, viscosity, Petroff's equation, hydrodynamic theory, thin and thick film lubrication, design consideration of sliding contact bearing, bearing load, description of thrust bearing. Lectures 07

Module 4: Rolling contact bearing: Types of rolling contact bearing, bearing load-life relationship, combined radial and thrust loading, variable loading, selection of ball and radial bearing, lubrication of ball and roller bearing. Lectures 07

Module 5: Flywheel: solid disk and rimmed flywheel, fluctuation of energy, torque analysis, stresses in rimmed flywheel. Belt drive: types of belt drive, belt construction and geometric relationship, analysis of belt tension, condition of maximum power. Lectures 07

Module 6: IC engine: principle parts of IC engine, design of cylinder, design of piston, design of connecting rod, design of crank shaft, valve gear mechanism, and design of valves. Lectures 07

Text / Reference Books:

1. V. B. Bhandari. Design of machine element. Tata McGraw-Hill.
2. J. Keith Nisbett, Richard G. Budynas. Shigley's Mechanical Engineering Design. Tata McGraw-Hill.
3. R. S. Khurmi, J. K. Gupta. A textbook of machine design. Eurasia Publishing House (Pvt.) Ltd.
4. Robert L. Norton. Machine design: an integrated approach. Pearson Education.
5. Design data book. P.S.G. College Technology.
6. V. Ganesan. Internal combustion engines. Tata McGraw-Hill.

ME125 Machine Tools And Machining

L-T-P-Cr: 3-1-0-4

Pre-requisites: Basic knowledge of primary shaping processes properties of different material and mechanics of deformation.

Objective: This Course is core subject for mechanical as well as Production Engineering students which will give the knowledge of various machine tools as well as various machining processes .The modules 5 and 6 shall deals with the metrology and jigs & fixtures.

Outcome: Students are able to know the mechanics of metals cuttings and different machining processes of manufacturing science and thus they can do the job in manufacturing sectors**.**

Module 1: Metal Cutting: Introduction to machine tools and machining operations. Mechanics of metal machining. Cutting forces, friction, Mechanics of chip formation, types of chips, tool angles, shear angle, Merchant's force circle diagram. Cutting fluids & lubricants. Tool wear and tool life. Temperatures and heat transfer and its Measurement, tool life and tool wear aspects. Theoretical models of shear angle solution, Basic concepts of cost and economics of metal cutting operations, Tool nomenclature, chip control and design for machining. Lectures 10

Module 2: Machine Tools: Lathe, principle, types, operations, turret/capstan, semi/automatic, tool layout, Shaper, slotter, planer, operation, drive, Milling, Milling Cutter, up and down milling, dividing head indexing, Max chip thickness, and power required. Lectures 08

Module 3: Drilling and finishing: Drilling and boring, drilling, boring, reaming tools, Geometry of twist drill. Grinding, grinding wheel, abrasive, cutting action, grinding wheel specification, grinding wheel wear, alterations, wear, fracture wear, dressing and trimming. Max chip thickness and guest criteria. Flat and cylindrical grinding. Centre-less grinding, super finishing, honing, lapping, and polishing. Lectures 06

Module 4: Computer Controlled manufacturing process: NC, CNC, DNC, part programming, Introduction to computer aided manufacturing, Flexible manufacturing processes and robotics. Introduction to modern machining processes. Lectures 08

Module 5: Metrology: Tolerance and limit systems, limit gauges, Measurement of surface roughness, Inspection of gears and screw threads. Lectures 06

Module 6: Jigs and Fixtures: Locating Elements, clamping devices, principles of jigs and fixtures design. Lectures 04

Text/Reference Books:

1. Amitabh Ghose & Asok Kumar mallik ,*Manufacturing Science*, East West Publication
2. P.N. Rao ,*Manufacturing Technology*, TMH
3. R.K. Jain, *Production Technology*, Khanna Publisher
4. Serope Kalpakjian & Steven R. Schmid, *Manufacturing Engineering & Technology*, Pearson Publisher.

ME126 Machine Tools And Machining Lab.

L-T-P-Cr: 0-0-3-1

LIST OF EXPERIMENTS:

1. Study of Lathes, their classification and working processes.
2. Study of CNC and NC machines and it working processes.
3. Study of cutting tools e.g. (a) Drilling (b)Milling (c) Turning (d) Grinding (e) Broaching tools.
4. Fabrication of shaft for bicycle.
5. Fabrication of a gear.
6. Fabrication of splined hub.
7. Study of Grinding machine and its working processes.
8. Study of Broaching machine and its working processes.
9. Study of different jigs and fixtures.

ME141 Computer Aided Design And Computer Aided Manufacturing (Cad/Cam)

L-T-P-Cr: 3-0-0-3

Pre-requisite: Basic knowledge of Computer

Objective: The syllabus is intended to provide a comprehensive survey of the technical topics related to CAD/CAM. These topics include interactive computer graphics and CAD, numerical control, computer numerical control, direct numerical control, computer process control and flexible manufacturing system.

Outcome: Students are able to understand the fundamentals of CAD/CAM and Automation.

Module 1: Introduction: CAD/CAM Defined, Product Cycle and CAD/CAM, Automation and CAD/CAM, Computer Technology. Lectures 07

Module 2: Basic Concepts: Design Process, Application of Computer for Design, Hardware and Software requirement of CAD, Benefits of CAD, Engineering Application of CAD, Hardware in CAD. Lectures 07

Module 3: Finite Element Method: Introduction to Finite Elements Method, General descriptions, Concept of FEM - discretization and interpolation function, steps on finite element analysis procedure, Introduction to Auto CAD. Lectures 07

Module 4: Conventional Numerical Control: Introduction, Basic components of NC system, NC procedure, NC Coordinate System, NC Motion Control Systems, Punched Tape, Tape Coding and Format. Lectures 07

Module 5: NC Part Programming & Computer Control in NC: Manual Part Programming, Computer assisted Part Programming, APT Language, Computer Control System, Direct Numerical Control. Lectures 07

Module 6: Flexible Manufacturing Systems: Introduction, Different FMS Levels, FMS implementation, Automated Guided Vehicle Systems, AGVS Controller Structure, AGVS Classification, Applications Lectures 07

Suggested Readings

1. CAD/CAM by M. Groover & E. Zimmers ; Pearson.
2. CAD/CAM by Chirs McMoha; Pearson.
3. CAD/CAM – Theory and Practise by Ibrahim Zeid; TMH.
4. CAD/CAM – Principles and Applications by P. N. Rao; TMH.

ME142 Advanced Strength of Materials

L-T-P-Cr: 3-0-0-3

Pre-requisite: Strength of Materials.

Objective: To provide the complete formulation of stress in different mechanical parts which are used in actual design such as pressure vessels, turbine disc, crane hook etc.

Outcome: After studying this course, students are able to analyse the complex problems of theory of elasticity/plasticity and can design the complex mechanical components.

Module 1: Theory of elasticity: The state stress at a point, stress tenson, Stress components on an Arbitary plane, Principal stresses, stress invariants, Octahedral stresses. The state of strain at a point. Plane strain, strain Rossetts. Lectures 08

Module 2: Energy method, strain energy due to direct bending and shear, Castigliano's theorems and application to deflection and rotation of the beam Maxwell reciprocal theorem. Fictitious load method, Theorem of virtual work. Lectures 08

Module 3: Theories of Yielding: Different theories of failure comparision of theories of failure, yield loci. Lectures 05

Module 4: Unsymmetrical Bonding: Flexural stresses due to unsymmetrical bonding of beam. Shear Centre, shear centre of thin walled open across section, shear flow. Lectures 08

Module 5: Beams with large original curvature: Stresses in Crane hooks, rings and links. Lectures 05

Module 6: Thick cylinders and sphere, radial and hoop stresses, application of compound stress theories, Compound cylinders, shrink fit. Rotating Discus and rings, thin disc of uniform thickness, disc of uniform strength. Lectures 08

Suggested Readings:

1. Advanced Mechanics of Solid – L. S. Srinath.
2. Solid Mechanics – Kazimi.
3. Strength of metarials – G H Ryder.
4. Mechanics of materials – Arthur Martay
5. MOS - Timoshenko.
6. MOS – Popov.

ME143 Production And Operations Management

L-T-P-Cr: 3-0-0-3

Pre-requisite: Basics of Production Processes and Production Systems.
Objective: To be familiar with the engineering practices for managing production & operations in productive industries and organizations.
Outcome: Students are able to grasp the engineering practices & management principles in productive organization for practicing and managing the same on being exposed.

Module 1: Introduction, Historical Background, Management approaches to planning, analysis and control, Functions involved in Production, Planning and Control, Operations Strategy, Break-Even analysis, Capacity Planning, Types of Industry: Job, batch, continuous, mass and flow productions. Lectures 06

Module 2: Forecasting techniques (subjective & objective): causal and time series models, moving average, exponential smoothing, trend and seasonality. Lectures 04

Module 3: Operations Scheduling, Sequencing – upto n Jobs on Two Machines, Assembly Line Balancing. Lectures 06

Module 4: Inventory Management – functions, costs, classifications, inventory models under certainty (EOQ models), introduction to inventory models under uncertainty, quantity discount, value analysis (ABC analysis etc.). Lectures 09

Module 5: Production Planning & Control, Functions of PPC, Push and Pull Production Systems – Aggregate Production Planning, MPS, MRP, MRP-II, ERP, JIT – Kanban system. Lectures 09

Module 6: Introduction to Supply Chain Operations Management, Building blocks of a supply chain network, Types of supply chains and examples, Strategic, tactical and operational decisions in supply chains, DRP, Supply chain inventory management: (Q, R) models, multi-echelon supply chains; Supply chain performance measures. Lectures 08

Text/Reference Books:

1. Production & Operations Analysis – Steven Nahmias (TMH)
2. Operations Management (Theory and Practice) – B. Mahadevan (Pearson Education)
3. Designing & Managing the Supply Chains – Concepts, Strategies and Case Studies, David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Ravi Shankar (TMH)
4. Manufacturing Planning and Control, Volman
5. Supply Chain Management – Strategy, Planning & Operation; Sunil Chopra, Peter Meindl, D.K. Kalra (Pearson Prentice Hall).

ME144 Statistical Quality Control

L- T- P-Cr: 3 - 0- 0-3

Prerequisite: NIL

Objective: To familiarize the students about the various quality tools

Outcome: Students will create an awareness about the importance and benefits of quality control activities

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Module 1: Quality control concepts and definitions, History of quality control and improvement, Quality philosophies. Lectures 07

Module 2: Basics of Inferential and descriptive statistics, important continuous and discreet distributions. Lectures 06

Module 3: The magnificent seven quality control tools, Control charts for variables and attributes, Special control charts: CUSUM and EWMA charts, control charts for short production runs and multiple-stream processes, Process capability analysis, Six Sigma Quality Concept, Introduction to designed experiments. Lectures 08

Module 4: Introduction of basic matrix algebra, Hotelling T^2 Control Chart, Multivariate EWMA and CUSUM charts, Multivariate statistical projection based methods. Lectures 07

Module 5: Process monitoring and process regulation, Process control by feedback adjustment, Combining SPC and EPC. Lectures 07

Module 6: Guidelines for using acceptance sampling, Single – sampling plans for attributes, Double, multiple and sequential sampling, the Dodge – Romig sampling plans. Lectures 07

Text/Reference Books:

1. Introduction to Statistical Quality Control, D C Montgomery, Wiley.
2. Grant and Leavarworth "Statistical Quality Control" McGraw Hill.
3. Total Quality Management, Dale H.Besterfiled, Pearson Education Asia.
4. Statistical Quality Control, Eugene L Grant and Richard S Leavenworth, 7th Edition, TMH.

ME145 Refrigeration & Air Conditioning

L-T-P-Cr: 3-0-0-3

Pre-requisite: Basic concepts of Thermodynamics and Heat Transfer.

Objective: To familiarize students with the terminology associated with refrigeration, refrigerants, and components of refrigeration systems, psychrometry and air-conditioning.

Outcome: Students are able to understand the fundamentals of Refrigeration, psychometry and air-condition, and their applications.

Module 1: Air Refrigeration System: Refrigeration machine, heat pump, coefficient of performance, ideal refrigeration cycle, Bell-coleman, refrigeration cycle, open and closed systems, application of air refrigeration in air crafts. Lectures 03

Module 2: Vapour Compression System: Simple vapour compression refrigeration cycle, merits and demerits of this system over air refrigeration system, factors affecting its performance, sub-cooling and superheating of vapour, wet and dry compression, multi-stage vapour compression system, intercooler, flash chamber, accumulator and heat exchanger, Refrigerants: classification and nomenclature, primary and secondary refrigerants, properties, selection, leakage of refrigerants and methods of detection. Lectures 11

Module 3: Vapour Absorption System: Simple and modified vapour absorption refrigeration system, Electrolux refrigerator, COP of heat operated refrigeration systems. Lectures 07

Module 4: Special Refrigeration System: Absorption, cascade, vortex, thermoelectric and steam jet refrigeration system. Equipment: Elementary discussion of refrigerating equipment, ice plant and cold storage. Lectures 06

Module 5: Psychrometry: Properties of air-vapour mixture, wet bulb, dew point, dry bulb temperatures, humidity, specific humidity ratio, degree of saturation, relative humidity, total heat, psychrometric relation, psychrometric charts and its uses, psychrometric processes, evaporative cooling. Lectures 05

Module 6: Air-conditioning: General principles, requirement for comfort and air-conditioning, thermodynamics of human body, estimation of heating and cooling loads, capacity of cooling coils, humidification and dehumidification units, conditioner, central air-conditioner, year around air condition, humidity and temperature control, industrial application of air-conditioning system.
Lectures 10

Text Books:

1. Refrigeration and air conditioning – C. P. Arora.
2. Refrigeration – Dessart.
3. Refrigeration and Air Conditioning – R. C. Arora.
4. Refrigeration and Air Conditioning – Stoecker & Jones

Reference Books:

5. Refrigeration and Air Conditioning – Domkundwar.
6. Refrigeration and Air Conditioning – Manohar Prasad.
7. Refrigeration and Air Conditioning – Jordan & Priester.

ME146 Measurement & Instrumentation

L - T- P-Cr: 3 - 0- 0- 3

Pre-requisite: NIL

Objective: To familiarize students about the various measuring instruments.

Outcome: Students are able to use and design measuring instruments for measuring the physical variables.

Module 1: General Concepts: Introduction to Measurement and Instrumentation, Standards of Measurements, Methods and Modes of Measurement, Generalized Measurement Systems, Classification of Instruments; Static and Dynamic Characteristics of Measurements. Errors in Measurement: Types of Error, Sources of Error, Statistical Analysis of Data.
Lectures 07

Module 2: Introduction, Principles of Measuring Instruments, Linear and Angular Measurements, Measurement of Circularity, Straightness, Flatness, Squareness and Parallelism Measurement, Comparators: Electrical, Mechanical and Pneumatic Comparators. Lectures 07

Module 3: Introduction, Classification of Transducers, Electro – Mechanical and Resistance Transducers, Thermoelectric and Photoelectric Transducers, Types of Amplifiers: Mechanical. Fluid and Electrical Amplifiers, Types of Signal Transmission: Mechanical, Electrical, Pneumatic and Magnetic Transmission Lectures 07

Module 4: Analog Devices: Moving Iron Instruments, Moving Coil Instruments, Rectifier Instruments, Wattmeter, Voltmeter, Multimeter. Digital Devices: Light Emitting Diode, Liquid Crystal Display, Numerical Indicator Tubes, Recorders: Cathode Ray Oscilloscope, UV Recorders, Magnetic Tape Recorders. Lectures 07

Module 5: Temperature Measurements: Expansion, Pressure and Electrical Resistance Thermometers, Radiation and Optical Pyrometers. Pressure Measurements: Manometers, Mechanical Gauges, Electrical Pressure Transducers. Flow Measurements: Venturimeter, Orificemeter Plate Meter, Flow Nozzles, Pitot Tubes, Electromagnetic and Ultrasonic Flow Meters. Lectures 08

Module 6: Displacement Measurement, Velocity / Speed and Acceleration Measurement, Force and Torque Measurement, Introduction to Mechatronics Control Systems: Classification of Control System, Open and Closed – loop control systems, Time response of control system, Industrial controllers, Pneumatic and Hydraulic control systems, Microcontrollers

Lectures 06

Text/Reference Books:

1. Mechanical Measurements, Beckwith, Marangoni and Lienhard, 6th Edition, Pearson Education
2. Mechanical Measurement and Instrumentation, R K Rajput, S K Kataria.
3. Mechanical Measurements, Sirohi and Radhakrishna, New Age International.

ME147 Automobile Engineering

L-T-P-Cr: 3-0-0- 3

Prerequisite: Elementary knowledge of thermodynamics and mechanics of Solid.

Objective: Learn about different parts of automobile and understand their working principle.

Outcome: Students understand the function of principle components of automobile, and with the help of machine design theory, they able to design motor vehicles.

Module 1: Introduction: overview of different components of an automobile, classification of engines, Otto cycle, Diesel cycle. Automotive engines: four-stroke engine, two-stroke engine, engine construction, cylinder block, cylinder head, cylinder liners, crankcase, piston, piston rings, connecting rod, crankshaft, camshaft, valves, valve operating mechanism, valve-timing diagrams, engine performance characteristics, tractive resistance. Lectures 10

Module 2: Fuel system: Fuel supply systems in petrol and diesel engines, fuel pump for petrol engine, simple carburettor, types of carburettor, petrol injection, MPFI system, fuel pump for diesel engine, fuel injector for diesel engine. Ignition system: battery ignition systems, magneto ignition systems, and electronic ignition system. Lubrication systems: characteristics of lubricants, types of engine lubrication. Cooling system: methods of cooling, air cooling, water cooling system. Lectures 10

Module 3: Chassis frames: function and construction of chassis, conventional and frameless. Wheels and tyres: wire wheel, disc wheel, pneumatic tyres. Lectures 03

Module 4: Spring and suspension system: types of springs, leaf spring, hotch-kiss arrangement, types of suspension system, independent front suspension, independent rear suspension, shock absorbers. Steering system: front axle, wheel alignment, principle of correct steering, layout of steering system. Lectures 06

Module 5: Driveline system: propeller shaft, universal coupling, geometric consideration of Hooke's joint, differential assembly. Clutch: types of clutches, working of friction clutch. Gear box: principle of gearing, sliding mesh gear box, constant mesh gear box, synchro mesh gear box, overdrive. Brake: principles of braking, types of brake, drum brake, disc brake, hydraulic brake. Lectures 10

Module 6: Emission control: effects of auto exhaust, methods for reduction of formation of pollutants. Lectures 03

Text/Reference Books:

1. K. M. Gupta, *Automobile Engineering* volume 1 and 2, Umesh Publications.
2. Kirpal Singh, *Automobile Engineering* volume 1 and 2, SPD.
3. S. Srinivasan, *Automotive Mechanics,* Tata McGraw-Hill.
4. William H. Crouse, *Automotive Mechanics.* Tata McGraw-Hill.
5. Newton, Steeds, Garette. *The Motor Vehicle.* Butterworths.

ME148 Mechanical Vibrations

L-T-P-Cr: 3-0-0-3

Pre-requisite: NIL

Objective: To learn the linear vibration in detail in mechanical engineering point of view and an exposure of non-linear vibration.

Outcome: Students are able to analyse the complex problems related to single and multi-degree of freedom mechanical systems.

Module 1: Fourier Analysis and Single Degree of Freedom Systems: Importance of Mechanical Vibration, Classification of Vibration, Fourier analysis, Undamped and Damped Free Vibration of Single Degree of Freedom Systems. Lectures 07

Module 2: Types of Damping: Viscous, Coulomb and Solid dampings, Energy Dissipation in Damping, Different Cases of Viscous Damping, Logarithmic Decrements, Forced Vibration, Support Motion: Absolute and Relative Motions, Characteristics Curves, Vibration Isolation, Transmissibility. Lectures 07

Module 3: Two Degree of Freedom Systems: Free and Forced Vibration, Semi-definite Systems, Coordinate Coupling and Principle Coordinates, Dynamic Vibration Absorber. Lectures 07

Module 4: Multi Degree of Freedom Systems: Lagrange's Equations, Generalized Coordinates, Matrix Method, Orthogonality of Normal Modes, Natural Frequencies and Mode Shapes: Dunkerley's Method, Rayleigh's Method, Holzer's Method, Matrix Iteration Method, Jacobi's Method, Eigenvalues and Eigenvectors. Lectures 08

Module 5: Continuous Systems: Transverse Vibration of Strings, Longitudinal Vibration of Bars, Torsional Vibration of Bars, Transverse Vibration of Beams, Wave Equation in One Dimension, Initial and Boundary Conditions. Lectures 06

Module 6: Vibration Measurement and Applications: Seismic Instruments - Accelerometers, Vibrometers, Phase Distortion, Frequency Measuring Instruments, Vibration Exciters: Mechanical and Electromagnetic Types, Machine Condition Monitoring and Diagnosis. Introduction to Non-linear Vibration. Lectures 07

Text Books:

1. Mechanical Vibration by Singiresu S. Rao (Pearson Publication)
2. Vibrations -Theory and Application by W. T. Thomson (Prentice Hall of India)
3. Theory and Practice of Mechanical Vibrations by J.S. Rao and K. Gupta (Wiley Eastern)

Reference Books:

4. Mechanical Vibration Analysis by P. Srinivasan (Tata McGraw Hill)
5. Mechanical Vibrations by V.P. Singh, Dhanpat Rai & Co. (P) Ltd.

ME149 Total Productive Maintenance And Value Engineering

L-T-P-Cr: 3-0-0-3

Pre-requisite: Familiarity with Production Processes and Systems. Industrial (vocational) Training is preferred.

Objectives: To make familiar with the plant maintenance strategies & industrial engineering practices for any productive organization and to introduce the basics on Value Engineering & Value Analysis.

Outcome: Students are equipped with basics to grasp engineering practices for managing productive maintenance in a plant that has either adopted TPM philosophy or that is going to adopt the same. Basics on Value Engineering enable students to lay foundation for its industrial practice & consultancy.

Module 1: Introduction to TPM, Targets of TPM, Implementation, Measurement of overall performance, Pillars of TPM. Lectures 04

Module 2: Maintainability and Reliability, failure, failure density, failure Rate, hazard rate, Mean Time To Failure (MTTF), Mean Time Between Failure (MTBF), availability, life characteristic phases, modes of failure, areas of reliability, quality and reliability assurance rules, product liability, maintenance strategies. Lectures 10

Module 3: Work Study and Method Study: Taylor's scientific management, Gilbreths's contributions; productivity – concepts and measurements; method study, micro-motion study, principles of motion economy. Lectures 08

Module 4: Work Measurement: Uses and techniques of work measurement, Time study, work sampling, standard data, PMTS, MTM, work factor. Lectures 06

Module 5: Value Engineering and Value Analysis: Definition and Concept, Objectives, Types of value, Phases of VE and VA, Differences between VE and VA, Techniques and Applications. Lectures 10

Module 6: Work Design: Introduction to work design and job design, Effective job design, socio-technical approach to job design. Lectures 04

Text/Reference Books:

1. Terotechnology and Reliability Engineering – Basu & Bhaduri. (Asian Books Publications).
2. Industrial Engineering and Production Management - M. S. Mahajan. (Dhanpat Rai & Co.)
3. Industrial Engineering and Management - A. P. Verma (Katson Books)

ME150 Non-Conventional Manufacturing

L-T-P-Cr: 3-0-0-3

Pre-requisite: Basic knowledge of manufacturing process.

Objective: To understand how the material removal by using various energy and to know how the new materials and complex parts are produced with high accuracy by using new technology.

Outcome: Students will be able to understand the fundamentals of various non-conventional machining processes and their influence on performance and their applications.

Module 1: Introduction: Historical background of non-conventional machining processes, Classification, Basic fundamentals of various process and related comparison.

Lectures 04

Module 2: Mechanical Machining Process: Principle and working and applications of mechanical machining processes such as ultrasonic machining, water jet cutting. Lectures 07

Module 3: Thermal and Chemical Machining Process: Principle and working and applications of thermal and chemical machining processes such as electro-discharge machining, electro-chemical machining. Lectures 07

Module 4: Non-conventional welding process: Principle and working and application of non-conventional welding processes such as laser beam welding, electron beam welding, ultrasonic welding, plasma arc welding. explosive welding, cladding. under water welding, metallising.

Lectures 10

Module 5: Non-conventional forming process: Principle, working and applications of high energy forming processes such as explosive forming, electro-magnetic forming, electro-discharge forming, water hammer forming, explosive compaction. Lectures 10

Module 6: Introduction to Micro Manufacturing: Micro manufacturing fundamentals, significance, application of NCMPs for micro manufacturing, Micro to Nano finishing processing information.

Lectures 04

Text Books:

1. P.C. Pandey and H.S. Shah, *Modern Machining Processes*, Tata Mcgraw-Hill Publishing Co. Ltd, New Delhi, 1980.
2. A. Ghosh and A.K. Mallik, *Manufacturing Science,* 2nd edition, Affiliated East West Press, New Delhi.
3. G.F. Benedict, *Nontraditional Manufacturing Processes*, Marcel Dekker Inc., New York (ISBN 0-8247-7352-7), 1987.

References Books:

1. V.K. Jain, *Advanced Machining Processes*, Allied Publishers, 2009.
2. V.K. Jain, *Introduction to Micromachining*, Alpha Science International Limited, 2010.
3. J. A. McGeough, *Micromachining of Engineering Materials*, Taylor & Francis, 2001.

ME151 Finite Element Methods

L-T-P-Cr: 3-0-0-3

Pre-requisite: Knowledge of matrix solution, strength of material and basic heat transfer.

Objectives : To solve the realistic problems by making use of this tool.

Outcome : Ability to resolve the situations in numerical world.

Module 1: Introduction to Finit Element methods – General descriptions, Concept of finite elements discretization and interpolation function, steps on finite element analysis's procedure.

Lectures 06

Module 2: Displacement formulatins for 1D, triangles, rectangular and axisymmetric elastic problems, three dimensional elements, Assembly, global and local co-ordinate system, Boundary conditions, The potential energy approach. Lectures 10

Module 3: Isoparanetric, interpolation function and numerical integration. Lectures 04

Module 4: Function and functionals, Euler- Lagrange equation, Boudary conditions, determination of functionals for plane and axisymmetric elastic problems, heat conduction problems.

Lectures 06

Module 5: Coordinates and shapes functions – Linear, Quadratic, Triangular, Axisymmetric, Euler – Lagrange equation, Galerkins Approach, Assembly of globlal fitness matrix, Boundary conditions such as convection, radiation etc. Lectures 10

Module 6: Unsteady state heat transfer problems using finite difference time stepping techniques like Euler, Crank – Nicolson's and implicit methods. Lectures 06

Text/Reference Books:

1. Finite Element Method by D. L. Logan, "Lengage Learning".
2. Finite Element Methods for Engineers by U. S. Dixit, "Lengage Learning".

ME152 Gas Turbine& Jet Propulsion

L-T-P-Cr: 3-0-0-3

Pre-requisite: Basics of Thermodynamics and Heat transfer, Heat circuit analysis, Heat transfer by mass transport.

Objective: Construction and working of Gas Turbine with Applications.

Outcome: Knowledge of Gas Turbine, Importance of Gas Turbine, uses of gas turbine in air conditioning and in Gas power production, application of Rocket and jet propulsions theory.

Module 1: An overview of Gas Turbines: Introduction, Components of gas turbine, the brayton cycle, Modifications of the brayton cycle. Gas turbine Material, Gas turbine Fuel, Gas turbine Application, Comparison of gas turbines with other prime movers. Lectures 07

Module 2: Gas Turbine Compressors: Centrifugal compressor, Axial compressor, Typical gas turbine Compressor characteristics. Problems. Lectures 07

Module 3: Gas turbine Combustors: Introduction, Zones of Combustor, Major type of combustor, Combustion terms, and Combustor efficiency. Lectures 07

Module 4: Gas turbines Geometry: Degree of reaction, Utilization factor, Work factor, Impulse turbine, Reaction turbine, Turbine blade cooling method, Turbine blade cooling designs.

Lectures 07

Module 5: Gas turbine blade materials, Turbine Wheel alloy Coatings for Gas turbine materials. Gas turbine lubrication and fuel systems: Gas turbine Lubrication system, Fuel system, Liquid fuels, Gaseous fuels. Gas turbine instrumentation and control system. Lectures 07

Module 6: - Fundamentals of jet propulsion - Propulsion cycle - Power and efficiency calculations. Working of Turbojet, turbofan, and turboprop engines - Fundamentals of rocket propulsion.
Lectures 07

Text/Reference Books:

1. Gas turbine engineering hand book by Boyce MP, Gulf publishing company, Houston, Tex.
2. Power Generation Hand book selection, applications, operation, and maintenance by Philip Kiamesh
3. McGraw – Hill Gas turbine theory by HIH Saravanamuttoo, H. Cohen and GFC Rogers, Pearson
4. Gas turbine by V Kansan, Tata McGraw hill education private limited.
5. Heat and Mass Transfer, by F. White, TMH

ME153 Mechatronics & Robotics

L-T-P-Cr: 3-0-0-3

Pre-requisite: Basic knowledge of Automation.

Objective: Mechatronics deals with the design of a system with the aid of mechanical and electronic components. Robotics is a subject that attracts many young minds, mainly due to the exhaustive portrayal of robots in many science fiction stories and popular movies.

Outcome: On completion of the course the students will be able to understand, the mechatronic system design and their structure, mechanism, ergonomic and safety; theoretical and practical aspects of computer interfacing and real time data acquisition and control; motion control of driver and motion converter; fundamentals of Robotics & Automation.

Module 1: Introduction- Definition of mechatronics. Mechatronics in manufacturing, products and design. Review of fundamentals of electronics. Lectures 05

Module 2: Mechatronics Elements- Data conversion devices, sensors, micro sensors, transducers, signal processing devices, relays, contactors and timers. Lectures 07

Module 3: Processors/ Controller- Microprocessors, microcontrollers, PID controllers and PLCs. Drive And Control System - Types of drive systems, Dynamic performance, Actuators-Pneumatic and hydraulic actuators, controls approaches of robot, open loop and closed-loop control system.
Lectures 09

Module 4: Basic Concepts in Robotics - Introduction, Definition, Basic structure of robot, Resolution, Accuracy, Repeatability, Work envelope, pay load and degrees of freedom. Classification Of Robot System - Point-to-point and continuous path systems, loops of robotic system, robot anatomy, Basic configurations- Cartesian, cylindrical, polar and jointed-arm configuration. SCARA robot and spatial configuration. Lectures 08

Module 5: Robot End Effectors - Robot gripper and gripping mechanism, types of gripper, Grasping requirements for the gripper. Sensor System in Robotics - Sensor and Transducer, Desirable features, tactile and non-tactile sensors- Touch sensor, Force and Torque Sensor, Proximity Sensor, Range Sensors; Machine vision and artificial intelligence.
Lectures 07

Module 6: Robot Programming - Programming methods – Manual teaching and lead through teaching, Programming through Textual robot languages. Lectures 06

Text/Reference Books:

1. Introduction to Robotics by – S. K. Saha; McGraw Hill
2. Robotics – Fundamental Concept and Analysis by Ashitava Ghosal; Oxford.
3. Robotics – Control, Sensing, Vision and Intelligence by K. S. Fu; TMH.
4. Robotics and Manufacturing Automation by C. Ray Asfahl; Wiley.
5. Industrial Automation and Robotics by Goyal and Bhandari.

ME154 Tribology

L-T-P=Cr: 3-0-0-3

Pre-requisite: NIL.

Objective: Tribology, which deals with integrated study of friction, lubrication and wear, is a multi-disciplinary subject immensely related to design, manufacture and operational exploitation, spreading its tentacles to various aspects of maintenance and sustainable performance of capital equipment.

Outcome: Students are able to understand the complicated phenomena, basic laws and applications of friction, lubrication and wear to real-life cases with the basic knowledge of surface integrity and contact, involving design, manufacture and maintenance of machinery.

Module 1: Introduction to Tribology, Definitions, Basic Laws, Viscosity of Lubricants, Viscosity Standards and Hydrodynamic Equations. Lectures 06

Module 2: Surface Roughness and its Standardization, Measurement Techniques: contact and non-contact types, Instrument for measuring statistical parameters, statistical analysis of surfaces and their characteristics. Lectures 08

Module 3: Friction and Wear: Laws of friction, single asperity adhesion theory of friction, modified theory of adhesion, adhesion theory with contaminated films, various types of frictions defined, phenomenon of wear, laws of wear, adhesive wear, tribo monitoring for friction and wear, wear particle analysis ferrography. Lectures 07

Module 4: Hydrodynamic Slider Bearings, Hydrodynamic Journal Bearings, Hydrostatic Aerostatic Bearings, Antifriction Bearings. Lectures 08

Module 5: Elastohydrodynamic Lubrication, selection of lubricants, properties, selection stages, regime of lubrication, typical lubricant tests, commonly used lubricants and hazards, ferrography, classification and uses of Solid Lubricants. Lectures 07

Module 6: Tribological Behaviour of Asperities Contact: Contact stress, surface roughness and Hydrodynamic actions, Non-conforming contact, average Reynolds equation for partial lubrication, Asperity contact of rough surfaces, contact deformation and Tribo properties of plastics. Lectures 06

Text Books:

1. Fundamentals of Tribology by S. K. Basu, S. N. Sengupta and B. B. Ahuja; PHI Learning pvt. ltd., New Delhi
2. Tribology in Indertrion- By Sushil Kumar Srivastava

3. Introduction to Tribology of Bearings- By B.C. Majumdar ; A.H.Wheeler
4. Principles of Tribology – By J. Halling, Macmillan
5. Friction and wear of Materials- By E. Robinowicz, Johan Wiley
6. Principles of Lubrication-By A. Cameron, Longmans
7. Mechanics and Chemistry in Lubrication- By Dorinson and Ludema , Elsevier

Reference Books:

1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2. Hand Book of Tribology -- WHILEY
3. Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.
4. Tribology in Industries by Sushil. K. Srivastava, S Chand & Publications.
5. Basic Lubrication theory by Alastair Cameron.

ME161 Renewable Energy Systems

L-T-P-Cr: 3-0-0-3

Pre-requisite: Basics of Thermodynamics, Heat Transfer and Electricity Generation.

Objective: An exposure of renewable energy systems and techniques to generate electricity on account of renewable energy sources.

Outcome: Knowledge of electricity generation from renewable energy sources such as solar, hydraulic, wind and bio-mass.

Module 1: Principles of Renewable Energy: Introduction, Energy and sustainable development, Fundamentals, Scientific principles of renewable energy, Technical implications, Social implications, Problems. Lectures 06

Module 2: Solar radiation: Introduction, Extra-terrestrial solar radiation, Components of radiation, Geometry of collector and the solar beam, Effects of the Earth's atmosphere Measurements of solar radiation, Estimation of solar radiation, Solar water heating: Introduction, Calculation of heat balance: general remarks, Uncovered solar water heaters – progressive analysis, Improved solar water heaters, Evacuated collectors, Buildings and other solar thermal applications, Air heaters, Crop driers, Space cooling, Water desalination, Solar ponds, Solar concentrators, Solar thermal electric power systems, Problems. Lectures 12

Module 3: Photovoltaic generation: Introduction, The silicon p–n junction, Photon absorption at the junction, solar radiation absorption, Maximizing cell efficiency, Solar cell construction, Applications, Problems. Lectures 04

Module 4: Hydro-power: Introduction, Principles, Assessing the resource for small installations, An impulse turbine Reaction turbines, Hydroelectric systems,The hydraulic ram pump, Problems. Lectures 06

Module 5: Power from the wind: Introduction, Turbine types and terms, Linear momentum and basic theory, Dynamic matching, Blade element theory, Contents Characteristics of the wind, Power extraction by a turbine, Electricity generation, Mechanical power, Problems. Lectures 06

Module 6: Biomass and Biofuels: Introduction, Biofuel classification, Biomass production for energy farming, Direct combustion for heat, Pyrolysis (destructive distillation), Further thermochemical processes, Alcoholic fermentation, Anaerobic digestion for biogas, Wastes and residues, Vegetable oils and biodiesel, Problems. Lectures 08

Text/Reference Books:

1. Renewable Energy Resources by Johan Twidell and Tony Weir, Taylors and Francis Publication
2. Solar Energy by G N Tiwari, Narosa Publication
3. Green Power: The Eco-Friendly Energy Engineering by Nikolai V.Khartchenko, Tbi Publication
4. Duffie J. A. & Beckman W.A., Solar engineering of thermal processes, Wiley- international Publication
5. Solar Energy principal of thermal collector and storage by SP Sukhatme and JK Nayak, TMH Publication
6. Renewable Energy Resources by G N Tiwari and M K Ghosal, Narosa Publication
7. Bansal Keemann, Meliss, Renewable energy sources and conversion technology, Tata Mc Graw Hill.
8. Kothari D.P., Renewable energy resources and emerging technologies, Prentice Hall of India Pvt. Ltd.

ME162 Operations Research

L-T-P-Cr: 3- 0- 0- 3

Pre-requisite: NIL

Objective: To enable students to understand and apply operations research techniques in industrial operations for obtaining optimized solutions.

Outcome: Determination of optimal or near optimal solution to complex decision making problems.

Module 1: Introduction: Features of Operations Research (OR), Methodology of OR, Scopes and Objectives of OR, models in OR. Lectures 06

Module 2: Introduction, Assumptions of LPP, Mathematical formulation of LPP, Graphical Method, Simplex Method. Lectures 07

Module 3: Transportation Problems: Introduction, North – West Corner Method, Least Cost Method, Vogel's Approximation Method, Test for Optimality. Assignment Problems: Introduction, Hungarian Assignment Method, Unbalanced Assignment Problems. Lectures 08

Module 4: Sequencing: Introduction, Formulation of Sequencing Problem, Johnson's Rule. Network Analysis: Introduction, PERT and CPM, Time – Cost Trade-off (Project Crashing), Resource Leveling. Lectures 07

Module 5: Dynamic Programming: Introduction, Deterministic Dynamic Programming, Probabilistic Dynamic Programming. Simulation: Introduction, Monte Carlo Simulation, Simulation of Inventory and Queuing System. Lectures 07

Module 6: Queuing Theory: Introduction, General Structure of Queuing System, Operating Characteristics of Queuing System, Queuing Models. Replacement Theory: Introduction, Replacement Policies: Gradually Deteriorating Equipments, Items that Fail Suddenly. Lectures 07

Text/Reference Books:

1. Operations research – An Introduction, Hamdy A Taha, 8th Edition, Pearson Education.
2. Introduction to Operations Research, Hillier and Lieberman, 8th Edition, TMH.
3. Operations Research, R Panneerselvan, 2nd Edition, PHI.
4. Quantitative Techniques in Management, N D Vohra, 4th Edition, McGraw Hill.

ME163 Computational Fluid Dynamics

L-T-P-Cr: 3- 0- 0- 3

Pre-requisite: Heat Transfer and Numerical Analysis Techniques.

Objective: To introduce the CFD techniques and tools for modelling, simulating and analysing practical engineering problems with hands on experience using commercial software packages used in industry.

Outcome: Students are able to understand the use of different CFD techniques and tools for modelling, simulation and analysis of complex engineering problems.

Module 1: Introduction: Philosophy of Computational Fluid Dynamics, Computational Fluid Dynamics as a research tool, Computational Fluid Dynamics as a design tool, the impact of Computational Fluid Dynamics on automobile and engine applications, Industrial manufacturing applications, environmental engineering applications. Lectures 09

Module 2: Governing equations of Computational Fluid Dynamics: Models of the flow, the substantial derivative, divergence of velocity, continuity equation, momentum equation, energy equation, Physical boundary conditions. Lectures 08

Module 3: Partial differential equations: General method of determining the classification of partial differential equations, The impact of different equation on Computational Fluid Dynamics: Hyperbolic equations, Parabolic equations and Elliptic equations. Lectures 06

Module 4: Basic aspects of Discretization: Introduction to finite differences, Difference equations, Explicit and implicit approaches. Lectures 06

Module 5: Grids with appropriate transformation: General transformation of the equations, Matrices and Jacobians, Stretched (compressed) grids. Lectures 05

Module 6: Some Simple Computational Fluid Dynamics Techniques: Lax-Wendroff Technique, Mac Cormack's Technique, Relaxation Technique, Pressure Correction Technique, etc.

Lectures 08

Text/Reference Books:

1. John D. Anderson, Jr. "Computational Fluid Dynamics", McGraw-Hill, Inc.
2. Date, A. W., "Introduction to Computational Fluid Dynamics", Cambridge University Press, 2005.
3. Sengupta, T. P. "Fundamental of Computational Fluid Dynamics", Orient Longman, Hyderabad, India, 2004.
4. Patankar, S. V. "Numerical Fluid Flow and Heat Transfer", Hemisphere, New York, 1981.

ME164 Power Plant Engineering

L-T-P-Cr: 3-0-0- 3

Pre-requisite: Thermal Engineering.

Objective: Meant for the undergraduate course on Power Plant Engineering. Studied by the mechanical engineering students, this book is a comprehensive and up-to-date offering on the subject. It has detailed coverage on hydroelectric diesel engine and gas turbine power plants.

Outcome: Student are able to understand the fundamentals of Power plant engineering.

Module 1: Steam cycles and Combined Cycle Power Generation. Flows of steam as looking Fluid in Power cycles, Characteristics of ideal working Fluid - for vapour Power cycles, Binary vapour Cycles, Coupled Cycles, Combined Cycle Plants, Gas Turbine - Steam Turbine Power plant, Fuels & combustion : Coal, Coal Analysis, Synthetic Fuels, Bio-mass, Draught system, Fans, Heat of Combustion. Lectures 07

Module 2: Combustion Mechanism, Combustin Equipment and Firing methods:- Kinetics of Combustion Reactions, Combustion Equipment for furming coal, Fuel Bed Combustion, Pulverized coal firing system, Fluidized Bed Combustion, Combustion of Fuel Oil, Combustion of Gas- Combined Gas Fuel Oil Burnes. Steam Generators: Fire Tube bolers, Water Tube Boilers, Economics, Superheaters, Reheaters, Air Preheater, Fluidized Bed boilers, Electrostatic Precipitator, Ash Handling System. Lectures 08

Module 3: Steam Turbines: Introduction, Flow through nozzles, Turbine Blading, Electrical Energy Generation. Condenser, Feed water and circulatory water systems: Direct Contact Condensers, Surface Condensers, Feed water heaters, Circulating water system, Cooling Towers, Cooling Tower Calculations. Lectures 06

Module 4: Nuclear Power Plant : Nuclear Fission, Chain Reaction, Reflectors, Heat Transfer and Fluid Flow in Nuclear Reactors, Types of Reactor, Pressurized water Reactor, Boiling water Reactor, Gas cooled Reactors, Heavy water Reactors, Fusion Power Reactors. Lectures 06

Module 5: Hydroelectric Power Plant: Advantages and disadvantages of water power, Hydrological cycle, Hydraulic turbines, turbine size, Pelton wheel, Degree of Reaction, Francis Turbines, Propeller and Keplar turbine, performance of turbines, selection of turbines.

Diesel engine and gas turbine power plants: Layout of a Diesel engine power plant, Gas turbine power plant, Components of Gas turbine plant, Gas turbine Fuels, Gas turbine Materials.

Lectures 08

Module 6: Direct Energy Conversion: MHD Power generation, Thermoelectric Power Generation, Fuel cells, Geothermal Energy. Economic of Power generation, Load duration curves, location of power plants, power plant economics, coal fuelled electricity generating unit. Lectures 07

Text/Reference Books:

1. Power Plant Engineering – P.K. Nag.
2. Power Plant Engineering – Mahesh Verma.

ME165 Supply Chain Management

L - T- P- Cr: 3 - 0- 0 - 3

Pre-requisite: NIL

Objective: To understand the strategic role of Supply Chain for a given business environment.

Outcome: Will necessitate a basic understanding of concepts and techniques of Supply Chain Management.

Module 1: Basic concepts of Supply Chain Management (definitions and key issues), decisions phases in a supply chain, supply chain strategies. Lectures 07

Module 2: Drivers of Supply Chain performance and their associated Metrics, Supply Chain decision making framework, Network design factors, Distribution Network Design. Lectures 07

Module 3: Demand Forecasting: Basic approaches of Demand Forecasting, Qualitative forecasting methods, quantitative forecasting methods. Lectures 07

Module 4: Designing and Planning of Transportation Networks: Design options for a transportation network, performance characteristics for evaluating transportation modes, trade-offs in transportation design, managing risk in transportation. Lectures 07

Module 5: Role of Pricing and Revenue management, pricing and revenue management for perishable and seasonal goods, pricing and revenue management for bulk and spot contracts. . Lectures 08

Module 6: Supply Chain IT framework, Role of IT in Network Design, role of IT in Risk Management, role of IT in coordinating Supply Chain functions, future of IT in Supply Chain. Lectures 06

Text Book:

1. Sunil Chopra, Peter Meindl and D V Kalra, "Supply Chain Management" Pearson Education.

Reference Books:

1. Janat Shah, "Supply Chain Management", Pearson Education
2. Michael Hugos, "Essentials of Supply Chain Management", John Wiley & Sons
3. Russel and Taylor, "Operations Management", Prentice-Hall India
4. Shapiro, J. F., "Modeling the Supply Chain", Duxbury Thomson Learning

ME166 Safety Management

L-T-P-Cr: 3-0-0- 3

Pre-requisite: NIL

Objectives: This course is directed towards creating safety awareness, identifying hazards and mitigation of accidents along with introduction of legal requirements and following up action.

Outcome: After reading the course an engineer may develop confidence of over safe operations.

Module 1: Need, Modern safety concepts, OSHA norms. Lectures 03

Module 2: Safety Management function, Cost analysis of accidents, system safety analysis. Lectures 06

Module 3: Hazards identification and control. Pressure hazard, fire hazard and Electrical hazard. Lectures 12

Module 4: Hazard in construction industry, Hazard due to acceleration and fall, Mechanical hazard, Hazard due to heat and temperature. Lectures 11

Module 5: Safe practices rules, Personal protective equipment. Lectures 04

Module 6: Ergonomics. Lectures 06

Text/Reference Books:

1. Safety Management - John V. Grimaldi & Rollin H Simmands.

2. Ergonomics at work - Osborne, D. J, John wiley & Sons.s
3. Industrial safety Handbook - Handey, W, Mcgraw Hill.
4. Designer's Guide to OSHA - Mcgraw Hill.
5. Handbook of occupational safety and Health - Johnwiley & Sons.
6. Industrial Accident Prevention – Heinrich, Hetal, Mcgraw Hill.

ME167 Advanced Materials and Tools

L-T-P-Cr: 3-0-0- 3

Pre-requisite:

Objectives: To accelerate the design and development of various systems by deployment of advanced materials.

Outcome: Students are able to understand the applications of different types of advanced materials and their characterization techniques.

Module 1: Introduction to Advanced Materials, Light metals and alloys, Ti and Ti-based alloys and Intermetallics, Advanced Al alloys, High temperature materials, Cryogenic materials, Functionally Graded Materials, Nano-materials, Biomaterials, and Composites. . Lectures 07

Module 2: Materials characterization techniques: Scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, atomic absorption spectroscopy, differential scanning calorimetry. Lectures 07

Module 3: Nuclear Materials: Fuel and breeder materials manufacture and properties, Structural materials, Radiation damage in fuel elements, Structural coolant and control rod materials, Nuclear power, present and future states. Lectures 07

Module 4: Smart Materials: Synthesis of smart materials, Types of smart materials, Micro sensors, Hybrid smart materials, Electro-Rheological (Fluids) smart materials, Piezoelectric smart materials, Oxides for nuclear reactors. Lectures 07

Module 5: Shape Memory Alloys: Synthesis, Types of shape memory alloys, Nickel-Titanium alloy (Nitinol), Cu based alloys, Chiral materials, Applications, Fastners, Fibers, Reaction vessels, Nuclear reactors, Chemical plants, Satellite antenna, Blood clot filter, Plastics. Lectures 07

Module 6: Laser and Optical Fibers: Operation of lasers, Population inversion, Types of lasers, Gas lasers, He-Ne laser, Carbondioxide gas laser, Nitrogen gas laser, Argon ion gas laser, Solid state lasers, Ruby laser, Nd-YAG laser, Semiconductor lasers, Application of lasers in communication with optical fibres. Lectures 07

Text Books:

1. Michel Ashby, Materials Engineering Science Processing and Design, Butterworth-Heinemann, 2007.
2. B.S. Murthy et al., Textbook of Nano Science and Nanotechnology, Universities Press, 2012.
3. S. Glasstone and A. Sesonke, Nuclear Reactor Engineering, CBS Publishers & Distributors, Delhi, 2003.
4. S. C. Sharma, Composite Materials, Narosa, 2000.
5. J. B. Park, J. D. Bronzino, Park B. Park, Biomaterials: Principles and Applications, Crc Press, 2002.
6. M. Schwartz, Smart Materials, CRC Press,2008
7. K. Thyagarajan, Ajoy Ghatak Lasers:Fundamentals and Applications, Springer, 2010

Reference Books:

1. Y. Waseda, A. Muramatsu, Yoshio Waseda, Morphology Control of Materials and Nanoparticles: Advanced Materials Processing and Characterization, Springer, 2004.
2. M.F. Ashby: Engineering Materials, 4th Edition, Elsevier, 2005.
3. M.F. Ashby: Materials Selection in Mechanical Design, Butterworth Heinemann, 2005.
4. ASM Publication, Vol.20: Materials Selection and Design, ASM, 1997.
5. Pat L. Mangonon: The Principles of Materials Selection and Design, Prentice Hall International, Inc.
6. T. Pradeep, Nano: The Essentials; TaTa McGraw-Hill, 2008.
7. F.L. Matthews and R.D.Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, London, 1994.
8. Bodansky, Nuclear Energy: Principles, Practices and Projects, Springer, 2004.
9. S. V. Bhat, Sujata V. Bhat, S. V. Bhat, Biomaterials, Springer Netherlands, 2002.
10. Z. L. Wang and Z. C. Kang, Functional and Smart Materials Structural Evolution and Structure Analysis, Plenum Press, 1998.

ME191 Minor Project - I

L-T-P-Cr: 0-0-3-1

Note: The project can be selected from the concern faculty member.

GE103 Industrial Interaction & Soft Skill Development

Credit: 0

Note: Contact the concern department and faculty member.

ME193 Minor Project - II

L-T-P-Cr: 0-0-6- 2

Note: The project can be selected from the concern faculty member.

ME192 Industrial Training

Credit: 1

Note: Contact to the concern department.

ME194 General Seminar

L-T-P-Cr: 0-0-6-2

Note: Contact to the concern faculty member of the mechanical department.

ME195 Major Project

Credits: 20

Note: Contact to the mechanical department.

ME196 Comprehensive Viva

Credits: 2

Note: Questions will be asked from the syllabus of any Mechanical Engineering Course of any semester in the comprehensive viva.