ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

(Four Year Degree Programme) (Choice Based Credit System)

(FULL–TIME)

REGULATIONS AND SYLLABUS

REGULATIONS

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as subjects of study and candidates who have passed the Higher Secondary Examination through vocational stream under Engineering, conducted by the Board of Secondary Education, Government of Tamilnadu or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

Candidates who have passed the Diploma course in Engineering of the State Board of Technical Education, TamilNadu (listed in Annexure-1) will be eligible for admission to the second year of the four year degree programme in B.E. under the lateral entry scheme provided they satisfy other conditions.

2. Branches of Study in B.E.

BRANCH I - Civil Engineering
BRANCH II - Civil and Structural Engineering
BRANCH III - Mechanical Engineering
BRANCH IV - Mechanical Engineering (Manufacturing)
BRANCH V - Electrical and Electronics Engineering
BRANCH VI - Electronics and Instrumentation Engineering
BRANCH VII - Chemical Engineering
BRANCH VIII - Computer Science and Engineering
BRANCH IX - Information Technology
BRANCH X - Electronics and Communication Engineering

3. Courses of Study

The courses of study and the respective syllabi are given separately.

4. Scheme of Examinations

The scheme of Examinations is given separately.

5. Choice Based Credit System (CBCS)

The curriculum includes six components namely Humanities/Social Sciences/Management, Basic Sciences, Engineering Sciences, Professional Core, Professional Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of theory and practical courses. The total credits for the entire degree Programme is 176 (135 for lateral entry students).

6. Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of four academic years and has passed the prescribed examinations in all the four academic years. For the award of the degree, a student has to

1) Earn a minimum of 176 credits (135 for lateral entry students).
2) Serve in any one of the Co-curricular activities such as
   - National Cadet Corps (NCC)
   - National Service Scheme (NSS)
   - National Sports Organization (NSO) and
   - Youth Red Cross (YRC)

for at least one year. The students enrolled in any one of the co-curricular activities (NCC / NSS / NSO / YRC) will undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid. While the training activities will normally be during weekends, the camp will normally be during vacation period.

(OR)

Enroll as a student member of a recognized professional society such as

- Student Chapters of Institution of Engineers (India)
- Student Chapters of other Professional bodies like ICI, ISA, IIChE

7. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture / tutorial per week and one credit for two hours or part thereof for laboratory or practical or drawing per week.

8. Duration of the Programme

A student is normally expected to complete the B.E. programme in four years but in any case not more than eight years from the time of admission.

9. Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first, second and third semesters without any option.

Every other student shall enroll for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 176 (135 for lateral entry students) credits in order to be eligible for obtaining the degree. However the student is entitled to enjoy an option to earn either more or less than the total number of credits prescribed in the curriculum of a particular semester on the following guidelines:

The slow learners may be allowed to withdraw certain courses with the approval by Head of the Department and those courses may be completed by them in the fifth year of study and still they are eligible to be awarded with I Class. A student can withdraw a maximum of 2 courses per semester from IV semester to VII semester and take up those courses in the fifth year of study. However, courses

withdrawn during odd semesters (V and VII) must be registered in the odd semester of fifth year and courses withdrawn during even semesters (IV and VI) must be registered in the even semester of fifth year.

The advance learners may be allowed to take up the open elective subjects of eighth semester in sixth and seventh semesters one in each to enable them to pursue industrial training / project work in the entire eighth semester period provided they should register those courses in the fifth semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

10. Seminar / Industrial Training

The student has to present a seminar on the chosen topic. However, the student can select a topic duly approved by the Seminar Coordinator and the Head of the Department concerned. The student who has presented the seminar has to submit a report and appear for viva-voce examination at the end of the semester.

11. Project Work

The student typically registers for project at the end of seventh semester and completes it at the end of the eighth semester along with the courses prescribed for study in the eighth semester. However a student who has registered and successfully completed the courses of eighth semester by acquiring additional credits in the earlier semesters can attempt to spend his / her period of study in an industry and complete his / her project work, submit the project report and appear for viva-voce examination at the end of eighth semester.

12. Industrial Training (Value added courses)

One credit courses shall be offered by a Department with the prior approval from the Dean, Faculty of Engineering and Technology. For one credit course, a relevant potential topic may be selected by a committee consisting of Head of the department concerned and the Board of Studies member from the Department and a senior faculty member from the department concerned. An expert from industry familiar with the topic chosen may be accordingly invited to handle classes for the students. The details of the syllabus, time table and the name of the industrial expert may be sent by the above committee to the Dean for approval. The credits earned through the one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. Students can take a maximum of two one credit courses (one each in VI and VII semesters). They shall be allowed to take one credit courses offered in other Departments with the permission of Head of the Department offering the course. A separate mark sheet shall be issued for one credit courses.

13. Electives

The elective courses fall under two categories: Professional Electives and Open Electives. The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the Department concerned. Apart from the various Professional elective courses, a student can choose the open electives from any specialization offered in any Department in the Faculty of Engineering & Technology during the entire period of study, with the approval of the Head of the Department and the Head of the Department offering the course.

Further, the student can also credit not more than two courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent of open electives.

14. Assessment

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	: 10 marks
Second assessment (Mid-Semester Test-II)	: 10 marks
Third Assessment	: 5 marks
End Semester Examination	: 75 marks

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	: 15 marks
Second assessment (Test-II)	: 15 marks
Maintenance of record book	: 10 marks
End Semester Examination	: 60 marks

The continuous assessment marks for the seminar / industrial training will be 40 and to be assessed by a seminar committee consisting of the Seminar Coordinator and a minimum of two members nominated by the Head of the Department. The continuous assessment marks will be awarded at the end of seminar session. 60 marks are allotted for the seminar / industrial training and viva voce examination conducted based on the seminar / industrial training report at the end of the semester.

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

15. Substitute Assessment

A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Dean / Head of the Department within a week from the date of the missed assessment.

16. Student Counselors' (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain

number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

17. Class Committee

For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator. The composition of the class committee during first and second semesters will be as follows:

- Course coordinators of all courses.
- All Heads of the Sections, among whom one may be nominated as Chairman by the Dean.
- The Dean may opt to be a member or the Chairman.

For each of the higher semesters, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from third to eighth semester will be as follows:

- Teachers of the individual courses.
- A seminar coordinator (for seventh semester only) shall be appointed by the Head of the Department
- A project coordinator (for eighth semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory / 40 marks for seminar / industrial training, practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department (to the Dean in the case of I & II Semester) for approval and transmission to the Controller of Examinations.

18. Attendance Requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate /

concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

19. Temporary Break of Study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

The student applies for break of study, the student shall apply to the Dean in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Head of the department concerned to the Dean.

However, the student must complete the entire programme within the maximum period of eight years.

20. Procedure for withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' appears in the mark sheet for such candidates.

21. Passing and Declaration of Examination Results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'
Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

22. Awarding Degree

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

- For First Class with Distinction, the student must earn a minimum of 176 credits within four years (135 credits within three years for lateral entry students) for from the time of admission , pass all the courses in the first attempt and obtain a CGPA of 8.25 or above for all the subjects from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).
- For First Class, the student must earn a minimum of 176 credits within five years (135 credits within four years for lateral entry students) from the time of admission and obtain a CGPA of 6.75 or above for all the subjects from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students)..
- For Second Class, the student must earn a minimum of 176 credits within eight years (135 credits within seven years for lateral entry students) from the time of admission.

23. Ranking of Candidates

The candidates who are eligible to get the B.E. degree in the First Class with Distinction will be ranked together on the basis of CGPA for all the subjects of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The Candidates passing with First Class will be ranked next after those with distinction on the basis of CGPA for all the subjects of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The ranking of candidates will be done separately for each branch of study.

24. Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

COURSES AND CREDITS – SUMMARY SHEET

Semester	No. of Courses		HS	BS	ES	PC	PE	OE	S&IT	Proj.	Total Credits
	T+P	Total									
I	4+2	**6**	3*	9	5	-	-	-	-	-	17
			1**	3	2						
II	4+4	**8**	4	13	7	-	-	-	-	-	24
			1	5	2						
III	6+2	**8**	3	4	8	8	-	-	-	-	23
			1	1	3	3					
IV	6+2	**8**	-	4	3	16	-	-	-	-	23
				1	1	6					
V	6+3	**9**	-	-	-	17	8	-	-	-	25
						6	3				
VI	6+3	**9**	-	-	-	10	11	3	-	-	24
						4	4	1			
VII	5+3	**8**	3	-	-	5	8	3	1	-	20
			1			2	3	1	1		
VIII	2+1	**3**	-	-	-	-	-	6	-	14	20
								2	-	1	
Total Courses	39+20	**59**	**4**	**10**	**8**	**21**	**10**	**4**	**1**	**1**	**-**
Total credits		**-**	**13**	**30**	**23**	**56**	**27**	**12**	**1**	**14**	**176**

COURSE CODE FOR PROGRAMMES

Code (First Two digits)	Details
00	Common course for the faculty
01	Civil Engg. Course
02	Civil and Structural Engg. course
03	Mechanical Engg. Course
04	Mechanical Engg (Manufacturing). Course
05	Electrical and Electronics Engg. Course
06	Electronics and Instrumentation Engg. course
07	Chemical Engg. course
08	Computer Science and Engg. course
09	Information Technology course
10	Electronics and Communication Engg. course
XX	Code of the programme concerned (01 to 10)

Code (3rd and 4th Digits)	Details
HS	Humanities Theory
HP	Humanities Practical
BS	Basic Science Theory
BP	Basic Science Practical
ES	Engineering Science Theory
SP	Engineering Science Practical
PC	Professional Core Theory
CP	Professional Core Practical
PE	Professional Elective Theory
EP	Professional Elective Practical
ST	Seminar / Industrial Training
OE	Open Elective Theory
PV	Project and Viva-voce

5th digit represents the semester and 6th and 7th digits represent the serial number of courses.

Courses of Study and Scheme of Examinations for Eight Semesters
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
Choice Based Credit System (CBCS)
FIRST SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	FE	CA	Total	Credits
1	HS-I	00HS101	Technical English	4	-	-	75	25	100	3
2	BS-I	00BS102	Engineering Mathematics I	4	-	-	75	25	100	3
3	BS-II	00BS103	Applied Physics I	4	-	-	75	25	100	3
4	BS-III	00BS104	Applied Chemistry I	4	-	-	75	25	100	3
5	ES-I Lab	00SP105	Computer Programming Laboratory	-	1	3	60	40	100	3
6	ES-II Lab	00SP106	Engineering Workshop	-	-	3	60	40	100	2
			Total	**16**	**1**	**6**	**420**	**180**	**600**	**17**

SECOND SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	FE	CA	Total	Credits
1	BS-IV	00BS201	Engineering Mathematics II	4	-	-	75	25	100	3
2	BS-V	00BS202	Applied Physics II	4	-	-	75	25	100	3
3	BS-VI	00BS203	Applied Chemistry II	4	-	-	75	25	100	3
4	ES-I	00ES204	Basic Engineering*	4		-	75	25	100	3
5	HS-II	00HP205	Communication Skills and Language Laboratory	-	2	3	60	40	100	4
6	BS-I Lab	00BP206	Applied Physics Laboratory	-	-	3	60	40	100	2
7	BS-II Lab	00BP207	Applied Chemistry Laboratory	-	-	3	60	40	100	2
8	ES-III Lab	00SP208	Engineering Graphics	-	2	3	60	40	100	4
			Total	**16**	**4**	**12**	**540**	**260**	**800**	**24**

* **Basic Civil Engg.** Course for Mech., Manuf., EEE, EIE, ECE, CSE & IT
Basic Electrical Engg. Course for Civil, Civil and Structural, Mech., Manuf.& Chem. Engg.
Basic Mechanical Engg. Course for Civil, Civil and Structural, EEE, EIE, ECE, CSE, IT & Chem. Engg.
L-Lecture; **T**-Tutorial; **P**-Practical. **FE**-Final Examination; **CA**-Continuous Assessment

THIRD SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	FE	CA	Total	Credits
1	HS-III	00HS301	Environmental Studies	4	-	-	75	25	100	3
2	BS-VII	00BS302	Engineering Mathematics- III	4	1	-	75	25	100	4
3	ES-II	00ES303	Engineering Mechanics	4	-	-	75	25	100	3
4	ES-III	05ES304	Fluid Mechanics and Hydraulic Machinery	4	-	-	75	25	100	3
5	PC-I	05PC305	Electric Circuits	4	-	-	75	25	100	3
6	PC-II	05PC306	Electronic Devices and Circuits	4	-	-	75	25	100	3
7	ES-IV lab	05SP307	Hydraulics Lab	-	-	3	60	40	100	2
8	PC-I Lab	05CP308	Circuits and Devices Lab	-	-	3	60	40	100	2
			Total	**24**	**1**	**6**	**570**	**230**	**800**	**23**

FOURTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	FE	CA	Total	Credits
1	BS-VIII	05BS401	Probability, Random Process and Numerical Methods	4	-	-	75	25	100	3
2	ES-IV	05ES402	Material Science	4	1	-	75	25	100	4
3	PC-III	05PC403	Electromagnetic Fields	4	-	-	75	25	100	3
4	PC-IV	05PC404	Electrical Machines	4	-	-	75	25	100	3
5	PC-V	05PC405	Digital Electronics	4	-	-	75	25	100	3
6	PC-VI	05PC406	Analog Integrated Circuits	4	-	-	75	25	100	3
7	PC-II Lab	05CP407	Electrical Machines Lab	-	-	3	60	40	100	2
8	PC-III Lab	05CP408	Analog and Digital Integrated Circuits Lab	-	-	3	60	40	100	2
			Total	**24**	**1**	**6**	**570**	**230**	**800**	**23**

FIFTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	FE	CA	Total	Credits
1	PC-VII	05PC501	Electrical Measurements and Instruments	4	1	-	75	25	100	4
2	PC-VIII	05PC502	Control Systems	4	-	-	75	25	100	3
3	PC-IX	05PC503	Power Electronics	4	-	-	75	25	100	3
4	PC-X	05PC504	Transmission and Distribution	4	-	-	75	25	100	3
5	PE-I	05PE505	Professional Elective-I	4	-	-	75	25	100	3
6	PE-II	05PE506	Professional Elective-II	4	-	-	75	25	100	3
7	PC-IV Lab	05CP507	Measurements and Instruments Lab	-	-	3	60	40	100	2
8	PC-V Lab	05CP508	Power Electronics and Drives Lab	-	-	3	60	40	100	2
9	PE-I Lab	05EP509	Professional Elective-I Lab	-	-	3	60	40	100	2
			Total	**24**	**1**	**9**	**630**	**270**	**900**	**25**

SIXTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	FE	CA	Total	Credits
1	PC-XI	05PC601	Electrical Machine Design	4	-	-	75	25	100	3
2	PC-XII	05PC602	Power System Analysis	4	-	-	75	25	100	3
3	PE-III	05PE603	Professional Elective-III	4	-	-	75	25	100	3
4	PE-IV	05PE604	Professional Elective-IV	4	-	-	75	25	100	3
5	PE-V	05PE605	Professional Elective-V	4	-	-	75	25	100	3
6	OE-I	05OE606	Open Elective-I	4	-	-	75	25	100	3
7	PC-VI Lab	05CP607	Control Systems Lab	-	-	3	60	40	100	2
8	PC-VII Lab	05CP608	Power System Simulation Lab	-	-	3	60	40	100	2
9	PE-II Lab	05EP609	Professional Elective-II Lab	-	-	3	60	40	100	2
			Total	**24**	**-**	**9**	**630**	**270**	**900**	**24**

SEVENTH SEMESTER

Sl. No	Category	Course Code	Course	L	T	P	S	FE	CA	Total	Credits
1	HS-IV	00HS701	Engineering Ethics	4	-	-	-	75	25	100	3
2	PC-XIII	05PC702	Protection, Switchgear and Utilization	4	-	-	-	75	25	100	3
3	PE-VI	05PE703	Professional Elective-VI	4	-	-	-	75	25	100	3
4	PE-VII	05PE704	Professional Elective-VII	4	-	-	-	75	25	100	3
5	OE-II	05OE705	Open Elective-II	4	-	-	-	75	25	100	3
6	PC-VIII Lab	05CP706	Electrical Estimation and CADD Lab	-	-	3	-	60	40	100	2
7	PE-III Lab	05EP707	Professional Elective-III Lab	-	-	3	-	60	40	100	2
8	S & IT	05ST708	Seminar/Industrial Training	-	-	-	1	60	40	100	1
			Total	**20**	**-**	**6**	**1**	**555**	**245**	**800**	**20**

EIGHTH SEMESTER

Sl. No.	Category	Course Code	Course	L	T	P	FE	CA	Total	Credits
1	OE-III	05OE801	Open Elective-III	4	-	-	75	25	100	3
2	OE-IV	05OE802	Open Elective-IV	4	-	-	75	25	100	3
3	Proj.	05PV803	Project Work and Viva-voce	-	-	15	60	40	100	14
			Total	**8**	**-**	**15**	**210**	**90**	**300**	**20**

SYLLABUS
FIRST SEMSTER

00HS101	TECHNICAL ENGLISH	L	T	P
		4	0	0

Course Objectives

- English technical communication focuses on developing the proficiency of engineering students in communicative skills, ensuring them to face the demand of their profession with high command in English.
- At the end of the course, the learners will be able to use English for all purposes of technical communication and come out in "flying colours".

Unit–I : Listening Strategies

This unit makes the students to get exposed to the listening exercises and get registered in their minds the nuances of listening and its importance.

1) Listening process
2) Types of listening
3) Barriers to listening
4) Characteristics of good listeners
5) Team listening and note making.

Unit–II : Critical Reading and Creative Writing Skills

This unit introduces communication model like courtesy, body language, role play and good presentation in an effective manner, where the students are given an opportunity to observe, analyze, interpret, imagine and implement their ideas too.

Poem: Road not taken – Robert Frost
Ulysses – Alfred Lord Tennyson.

Prose: Of Studies – Francis Bacon
Science – Destroyer or creator – J. Bronowski

Play: Pygmalion – Bernardshaw.

Unit–III : Speaking Skill

Students shall be motivated to speak in English on familiar or unfamiliar topics. It is a platform to train the students to achieve competency in oral expression.

1) Interview Techniques
2) Group discussion
3) Making presentation and Discussing on the presentation.
4) Sample interviews
5) Dialogue writing

Unit–IV : Professional Writing

Students shall be trained to create their own proficiency in writing like - calling for quotation, asking clarification, placing orders and so on.

1) Poster making
2) Letter writing (formal and E-mail)
3) Analytical writing
4) Format of memos.
5) Report Writing

Unit–V : Theoretical Writing

The nuances of English grammar may be taught to the students so as to present flawless English both in their oral and written communication

1) Vocabulary – Homonyms, Homophones, Acronyms & Abbreviations, Idioms & Phrases.
2) Single word substitution
3) Concord
4) Tag Questions
5) Active voice and passive voice

Text Book

Rizvi, Ashraf. 2006. *"Effective Technical Communication"*. New Delhi. Tata McGraw Hill Publication Company Ltd.

Reference Books

1) Raman, Meenakshi and Sangeetha Sharma. 2004. *"Technical Communication: Principles and Practice"*. New Delhi: OUP.
2) Bailey, Stephen. "*Academic Writing: A Practical Guide for Students*". New York: Rutledge. 2011.
3) Gerson, Sharon J and Steven M. Gerson. 2007. "*Technical Writing: Process and Product*". Delhi: Pearson Prentice Hallan, 1980.

Course Outcomes

1) Understand the role of speaking in English and its contribution to their success.
2) Help the students increase the lingual power and word power, and frame suitable structures to use appropriately in different contexts.
3) Initiate the students to adopt different strategies for personal and professional writing.
4) Train the students use diversified rhetorical functions of technical English.

00BS102	ENGINEERING MATHEMATICS - I	L	T	P
		4	0	0

Course Objectives

To acquaint the student with the concepts in

- Matrices,
- Differential calculus,
- Multiple integrals,
- Vector calculus, which are most important in connection with practical engineering problems.

Unit–I : Matrices

Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties – Cayley-Hamilton theorem – Orthogonal transformation of a real symmetric matrix to diagonal form – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit–II : Differential Calculus

Curvature in Cartesian and parametric co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes.

Unit–III : Differential Calculus: Functions of Several Variables

Jacobians – Taylor's and Maclaurin's series expansions of functions of two variables – Maxima and Minima of functions of two variables – Constrained Maxima and Minima by Lagrange Method.

Unit–IV : Multiple Integrals

Double integration – Cartesian and polar co-ordinates – change of order of integration – area as a double integral – triple integration – Volume as a triple integral.

Unit–V : Laplace Transform

Definition, Transform of elementary functions, Properties, Derivatives and integrals of transforms, Transforms of derivatives, Convolution theorem, Transforms of periodic functions,Inverse Laplace transform, Application to solution of linear ordinary differential equations of second order with constant coefficients.

(in all units, proof of theorems are not included)

Text Books

1) Venkataraman, M.K., Engineering Mathematics, Volumes I (2008) and II (2009), The National Publishing Company, Chennai.
2) Veerarajan T, Engineering Mathematics, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

Reference Books

Grewal B S, Higher Engineering Mathematics, Khanna Publishers, Delhi, 40th Edition, 2007.Erwin Kreysig, Advenced Engineering Mathematics, John Wiley & Sons, 8th Edition, 2002.

Course Outcomes

1) This course equips students to have knowledge and understanding in matrices, differential calculus, multiple integrals and Laplace transforms.
2) Students will be able to solve problems related to above fields in engineering applications.

00BS103	APPLIED PHYSICS – I	L	T	P
		4	0	0

Course Objectives

At the end of the course the students would be exposed to fundamental knowledge in various engineering subjects and applications

- Determine the different modulus of elasticity and viscosity of the less and highly viscous liquids.
- Design of acoustically good buildings.
- Interferometric techniques in metrology, communication and civil engineering.
- Application of quantum physics to optical and electrical phenomena.
- Application of ultrasonics and acoustics.
- Structure identification of engineering materials.
- Applications of Radio isotopes and power reactor systems.

Unit–I : Properties of Matter

Introduction to elasticity - Hook's law - Different modulii of elasticity - Bending of beams – Determination of Young's modulus by Uniform and Nonuniform bending – I-shapegirder – Torsional pendulum - Theory – Experiment and its applications. Introduction to Viscosity – streamline and turbulent flow – Poiseuille's equation-capillary flow method – Stoke's law – terminal velocity – determination of viscosity by Stoke's method.

Unit–II : Sound

Introduction to Acoustics - factors affecting acoustics of buildings and their remedies– absorption coefficient– Sabine's formula for reverberation time.

Introduction to Ultrasonics – production – magnetostriction and piezo electric methods – Detection of Ultrasonic waves (Acoustics grating) – Applications.

Unit–III : Optics

Interference – Air wedge – Michelson's interferometer – Diffraction - Dispersive power of prism and grating – Polarisation – Types of Polarisation - theory of plane, Circularly and elliptically polarized light – photo elasticity -Stress optic law – Effect of a stressed model in plane polariscope – Isoclinic and Isochromatic fringes – photo elastic bench – uses.

Unit–IV : Crystal Physics

Lattice - Unit cell - Bravais lattice - Atomic radius, co-ordination number, Packing factor and their calculations of SC,BCC,FCC and HCP crystal structures - Miller indices - Crystal imperfections (Point defect, Line defect, surface defect and volume defect).

Unit–V : Nuclear Physics

Introduction - General properties of Nucleus – Mass defect, Binding energy, Nuclear models – Liquid drop model and Nuclear shell model - Nuclear detector – G.M counter – Scintillation Counter – Ionisation Chamber – Fission, Fusion, Thermonuclear reaction and Stellar energy – Nuclear reactor – General nuclear reactor – Breeder nuclear reactor.

Text Books

1) Arumugam, M., "Engineering Phyisics", Anuradha Agencies, Kumbakonam, 2000.
2) Gaur, R.K. and Gupta, S.L., "Engineering Physics", DhanpatRai Publishers, New Delhi, 2003.

Reference Books

1) Pillai, S.O., "Solid State Physics", New Age International Publication, New Delhi, Seventh Edition, 2015.
2) Palanisamy P.K. "Physics for Engineers", Scitech Publication (India) Pvt. Ltd., Chennai, Second Edition, 2005.
3) Mani. P. "Engineering Phyisics", Dhanam Publication, Chennai, 2011.
4) Rajendran, V. and Marikani, A., "Applied Physics for Engineers", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
5) Theraja, B.L, "Modern Physics", Chand & Company Ltd., Edition 1990.
6) Tayal, D.G., "Nuclear Physics", Himalaya publishing house, 2007.
7) Ghoshal, S.N., "Nuclear Physics", S.Chand & Company Ltd., 2012.
8) Avadhanulu, M.N. and Kshirsagar, P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005.

Course Outcomes

1) The Engineering students can gain the basic knowledge in the field of optics, sound, nuclear physics and crystalline materials etc.
2) It will be useful to apply in engineering applications.

00BS104	APPLIED CHEMISTRY – I	L	T	P
		4	0	0

Course Objectives

To make the student conversant with the

- Water treatment techniques and disinfection methods.
- Working principle of electrochemical cells.
- Sources, refining and various types of fuels.
- Mechanism, classification, applications of lubricants and introduction adhesives.
- Surface chemistry, principle and applications of chromatography.

Unit–I : Water Treatment

Water – Hardness of water – softening of water by ion-exchange process and zeolite process – boiler feed water – specifications – boiler troubles (Sludge and scale formation, priming and foaming, caustic embrittlement and boiler corrosion) – removal of dissolved CO_2, O_2 and acids – internal treatment of boiler feed water (colloidal, carbonate, phosphate, calgon and EDTA conditioning) – disinfection of water – break point chlorination – desalination of brackish water by reverse osmosis method - Determination of total hardness by EDTA method.

Unit–II : Electrochemistry

Electrochemical cell – EMF – determination of EMF of electrochemical cell – single electrode potential – standard electrode potential – Nernst equation – reference electrodes – standard hydrogen electrode, calomel electrode, glass electrode – electrochemical series – concentration cell.

Unit–III : Fuels and Combustion

Classification of fuels – calorific value – HCV and LCV – Analysis of coal – proximate and ultimate analysis – carbonization of coal (HTC and LTC) – Manufacture of coke – properties of coke – flue gas analysis by Orsat's apparatus. Petroleum – Refining – Synthetic petrol – Fischer – Tropsch and Bergius process – cracking – polymerization process – knocking in petrol and diesel engines – octane number and cetane number – properties of straight run, cracked and polymer gasoline.

Unit–IV : Engineering Materials–I

Lubricants and their functions – Mechanisms of lubrication – classification of lubricants with example – lubricating oils – properties of lubricating oils (viscosity index, flash and fire points, cloud and pour points, oiliness, carbon residue and aniline point) – Solid lubricants – Greases – emulsion lubricants. Adhesives – Definition – adhesive action – development of adhesives strength – physical and chemical factors influencing adhesive action – bonding process of adhesives – adhesives for building and constructions – animal glues, casein glues.

Unit–V : Analytical Technique and Surface Chemistry

Chromatography – Definition – classifications – partition chromatography and adsorption chromatography.

Surfacechemistry – Definition – types of adsorption – characteristics of adsorption – adsorption isotherms – Freundlich's adsorption isotherms and Langmuir's adsorption isotherms – applications of adsorption.

Text Books

1) Sivasankar, B., (2012). '*Engineering Chemistry'*, Tata McGraw Hill Publishing company Limited, New Delhi.
2) Sivakumar, R. and Sivakumar, N. (2013). "*Engineering Chemistry"*, Tata McGraw Hill Company Limited, New Delhi.

Reference Books

1) Jain, P.C. and Monica Jain, (2010). '*Engineering Chemistry'*, Dhanpat Rai & Sons, New Delhi.
2) Dara, S.S. and Umare, S.S. (2014). '*Text book of Engineering Chemistry*,' S.Chand & Co. Ltd., New Delhi.
3) Gopalan, R., Venkappayya, D., and Nagarajan, S. (2008). '*Engineering Chemistry'*, Tata McGraw Hill Publishing Company Limited, New Delhi.

Course Outcomes

At the end of the course, the student will be able to

1) Understand and develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

2) Understand and apply the concepts of electrochemistry including electroplating.
3) Understand the properties, sources of fuel and the concept of combustion
4) Gain the knowledge about types of lubricants, uses & their mechanisms and to understand the binding process of adhesives, and its application in building and construction.
5) Separate and purify various organic and inorganic compounds using different chromatographic techniques.
6) Understand the concept of surface chemistry and its applications.

00SP105	COMPUTER PROGRAMMING LABORATORY	L	T	P
		0	1	3

Course Objectives

- To enable the students to have a good understanding about the concepts of "C" programming.
- To provide the hands on experience in basic concepts of AUTOCAD to students.

C Programs Based on the Following Concepts

Basic structure of C Programs – Constants – Variables - Data Types - – Keywords – Identifiers - Operators - Expressions – IF, IF-ELSE, Nested IF-ELSE, Switch, WHILE, DO, FOR and GOTO statements - Arrays: one dimensional and two dimensional – Strings - Functions.

Autocad

Introduction – Terminology – Coordinates - Operations – Control keys – Commands – Utility Commands –File Commands – Edit and Inquiry Commands – Display Control Commands – Modes – Layers – Colors – Blocks.

Special Features – Dimensioning – Angular, Diameter and Radius – Hatching – Patterns – Slides – Attributes – Configuring – Plotting– Exercises in AUTOCAD (2D Drawings only)

Text Books

1) E. Balagurusamy, Programming in Ansi C, Tata McGraw Hill Education, (2012) 6th Edition.
2) Cheryl R. Shrock, AutoCAD Pocket Reference, BPB Publications, (2015).

Reference Books

1) Yashavant P. Kanetkar, Let us C, BPB Publications, 14th Edition, (2016).
2) David Byrnes, AutoCAD 2010 for Dummies, Wiley Publishing Inc., (2010).

Course Outcomes

1) Understand the concepts of C programming.
2) Apply the syntax of conditional and looping statements for writing C programs
3) Use the features of AUTOCAD for 2D drawing

00SP106	ENGINEERING WORKSHOP	L	T	P
		0	0	3

Course Objectives

- To provide the students simple hands-on-experience in the basic aspects of production engineering in fitting, carpentry and sheet metal.

Workshop Practice in the following Shops.

Carpentry: Use of hand tools – exercises in planning and making joints namely, half lap joint, dovetail joint, mortising and tenoning.

Fitting: Use of bench tools, vice, hammers, chisels, files, hacksaw, centre punch, twist drill, taps and dies – Simple exercises in making T joint and dovetail joints.

Sheet Metal Work: Use of hand tools – Simple exercises in making objects like cone, funnel, tray, cylinder.

Smithy: Demonstration of hand forging and drop forging.

Course Outcomes

This course

1) Use basic tools of fitting, carpentry and sheet metal fabrication.
2) Experience in the fabrication of simple carpentry joints.
3) Develop skill to make simple fitting joints.
4) Train to make simple shapes of sheet material.
5) Distinguish hand forging and drop forging operation.

SECOND SEMESTER

00BS201	ENGINEERING MATHEMATICS II	L	T	P
		4	0	0

Course Objectives

- To acquaint the student with the concepts in ordinary differential equations and vector calculus.
- To acquaint the student with the techniques in the theory of analytic functions and complex integration.
- Above topics are most important in connection with practical engineering problems.

Unit–I : Ordinary Differential Equations

Second order linear differential equations with constant coefficients, Second order linear differential equations with variable coefficients (Euler and Legendre's linear equations), Simultaneous first order linear equations with constant coefficients, method of variation of parameters.

Unit–II : Vector Differentiation

Gradient, divergence and curl, directional derivative, unit normal vector, irrotational and solenoidal vector fields, expansion formulae for operators involving ∇.

Unit–III : Vector Integration

Line, surface and volume integrals, Green's theorem in a plane, Gauss divergence theorem, Stoke's theorem – Verification of the above theorems and evaluation of integrals using them.

Unit–IV : Analytic Functions

Functions of a complex variable, Analytic function, the necessary conditions (Cauchy-Riemann equations), sufficient conditions, Properties of analytic functions, harmonic functions, construction of Analytic function by Milne-Thomson method, Conformal mapping: $w = z^2$, $1/z$, e^z, sin z, cos z.

Unit–V : Complex Integration

Statement and application of Cauchy theorem, Cauchy integral formulas, Taylor and Laurent expansion, Singularities – Classification; Residues – Statement and application of Cauchy residue theorem, Contour integration round the unit circle.

(in all units, proof of theorems are not included)

Text Books

1) Venkataraman, M.K., Engineering Mathematics, Volumes I (2008) and II (2009), The National Publishing Company, Chennai.
2) Veerarajan, T., Engineering Mathematics, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

Reference Books

1) Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi, 40th Edition, 2007.
2) Erwin Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 8th Edition, 2002.

Course Outcomes

1) This course equips students to have knowledge and understanding in ordinary differential equations, vector calculus and complex variables.
2) Students will be able to solve problems related to above fields in engineering applications.

00BS202	APPLIED PHYSICS – II	L	T	P
		4	0	0

Course Objectives

At the end of the course the students would be exposed to fundamental knowledge in various materials and applications

- Application of lasers and fiber optics in engineering and technology.
- Astrophysics is the study of physics of the universe. In various objects, such as stars, planets and galaxies.
- To measure positions, brightness, spectra structure of gas clouds, planets, starts, galaxies, globular clusters, quasars etc.
- Physics of modern engineering materials.
- Electromagnetic phenomena and wave propagation
- Applications of nano materials, nano electronics and optoelectronic devices.
- Design of energy sources and applications of solar energy.

Unit–I : Laser and Fiber Optics

Introduction to laser - Einstein co-efficients (A&B) – properties of Laser- Types of laser – CO_2, Nd-YAG and Semiconductor lasers - Applications – Holography - Construction and reconstruction of hologram - Applications.

Fiber optics - Principle and propagation of light in optical fibers - Numerical aperture and acceptance angle - Types of optical fibers (Material, Mode and refractive index) - Applications - Fiber Optic communication system.

Unit–II : Dielectrics and Superconductors

Introduction to Dielectrics – Types of Dielectric materials - Dielectric constant – Determination of Dielectric constant (∑r) by Schering Bridge method – Different types of polarization – Local or Internal field – Clausius-Mosotti Equation – Dielectric Loss – Dielectric breakdown – Dielectric Properties and applications – Superconductivity – Properties – Meissner effect – Type I and Type II superconductors – BCS theory- High temperature Superconductors – Applications.

Unit–III : Nanomaterials

Introduction to Nanomaterials – properties – Types of nanomaterials – synthesis of nanomaterials - Top-down approaches – Mechanical grinding, Lithiography – Types of Lithiography - Bottomup approaches – physical vapour deposition method, Sol-gel method. Applications of nanomaterial. Carbon Nanotubes (CNT) – Introduction – Types of Carbon Nanotubes – Synthesis of Carbon Nanotubes – Properties and its application.

Unit–IV : Quantum Mechanics

Heisenberg uncertainty Principle - Wave particle dual nature – De Broglie's matter Waves – wave Velocity and group velocity.

The wave Equation, Schrödinger's Time dependent wave equation, Schrödinger's time independent wave equation - The Wave function and its physical significance - The particle in a box – energy quantization – Eigen values and Eigen functions.

Unit -V Energy Physics

Introduction to energy source - Energy sources and their availability (Conventional &non-conventional energy sources) – Solar energy – Introduction – Methods of Harvesting Solar energy (Solar cells, Solar battery, Solar heat collectors and Solar water heater) - Wind energy – basic components of a WECS (Wind Energy Conversion System) – Classification of WEC Systems – Advantages and disadvantages of WECS - Biomass – Biomass conversion - Biogas Generation - Classification of Biogas plants.

Text Books

1) Arumugam, M., "Engineering Physics", Anuradha Agencies, 2nd Edition, 1997.
2) Gaur, R.K. and Gupta, S.L., "Engineering Physics", DhanpatRai Publishers, New Delhi, 2003.

Reference Books

1) Rajendran, V., "Engineering Physics", Tata McGraw Hill Publishers, 2009.
2) Rai, G.D., "Non-conventional Energy Sources", Khauna Publications, 1993.
3) Martin Harwit, "Astrophysical Concepts", Springer, 4th Edition, 2006.
4) Dimitri Mihalas, "Stellar Atmospheres", San Francisco, W.H., Freeman & Company, 1978.

5) Wilson, M., Kannangara K., Smitt G., Simmons M. &Boguse B. "Nano technology", Basic science and emergine technology, Raguse Chapman hall Publications, 2002.
6) Kenneth Klabunde.J, "Nanoscale Materials in Chemistry", A John Eiley& Sons, Inc., Publication, 2001.
7) Mani. P. "Engineering Phyisics", Dhanam Publication, Chennai, 2011.
8) Agarwal, M.P., "Solar Energy", S.Chand & Co., I Edn, New Delhi, 1983.
9) John Twidell & Tony Weir, "Renewable Energy Resources", Taylor & Francis, 2005.
10) Carroll B.W. & D.A.Ostlie, "An Introduction to Modern Astrophysics", 2nd Edition, 2011.
11) Avadhanulu, M.N. and Kshirsagar, P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005.
12) Rai, G.D. *"Solar Energy* Utilization", Volume- & 2 by - Khanna Publishers, New Delhi.
13) Senthilkumar, G., Engineering Physics, VRB Publishers Pvt. Ltd., Chennai.
14) Ravikrishnan, A., Environmental Science and Engineering, Hitech Publishing Company PVT Ltd.
15) Rai, G.D., "Non-Conventional Energy Sources", Khanna Publishers.
16) Senthilnathan, S., Gnanapoongothai, T., Oudayakumar, K., Jayavarthanan, T., "Material Science", SSMP Publications.

Course Outcomes

1) The student will have the theoretical knowledge in this field of laser, dielectrics, Nano technique, energy physics etc.
2) It will be very useful to the students to apply in different field of engineering.

00BS203	APPLIED CHEMISTRY – II	L	T	P
		4	0	0

Course Objectives

To make the students to understand the

- Types of polymers and polymerization processes.
- Phase rule with different kinds of systems.
- Different types of corrosion and their mechanism.
- Working principle and applications of primary and secondary batteries.
- Engineering materials such as refractories and abrasives.

Unit–I : Polymers

High polymers: plastics – Thermoplastics and thermosetting resins. Addition polymerization and condensation polymerization – compounding of plastics – Moulding methods – Compression, injection and blow moulding – Important engineering plastics – polyethylene, PVC, Teflon, Polystyrenes, Nylon 6,6, Bakelite, Polyurethane – Rubber – natural rubber – vulcanization of rubber – Synthetic rubber – buna-S, butyl rubber, neoprene and polyurethane foams.

Unit–II : Phase Rule

Phase rule – statements and explanation of the terms involved – condensed phase rule – construction of phase diagram – water system – sulphur system – phase rule for two component alloy systems – thermal analysis – eutectic system – Lead-Silver system – simple eutectic formation – Zinc – Magnesium alloy system.

Unit–III : Corrosion and Prevention

Corrosion: Dry and wet corrosion – Pilling-Bedworth rule – mechanism of wet corrosion – types of wet corrosion – galvanic corrosion – differential aeration corrosion – factors affecting corrosions. Corrosion control methods – design and material selection – cathodic protections – sacrificial anode and impressed current method – corrosion inhibitors – protective coatings – surface preparations – Galvanizations, Tinning – electroplating – anodizing, phosphate coating, hot dipping.

Unit–IV : Energy Storage Devices

Types of battery – commercial voltaic cell – primary battery – secondary storage cell – lead – acid cell, nickel-cadmium cell, lithium battery – fuel cells – hydrogen-oxygen fuel cell – photovoltaic cell – principle, working and applications.

Unit–V : Engineering Materials-II

Refractories – classification (acidic, basic and neutral refractories) – properties (refractoriness, refractoriness under load, dimentional stability, porosity, thermal spalling) – fire clay bricks, alumina bricks and zirconia bricks. Abrasives – Moh's scale of hardness – natural abrasive (diamond, corundum, emery, garnets and quartz) – synthetic abrasives – silicon carbide, boron carbide and their uses.

Text Books

1) Sivasankar, B., (2012). *'Engineering Chemistry'*, Tata McGraw Hill Publishing Company Limited, New Delhi.
2) Sivakumar, R. and Sivakumar, N. (2013). *'Engineering Chemistry'*, Tata McGraw Hill Company Limited, New Delhi.

Reference Books

1) Jain, P.C. and Monica Jain (2010). *'Engineering Chemistry'*, DhanpatRai & Sons, New Delhi.
2) Dara, S.S. and Umare, S.S., (2014). *'Text book of Engineering Chemistry'*, S.Chand & Co. Ltd., New Delhi.
3) Gopalan, R., Venkappayya, D., and Nagarajan, S. (2008). *'Engineering Chemistry'*, Tata McGraw Hill Publishing Company Limited, New Delhi.
4) Gowariker, V.R., Viswanathan, N.V. and Jayadev Sreedhar, (2006). *'Polymer Science'*, New Age International P (Ltd.,), Chennai. (Unit I).
5) Puri, B.R., Sharma, L.R. & Pathania, M.S. (2013). *'Principles of Physical Chemistry'*, Vishal Publishing Company, New Delhi. (Unit II).

Course Outcomes

At the end of the course, the student will be able to

1) Understand the synthesis and applications of various types of polymers and moulding processes.

2) Understand the concept of phase rule and its applications, which is applicable in alloy preparation.
3) Understand the concept of corrosion and to apply the knowledge in the protection of different metals from corrosion.
4) Gain the knowledge about various energy storage devices, especially solar energy.
5) Have the knowledge of converting solar energy into most needy electrical energy efficiently and economically to reduce the environmental pollution.
6) Gain knowledge on classification, synthesis and applications of abrasives and refractories.

00ES204	BASIC ENGINEERING (CIVIL)	L	T	P
		2	0	0

Course Objectives

- To inculcate a knowledge on essentials of Civil Engineering
- To expose the students on the role, significance and contributions of Civil Engineering in satisfying societal needs
- To illustrate the concepts of various construction techniques

Unit–I

Introduction to Civil Engineering - various disciplines of Civil Engineering, relevance of Civil Engineering in the overall infrastructural development of the country. Introduction to various building materials – Stone, Bricks, Steel, Cement, Concrete, Timber – its characteristics, types and uses. Various types of buildings as per nbc; Selection of suitable site for buildings, Components of a residential building – its functions, Orientation of a building, simple definitions - plinth area / built up area, floor area / carpet area – floor space index.

Unit–II

Surveying - Principles and objectives of surveying; Types, Classifications of surveying, measurement of areas and distances – chain – compass: Introduction to Leveling, Total station, Remote sensing - fundamental principles and applications.

Building construction – foundations; Bearing capacity of soil, functions of foundations, Types - Shallow and Deep. Brick masonry – Header, Stretcher, Flemish and English Bond. Columns, Lintels, Roofs – functions, types, roofing materials, Floors – functions, types, flooring materials. Decorative finishes – plastering, interior design

Unit–III

Bridges – necessity - selection of site – components of a bridge: Dams – types – selection site - forces acting on a dam – Roads – uses - classification of roads – components of a road; Railways – basic components of permanent way – water supply – per capita requirement – sources – need for conservation of water – rain water harvesting - basic water treatment – Sewage and its disposal – basic definitions – Septic tank - components and functions.

Text Books

1) Ramesh Babu, V., A Text Book of Basic Civil Engineering, Anuradha Agencies, Kumbakonam, 1995.
2) Palanichamy, M.S., Basic Civil Engineering, Tata McGraw Hill Publishing Company Ltd, 2000.

Reference Books

1) Ramamrutham, V., Basic Civil Engineering, DhanpatRai Publishing Co. (P) Ltd., 1999.
2) Natarajan, K.V., Basic Civil Engineering, Dhanalakshmi Publications, Chennai, 2005.
3) Satheesh Gopi, Basic Civil Engineering, Pearson Publications, 2010.

Course Outcomes

1) Understand the basic knowledge on civil engineering materials
2) Develops the skill to satisfy the social needs
3) Describe the suitable method of construction technique

00ES204	BASIC ENGINEERING (ELECTRICAL)	L	T	P
		2	0	0

Course Objectives

- To impart the basic principles of generation of electrical energy.
- To explain the operation of electrical machines and various measuring instruments.
- To understand the basic concepts of circuit analysis.
- To provide an overview of the principles, operation and application of semiconductor devices like diodes, BJT, FET and a basic knowledge of fundamentals of Communication Systems.

Unit–I

Sources of Electrical energy–Generation of electrical energy – working principles of DC generators and alternators– Advantages of electrical energy over other forms of Energy.

Operating principle of DC motors– Types of DC motors– Characteristics and uses of DC motors. Working principles of Single and Three phase transformers. Operating Principle of three phase and single phase induction motors– types and uses of induction motors.

Working principles of MC and MI voltmeters and Ammeters, Dynamo meter type wattmeter, Induction type energy meter and Multimeter–types of wiring– requirements for house wiring–typical layout for a small house– earthing.

Unit–II

DC Circuits: Definition of current, voltage, power and energy– DC voltage and current sources– resistance, types of resistors, series and parallel connections of resistors, current and voltage division–loop method of analysis of simple circuits.

AC Circuits: Sinusoidal signals – average, r.m.s values –inductance, capacitance and their V–I relationships. Analysis of simple single phase series circuits– power and power factor–phasor diagrams– Introductions to three phase AC circuits.

Unit–III :

Basic Electronics: Principle and characteristics, uses of PN junction Diode, Zener diode, BJT, FET, UJT, Thyristors,- Operating principle of Half wave, Full wave and Bridge rectifiers.

Digital Electronics and Principles of Communication Systems: Symbol, truth table and functions of basic logic gates, universal gates, Half adder, Full adder. Communication systems–Microwave, Satellite, Fibreoptic and ISDN (block diagram description only).

Text Book

1) Nagrath, I.J., 2007. Elements of Electrical Engineering, 2nd Edition, 14th reprint, Tata McGraw Hill Publishing Co. Limited, New Delhi.

Reference Books

1) Gupta, B.R., 2002. *Principles of Electrical Engineering*, S. Chand &Co, NewDelhi.
2) Theraja, B.L. & Theraja. A.K., 2000. *Electrical Technology, Vol. I, II, and IV*, S. Chand and Co., New Delhi.
3) Floyd & Jain, 2009. *Digital Fundamentals*, 8th Edition, Person Education.
4) Anok Singh, 2006. *Principles of Communication Engineering*, 6th reprint, S. Chand & Company Ltd., Ram Nagar, New Delhi.

Course Outcomes

1) Provide comprehensive idea about simple circuit analysis, working principles of machines and common measuring instruments
2) Analyze the behavior of any dc and ac circuits
3) Characterize semiconductor devices that include diodes, BJT and digital functions.
4) Understand fundamental principles of communication systems

00ES204	BASIC ENGINEERING (MECHANICAL)	L	T	P
		2	0	0

Course Objectives

- To familiarize the students the functioning of different types of Boilers, the mountings and accessories.
- To provide basic knowledge about the use of various machine tools and the basic principles of welding, brazing and soldering.
- To illustrate the concepts of various metal forming operations and metal joining techniques.

Unit–I

Boilers-Classification – Description and working of Simple vertical boiler, Cochran boiler, Babcock and Wilcox boiler - Description and working of boiler mountings: water level indicator, Pressure gauge, Dead weight and Spring loaded Safety value, Fusible plug, Feed check value, Steam stop value and Blow–off cock - Description and working of boiler accessories: Economizer and Super heater.

Unit–II

Prime Movers: Steam turbines: Principles and working of Impulse and Reaction turbines – Comparison. Gas turbines: Principles and working of Open cycle and Closed cycle gas turbines. Internal Combustion Engines: Classification – principal parts – comparison of two strike and four stroke engines – working principle of petrol and diesel engines.

Unit–III

Machine Tools: Description of parts and operations performed – Lathe, Shaper and Drilling machine.

Metal Forming: Hot working versus cold working; Hand forging – Principle and operations; Rolling – Principle, rolling mill configurations; Extrusion – Direct versus indirect extrusion.

Metal Joining: Gas welding – principle, Oxy-acetylene welding – equipment, types of flames, advantages and disadvantages – Arc welding - principle, advantages and disadvantages – Brazing – Torch brazing, dip brazing, furnace brazing, resistance brazing – Soldering – Comparison of brazing and soldering.

Text Books

1) Prabhu, T.J., Jaiganesh V and Jebaraj S, Basic Mechanical Engineering, Scitech Publications Pvt. Ltd., Chennai, 2000.
2) Venugopal and Prabhuraj, T.J., Basic Mechanical Engineering, ARS publishers, Sirkali, 1996.

Reference Books

1) Hajra Choudhury, S.K., Nirjhar Roy, Hajra Choudhury, A.K., Elements of Workshop Technology, (Vol 1 and Vol II), Media Promoters, Pvt Ltd. (2008).
2) Rao, P.N., Manufacturing Technology: Foundry, Forming and Welding - Vol 1, McGraw Hill Education, (2013).
3) Steven R. Schmid, Serope Kalpakjian, Manufacturing Processes for Engineering Materials (English) 5th Edition, Pearson India, (2009).

Course Outcomes

1) Understand the construction and working principles of boiler operations.
2) Distinguish between steam turbines and gas turbines.
3) Select suitable manufacturing methods to produce a new component.

00HS205	COMMUNICATION SKILLS AND LANGUAGE LABORATORY	L	T	P
		0	2	3

Course Objectives

- The Language Lab focuses on the production and practices of sounds of language
- The Language Lab familiarizes the students with the use of English in everyday situations and contexts.

Theoretical Session (Internal Assessment Only)

1) English sound pattern
2) Sounds of English
3) Pronunciation
4) Stress and Intonation
5) Situational Dialogues/ Role play
6) Oral presentations- Prepared or Extempore
7) 'Just a Minute' sessions (JAM)
8) Describing Objects /situations/ people
9) Debate
10) Giving Directions

Practical Session

- To make the students recognize the sounds of English through Audio Visual Aids
- To enable the students speak fluently without fear
- To develop their communicative skill with individual practice through the prescribed package
- The Globarena Package consists of the following exercises
  - Reading comprehension
  - Listening comprehension
  - Vocabulary exercises
  - Phonetics
  - Role Play in dialogues
  - Auto Speak

Reference Books

1) Globarena Package for communicative English
2) Cambridge Advanced Learner's English Dictionary
3) Spoken English (CIEFL) in 3 volumes with 6 cassettes, OUP.
4) English Pronouncing Dictionary Daniel Jones Current Edition with CD.
5) Spoken English- R. K. Bansal and J. B. Harrison, Orient Longman 2006 Edn.
6) A Practical course in English Pronunciation, (with two Audio cassettes) by J. Sethi, KamleshSadanand& D.V. Jindal, Prentice-Hall of India Pvt. Ltd., New Delhi.
7) A text book of English Phonetics for Indian Students by T.Balasubramanian (Macmillan)
8) English Skills for Technical Students, WBSCTE with British Council, OL.

Distribution and Weightage of Marks

English Language Laboratory Practical Paper:

1) The practical examinations for the English Language Laboratory shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2) For the Language lab sessions, there shall be a continuous evaluation during the year for 40 sessional marks and 60 year-end Examination marks. The year-end Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

Course Outcomes

1) Help the students cultivate the habit of reading passages from the computer monitor, thus providing them with the required facility to face computer-based competitive exams such as GRE, TOEFL, GMAT, etc.
2) Train the students to use language effectively to face interviews, group discussions, and public speaking.
3) Initiate the students into greater use of the computer in resume preparation, report writing, format-making, etc.,

00BP206	APPLIED PHYSICS LABORATORY	L	T	P
		0	0	3

Course Objectives

The ability to offer students a variety of research opportunities

- To determine the radius of curvature of the plano convex lens and the wavelength of the sodium light by measuring the diameter of Newton's rings.
- We can use a spectrometer to measure this angle of deviation.
- To measure the modulus of elastic material by torsional pendulum and bending of a beam.
- To determine the resistivity of a given steel and brass wire.
- To find the velocity of ultrasonic waves in a liquid.
- Less viscosity of the liquid by poiseuille's method.

List of Experiments (Any Ten)

1) Non-Uniform Bending - Determination of Young's modulus of the given scale or beam.
2) Newton's rings- Determination of Radius of curvature of the given Plano convex lens.
3) Viscosity –Determination of co-efficient of Viscosity of a highly viscous liquid by Stoke's method.
4) Spectrometer – Dispersive power of a given prism.
5) Torsional Pendulum – Determination of Moment of Inertia of the metallic disc and Rigidity Modulus of the material of a wire.
6) Field along the axis of a coil- Determination of horizontal earth magnetic flux density.
7) Air wedge – Determination of thickness of a given thin wire and paper.
8) Viscosity - Determination of co-efficient of Viscosity of a less viscous liquid by Capillary flow method
9) Uniform bending- Determination of Young's modulus of the given scale or beam.
10) Spectrometer – Determination of wavelength of the prominent spectral lines using Grating.
11) Semiconductor diode laser – Determination of wavelength of Laser source using Grating.
12) Band gap determination of a Semiconductor.

Course Outcomes

1) To determine resistivity of a given steel and brass wire.
2) To find the velocity of ultrasonic waves in a liquid.
3) To measure the thickness of a thin materials.
4) To determine the band gap of a given semiconductor.
5) Diffraction patterns can be formed by light passing through a series of fine lines
6) Applications of opto electronic devices

00BP207	APPLIED CHEMISTRY LABORATORY	L	T	P
		0	0	3

Course Objectives

- To appreciate the practical significance of acidimetry, alkalimetry and permanganometry
- To analyze quantitatively the amount of a substance present in a given sample.
- To assess the composition of an alloy
- To test the water quality standards.

List of Experiments

1) Estimation of Potassium hydroxide
2) Estimation of Acetic acid in vinegar
3) Estimation of Temporary hardness of water sample
4) Estimation of Total hardness of water sample
5) Estimate separate amount of sodium carbonate and sodium hydroxide in a mixture.
6) Estimation of Ferrous sulphate
7) Estimation of Mohr's salt
8) Estimation of ferrous iron
9) Estimation of Oxalic acid
10) Determination of available free chlorine in a water sample.
11) Estimation of copper in brass by iodometry
12) Estimation of iron by dichrometry
13) Estimation of nickel in an alloy

Course Outcome

Gain knowledge in the quantitative chemical analysis of water quality related parameters, acid-base, redox and iodometry titrations.

00SP208	ENGINEERING GRAPHICS	L	T	P
		2	0	3

Course Objectives

- To develop the ability to produce simple engineering drawing and sketches based on current practice.
- To develop the means for communication of ideas, thoughts and design of objects, related to engineering applications, to others though drawing.
- To develop the skills to read manufacturing and construction drawings used in industry.
- To develop a working knowledge of the layout of plant and equipment.
- To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators.
- To expose the international standards of technical drawing

Unit–I

Introduction to Engineering Drawing, Use of drafting instruments– Lettering and dimensioning.

Construction of conic sections -Ellipse, Parabola & Hyperbola (Eccentricity Method, Rectangle method, Intersecting arcs method) - Special curves- Simple cycloids and involutes– Tangent and normal at points on the curves only.

Unit–II

Orthographic projections - Projections of Points- Projections of Straight lines (given the projections, to determine the true length and true inclinations).

Unit–III :

Projections of Solids like prism, pyramid, cylinder, cone, tetrahedron and octahedron in simple positions.

Auxiliary Projections of prism, pyramid, cylinder, cone when the axis is inclined to one plane only.

Unit–IV

Sections of prism, pyramid, cylinder, cone in simple position – true shape of sections.Intersection of surfaces - cylinder to cylinder and cylinder to cone with axis intersecting at right angles. Development of lateral surfaces of prism, pyramid, cylinder, cone and cut solids.

Unit–V

Isometric Projections of simple solids and combinations. Perspective Projections of simple solids. Conversion of Pictorial view of simple objects into Orthographic views

Text Books

1) Bhatt, N.D., Engineering Drawing - Charotar Bookstall, Anand – 388001.
2) Venugopal, K., Engineering Drawing and Graphics – New Age International (P) Ltd., Publishers, Chennai.

Reference Books

1) Gopalakrishna, K.R., Engineering Drawing, Vol. I and Vol. II, Subhas Stores, Avenue Road, Bangalore – 560002.
2) Kumar, M.S., Engineering Graphics, DD Publications, Chennai – 6400048.

Course Outcomes

1) Construct, read, and understand the Title and Revision Block
2) Usage of common drafting tools to construct engineering drawings enhances
3) Apply dimensions on engineering drawing.
4) Ability of converting sketches to engineered drawings will increase.
5) Developing cognitive and psychomotor skills, visualize images and their dimensions
6) Develop good communication skills and team work.

DEPARTMENT OF ELECTRICAL ENGINEERING

Vision

Empowering the community of students of Electrical and Electronics Engineering with very high morals, values, ethics, skills and technical knowledge through a rich curriculum blending the equal proportions of theoretical and hands-on experience by a process of transformation via hard-work and perseverance, with a view to serving the society in the role of socially responsible engineers so as to look after the needs of the nation and to elevate the standard of living of the people by incorporating innovation and sustained research.

Mission

- To attract the students to pursue not only the under graduation, but also up to the research level, with the exquisite infrastructure, learned faculties, state-of-the-art laboratories etc., from the Indian and International diasporas.
- To foster the global standards in learning, teaching and research that owes to an overall development of the department, faculties and students within the university and from across the globe as well.
- To enhance the calibre of students to be the most sought for, by the industrial and research entities.
- To enable for a diversified and challenging career that is ensued by the highest degree of professionalism, entrepreneurship, managerial and administrative expertise.

Programme Educational Objectives

The core objectives of the B.E. programme in Electrical and Electronics Engineering are intended towards;

PEO-1

Enriching the technicalities of domain-specific-knowledge and moulding the fraternity of students to be the best bet for industry, research and academia.

PEO-2

Creating awareness and keen-interest in updating and exploiting the prevailing cutting-edge technologies unto the best possible extent, so as to address any complex, non-linear, real-time engineering issues.

PEO-3

Enabling to redress the problems of the chosen field of engineering with 4Es – ethical, economical, efficient and environmental concerns.

PEO-4

Paving foundation for developing multifaceted skills on the road to leadership, entrepreneurship, professionalism, interpersonal, critical thinking, problem solving, decision making, communication / presentation and innovation / imagination.

Programme Outcomes

PO-1

Identification, Analysis and Formulation of Real-time Engineering Problems and Ability to devise Innovative Methodologies for their Effective and Efficient Tackling.

PO-2

Application of Technical, Mathematical, Reasoning and Logical skills to Design and Implement Novel Systems, with a view to enhance the Standard of Living of the Society.

PO-3

Evaluation and Validation upon the State-of-the-art Solution Strategies employed in Various Spheres of Electrical and Electronics Engineering.

PO-4

Indulging in and Valuing the Ethical Principles, Eco-friendliness, Societal-benefits and Socio-economic concerns.

PO-5

To emulate in the Research pertaining to the Fundamental and Advanced Areas of Power Systems, Power Electronics, Digital Electronics, Microprocessors/ Microcontrollers etc.

PO-6

Capability to excel in Multi-disciplinary Specializations and Research in bridging the gap between the Conventional and Modern Modalities / Requirements.

PO-7

Abiding by the Regulations, Norms, Standards and Rules that have been put forth by the Pioneers and Organizations of the E.E.E. Society.

PO-8

Exhibition of Skills that look after Team-playing Virtues and Nurturing Leadership Qualities, especially while working in tandem with Fellow Engineers for Social Goodness.

PO-9

Curiosity in developing Managerial and Administrative capabilities that aims for the betterment of Professionals and Professionalism.

PO-10

Ability to engage in self-education and life-long learning to enable competence globally.

Mapping of PO's with PEO's

Mapping of PEO Vs PO				
	PEO 1	**PEO 2**	**PEO 3**	**PEO 4**
PO 1	✓	✓		
PO 2	✓	✓		✓
PO 3	✓	✓	✓	
PO 4			✓	✓
PO 5	✓			
PO 6	✓	✓		
PO 7		✓	✓	
PO 8				✓
PO 9				✓
PO 10	✓			✓

ES – Engineering Science

1) Basic Engineering
2) Engineering Mechanics
3) Solid Mechanics
4) Construction Engineering Materials
5) Construction Engineering
6) Thermodynamics
7) Material Science
8) Fluid Mechanics and Hydraulic Machinery
9) Particle Mechanics and Mechanical Operations
10) Material Technology
11) Basic Electronics Engineering
12) Computer Programming Lab
13) Engineering Workshop
14) Engineering Graphics
15) Building Drawing Lab
16) Computer Practical I (Building Drawings)
17) Machine Drawing
18) Electrical & Electronics Lab
19) Hydraulics Lab
20) Particle Mechanics and Mechanical Operations Laboratory
21) Basic Electronics Engineering Lab

PE – Professional Elective Theory

1) Embedded Systems
2) RISC and CISC Processors
3) Signals and Systems
4) Special Machines
5) Industrial Control and Automation
6) Energy Management and Audit
7) Digital Signal Processing
8) Real Time Operating Systems
9) VLSI Design
10) Real Time Systems
11) Non-Conventional Energy
12) Computer Aided Power System Analysis
13) High Voltage Transmission Systems
14) Power Quality studies
15) Static Relays
16) Bio-Medical Electronics and Instrumentation
17) Solid State Drives

18) Power Plant Engineering
19) Flexible A.C Transmission Systems
20) Restructured Power Systems
21) Electrical Safety

PE Lab – Professional Elective Lab

1) Embedded Systems Lab
2) Signals and Systems Lab
3) System Design Lab
4) VLSI Design Lab
5) Energy Conversion Lab
6) Advanced Control Systems Lab

OE – Open Elective Theory

1) Communication Engineering
2) Data Structures and C++
3) Java Programming
4) Soft Computing Techniques
5) Quantitative Management Techniques
6) Computer Networks
7) Enterprise Resource Planning
8) Supply Chain Management
9) Cloud Computing
10) Internet of Things
11) Biology for Engineers
12) Disaster Management
13) Entrepreneurship
14) National Service Scheme
15) Human Rights

THIRD SEMESTER

00HS301	ENVIRONMENTAL STUDIES	L	T	P
		4	0	0

Course Objectives

- To realize the importance of environment for engineering students.
- To understand the basics of ecosystems.
- To make aware the student about global environmental problems and natural disasters.
- To give the ideas about advance technologies of engineering that will be useful to protect environment.

Unit–I : Multidisciplinary Nature of Environmental Studies

Definition, scope and importance - Need for public awareness. Natural resources and associated problems - Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies- Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.- Role of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

Unit–II : Ecosystems

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–III : Biodiversity and its Conservation

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit–IV: Environmental Pollution

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management: floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

Unit–V : Human Population and the Environment

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

Field Work

Visit to a local area to document environmental assets –river / forest / grassland / hill / mountain-Visit to a local polluted site – Urban / Rural / Industrial / Agricultural - Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. (Field work equal to 5 lecture hours)

Text Books

1) Agarwal, K.C., 2001. Environmental Biology, Nidi Publ. Ltd. Bikaner.
2) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R).

Reference Books

1) Brunner, R.C., 1989. Hazardous Waste Incineration, McGraw Hill Inc. 480p.
2) Clark, R.S., Marine Pollution, Clanderson Press Oxford (TB).
3) Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., 2001. Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p.
4) De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5) Down to Earth, Centre for Science and Environment (R).
6) Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p.
7) Hawkins, R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
8) Heywood, V.H. & Waston, R.T., 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
9) Jadhav, H. & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
10) Mckinney, M.L. & School, R.M., 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
11) Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB).
12) Miller, T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB).
13) Odum, E.P., 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
14) Rao M N. & Datta, A.K., 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
15) Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut.
16) Survey of the Environment, The Hindu (M).
17) Townsend, C., Harper J., and Michael Begon, Essentials of Ecology, Blackwell Science (TB).
18) Trivedi, R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R).

19) Trivedi, R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB).
20) Wanger, K.D., 1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

(M) Magazine (R) Reference (TB) Textbook

Course Outcomes

1) Understand the importance of environment.
2) Analyze the importance of environment in engineering.
3) Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
4) Employ awareness among the society about environmental problems and natural disasters.
5) Practice according to the present and future environmental issues.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1		✓		✓						
CO2	✓	✓		✓		✓				
CO3	✓	✓		✓						
CO4		✓		✓						
CO5	✓			✓		✓				✓

00BS302	**ENGINEERING MATHEMATICS – III**	**L**	**T**	**P**
		4	**1**	**0**

Course Objectives

- To train the students in partial differential equations, Fourier series, Boundary value problems, Fourier transform and Z-transform which can serve as basic tools for specialized studies in engineering.

Unit–I : Partial Differential Equations

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

Unit–II : Fourier Series

Dirichlet's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

Unit–III : Boundary Value Problems

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

Unit–IV : Fourier Transform

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's identity

Unit–V : Z – Transform and Difference Equations

Z – transform – Elementary properties – Inverse Z – transform - Convolution theorem – Solution of difference equations using Z – transform.

Text Books

1) Kandasamy, P., Thilagavathy, K. and Gunavathy, K., Engineering Mathematics, 6th ed., (Vol-I & II) S.Chand & Co Ltd. 2006, New Delhi.
2) Ventakataraman, M.K., 2003. Engineering Mathematics - The National Publishing Co., Chennai.

Reference Books

1) Veerarajan, T., Engineering Mathematics, 3rd edition, 2005, Tata McGraw Hill Pub.
2) Singaravelu, A., Engineering Mathematics, Meenakshi Publications, Chennai, 2004.

Course Outcomes

1) Acquire basic understanding of the most common partial differential equations.
2) Understand Fourier series, Fourier transform and Z-transform analysis.
3) Ability to solve some boundary value problems.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓							
CO2	✓	✓	✓							
CO3	✓	✓	✓							

00ES303	ENGINEERING MECHANICS	L	T	P
		4	0	0

Course Objectives

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To understand and predict the forces and its related motions.

Unit–I : Statics of Particles

Introduction-Units and Dimensions-Laws of Mechanics-Lami's Theorem-Parallelogram, Triangular and Polygon Law of Forces-Classification of Forces-Vectorial Representation of Forces-Coplanar Forces-Resolution of Forces.

Equilibrium of Particle-Vector representation of Space Force-Equilibrium of Particle in Space-Equivalent System of Forces-Principle of Transmissibility.

Unit–II : Equilibrium of Rigid Bodies

Free Body Diagram-Types of Supports- Types of loads- Types of beams-Action and Reaction of Forces- -Moments and Couples-Moment of a Force-Vectorial Representation of Moments and Couples.

Varignon's Theorem- Stable Equilibrium-Single Equivalent Force-Equilibrium of Rigid Bodies in Two Dimensions and Three Dimensions.

Unit–III : Geometrical Properties of Surfaces and Solids

Centroid and Centre of Gravity-Determination of Centroid of Sections of Different Geometry- Centre of Gravity of a Body-Area Moment of Inertia-Parallel Axis Theorem-Perpendicular Axis Theorem-Determination of Moment of Inertias of Rectangular, Triangular, Circular and Semi-circular- Moment of Inertias of structural Steel Sections of Standard and Composite Sections.

Polar Moment of Inertia-Radius of Gyration-Principal Moment of Inertia-Mass Moment of Inertia- Determination of Mass Moment of Inertia of a Thin Rectangular Plate, Thin Circular Disc, Solid Cylinder, Prism, Sphere and Cone from first principles.

Unit–IV : Dynamics of Particles

Introduction-Kinematics and Kinetics-Displacements, Velocity and Acceleration-Equations of Motion-Types of Motion-Rectilinear Motion-Relative Motion-Curvilinear Motion-Projectiles.

Newton's Laws of Motion-Linear Momentum-Impulse and Momentum-D'Alembert's Principle-Dynamic Equilibrium- Work Energy Equations-Law of Conservation of Energy-Principle of Work and Energy.

Unit–V : Friction and Elements of Rigid Body Dynamics

Friction Force-Laws of Sliding Friction-Equilibrium Analysis of simple systems with Sliding Friction-Wedge Friction.

Rolling Resistance-Translation and Rotation of Rigid Bodies-Velocity and Acceleration-General Plane Motion of Simple Rigid Bodies such as Cylinder, Disc/Wheel and Sphere.

Text Books

1) Beer, F.P., and Johnson, R., (2004). *Vector Mechanics for Engineers (Statics),* McGraw Hill Book Company, New Delhi.
2) Palanichamy, M.S. and Nagan, S., (2010). *Engineering Mechanics (Statics and Dynamics)*, Tata McGraw Hill Publishing Company, Ltd., New Delhi.

Reference Books

1) Natesan, S.C., (2002). Engineering Mechanics (Statics and Dynamics), First Edition, Umesh Publications, New Delhi.
2) S.S. Bhavikatti and K.G. Rajasekarappa, (1999). Engineering Mechanics, New Agent International (P) Ltd.
3) Sadhu Sing, (2000). *Engineering Mechanics,* Oxford & IBH Publishing Co., New Delhi.
4) Irving H. Shames, (2006). *Engineering Mechanics,* prentice Hall of India Ltd., New Delhi.
5) Hibbeller, R.C. and Ashok Gupta, (2010). *Engineering Mechanics: Statics and Dynamics,* Edition, Pearson Education.

Course Outcomes

1) Understand the forces and its related laws of mechanics in static and dynamic conditions.
2) Analyze the forces and its motions on particles, rigid bodies and structures.
3) Solve the moment of inertia of any section and masses for the structural members.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓			✓				
CO2	✓	✓	✓			✓				
CO3	✓	✓	✓			✓				

05ES304	FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P
		4	0	0

Course Objectives

- To understand the physical properties of fluids, fluid pressure and its measurement.
- To derive the equation of conservation of mass and its application.
- To solve problems of fluid kinematics and dynamics specifically flow through pipes and open channel flow.
- To use important concepts of continuity equation, Bernoulli's equation and apply the same to problems.
- To study the performance of Turbines, Radial flow, Reaction turbines and governing of turbines.
- To study the characteristics of Centrifugal pumps and reciprocating pumps.

Unit–I : Properties of Fluids, Fluid Pressure and its Measurement

Mass density, specific weight, specific volume, specific gravity, viscosity - Newton's law of viscosity - compressibility - surface tension and capillarity - real and ideal fluids.

Pressure - atmospheric and vacuum pressures - measurement of pressure by manometers and pressure gauges - total pressure and center of pressure – Buoyancy - metacentre - simple problems.

Unit–II : Dynamics of Fluid Flow

Kinematics of flow - types of fluid flow - continuity equation - Euler's equation of motion - Bernoulli's equation - practical applications - venturimeter, orificemeter and pitot tube. Simple treatment of orifices, mouthpieces, notches and weirs.

Flow through pipes - loss of energy due to friction - minor energy losses - hydraulic gradient and total energy line - flow through pipes in series - Flow through parallel pipes - power transmission through pipes - flow through nozzles.

Unit–III : Flow in Open Channels

Classification of flow in channels - Chezy's and Manning's formulae - most economical Rectangular, Trapezoidal and Circular sections of channel.-Non-uniform flow through open channels - specific energy and specific energy curve -

critical depth - critical velocity - critical, supercritical and subcritical flows - alternate depths.

Unit–IV : Impact of Jet and Turbines

Impact of jets - force exerted by a fluid on stationary and moving flat plates held in various positions - force exerted on curved plates - concept of velocity triangles.

Turbines: General layout of a hydroelectric power plant - Classification of turbines - velocity triangles for turbines - work done and efficiency, specific speed - Impulse turbine - Pelton Wheel – Reaction turbine - Francis turbine - simple problems - selection of turbines.

Unit–V : Pumps

Centrifugal pumps - main parts - work done - definitions of heads and efficiencies -multistage pumps - specific speed - priming - cavitations'.

Reciprocating pumps - main parts - working principle – slip - indicator diagrams - effects of acceleration and friction on indicator diagrams - maximum speed of a reciprocating pump - study of air vessels.

Text Books

1) P.N. Modi & Dr. S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 20th Edition, Standard Book House, New Delhi; 2015.
2) R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines" Laxmi Publications (P) Ltd, Madras; 2011.
3) Jagdish Lal, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, 9th Edition, New Delhi; 2014.

Reference Books

1) K.L. Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd. 8th Edition, New Delhi, 2014.
2) V.P. Vasandani, "Theory and Design of Hydraulic Machines including Basic Fluid Mechanics", Khanna Publishers, 11th Edition, New Delhi, 2016.

Course Outcomes

1) Apply the basic knowledge of fluid mechanics in finding fluid properties, performance parameters of hydraulic turbines and pumps.
2) Use fluid dynamics for study of flow through pipes and flow in open channels.
3) Present hydraulic design for the construction of efficient hydraulic turbines and pumps.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓	✓	✓			✓				
CO2	✓	✓	✓			✓				
CO3	✓	✓	✓			✓				

05PC 305	**ELECTRIC CIRCUITS**	**L**	**T**	**P**

		4	**0**	**0**

Course Objectives

- To provide sound knowledge of the fundamentals of electric circuits for analysis.
- To impart knowledge on solving circuits using network theorems.
- To introduce the phenomenon of resonance in coupled circuits.
- To obtain the transient response of circuits.
- To analyze the three phase circuit with phasor diagrams.
- To study magnetic circuits for the calculation of magnetic quantities.

Unit–I : DC Circuits

Types of sources - relation between voltage and current in network elements - active, passive, linear, nonlinear, unilateral, bilateral, lumped, distributed elements – Graph Theory - concept of tree, branch, cotree, link, loop, and cutset Kirchoff's laws - Series and Parallel circuits –Voltage and Current division techniques- Mesh Current and Node Voltage Methods.

Unit–II : Reduction Techniques and Network Theorems

Source Transformation – Star Delta Conversion - Thevenins Theorem – Norton's Theorem – Superposition Theorem – Maximum Power Transfer Theorem – Reciprocity Theorem (DC Circuits only).

Unit–III : AC Circuits

Characteristics of Sinusoids – Average and RMS Value –Form Factor – Peak Factor- Phase Difference - Phasor Representation - Concept of Impedance and Admittance -Purely Resistive Circuit - Purely Inductive Circuit - Purely Capacitive Circuit – Series RL, RC and RLC Circuit: Phasor diagram - Voltage Triangle, Impedance Triangle, Power Factor, Power Triangle.

Series and Parallel Resonance Circuits - Properties – Variation of X_L, X_C, R and Z with Frequency - Q Factor - Half-Power Frequencies - Selectivity – Bandwidth – Locus Diagram.

Unit–IV : Three Phase Circuits and Time Domain Analysis

Advantages of Three Phase System - Star and Delta Connected Balanced and Unbalanced Loads – Two Wattmeter Method of Power Measurement.

Unit functions, step, impulse, ramp and parabolic; solution of network problems using Laplace transform; transient and steady state response of RLC networks with different types of forcing functions. Complex frequency; poles and zeros of network functions (Introductory concept only).

Unit–V : Magnetic Circuits and Coupled Circuits

Magnetic circuit concept and laws - calculation of magnetic circuit quantities-series and parallel circuits- circuits with short airgaps - fringing with long air gaps - magnetization curve of ferromagnetic materials -energy of magnetic field - magnetic pull - hysteresis and eddy current losses with a.c. excitation -Faraday's Laws- Lenz Law – Statically and Dynamically Induced EMF - Coupled Circuits: Self and Mutual Inductance – Coefficient of Coupling –Dot Convention

Text Books

1) S. Salivahanan and S. Pravin Kumar, Circuit Theory, Vikas Publishing, 2014.
2) Sudhakar, A. and Shyam Mohan, S.P., Circuits and Network Analysis and Synthesis, Tata McGraw Hill Publishing Company Limited, New Delhi, Fourth Edition, 2010.

Reference Books

1) Charles K. Alexander, Matthew N.O. Sadiku, Fundamentals of Electric Circuits, McGraw Hill, Fifth Edition, 2013.
2) William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill publishers, New Delhi, Seventh Edition, 2011.
3) Chakrabarti, A., Circuit Theory (Analysis and Synthesis), Dhanpat Rai & Co, New Delhi, 2014.

Course Outcomes

1) Able to analyze electrical circuits.
2) Able to apply circuit theorems.
3) Learn the concepts of magnetic and coupled circuits.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2	✓	✓								
CO3		✓	✓							

05PC306	ELECTRONIC DEVICES AND CIRCUITS	L	T	P
		4	0	0

Course Objectives

- To provide exposure to basic electronic devices.
- Understand the construction working and characteristics of various switching devices.
- To analyze and design circuits using transistors and oscillators.

Unit–I : PN Junction Devices and its Applications

Formation of PN junction- Drift ad diffusion currents –biasing of PN junction-diffusion and transition capacitance- diode-–structure, operation and V-I characteristic- temperature effects-diode current equation – Power diodes - Zener diode – structure, operation and V-I characteristics- Diode clampers and clippers-Rectifiers: HWR, FWR, BR,- filters – Zener as regulator.

Unit–II : Switching Devices

Transistor – construction, operation and V-I characteristic (CE, CB and CC configurations) -DC operating point and Load line--breakdown-thermal runaway-heat sink- Methods of Biasing - Power Transistors -Transistor as a switch -UJT-structure, operation and V-I characteristics-UJT based saw tooth oscillators-IGBT`s - Switching characteristics-Thyristor family SCR`s, Diacs, Triacs - GTO`s and MCT`s - structure, operation and V-I characteristics.

Unit–III : Transistor Amplifiers

Transistor as an amplifier- Classification of amplifiers - Distortion - Frequency response -BJT Small signal hybrid model -analysis of CE, CB, CC amplifiers- Bandwidth of cascaded stages - Low frequency response of a RC coupled amplifier and influence of bypass capacitor -Difference Amplifier- Class A,B,C and Push-Pull Amplifier- Transformer coupled amplifier-Tuned amplifiers- Single tuned, double tuned and stagger tuned amplifiers.

Unit–IV : Field Effect Transistors

JFET- structure, operation and V-I characteristic – Methods of Biasing- MOSFET – types–structure, operation V-I characteristic-Zero bias and Drain feedback bias- MOSFET small signal model– analysis of CS and source follower.

Unit–V : Feedback Amplifiers and Oscillators

Concept of feedback-types- derivation of gain-merits and demerits of negative feedback and positive feedback – negative feedback types(voltage./ current, series / shunt feedback)-input and output impedance –classification of Oscillators-equation for the oscillation-condition for oscillations- phase shift, Wien bridge, Hartley, Colpitts and crystal oscillators

Text Books

1) S. Salivahanan and N. Suresh Kumar, "Electronic Devices and Circuits" Tata McGraw Hill Education, Third Edition, 2012.
2) V.K. Mehta, Rohit Mehta, "Principles of Electronics", S.Chand Publications, 2005.

Reference Books

1) Rashid, "Microelectronic Circuits" Thomson Publications, 2010.
2) Floyd, "Electron Devices" Pearson Asia 5th Edition, 2013.
3) Donald A. Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 5th Edition, 2007.
4) Jacob Milman, Christos. C. Halkias and Satyabratajit, "Electronic Devices and Circuits" Tata McGraw Hill Education Pvt. Ltd., Third Edition (Special Indian Edition), 2010.

Course Outcomes

1) Understand the concept of various electronic and switching devices by learning their characteristics.
2) Capable of designing amplifier and oscillator circuits.
3) Able to troubleshoot various electronic circuits.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2		✓								
CO3	✓									

05SP307	HYDRAULICS LABORATORY	L	T	P
		0	0	3

Course Objectives

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharge are to be explained and computed practically.
- To study of the characteristic features of pumps and turbines using experiments.
- To understand the significance and role of such utilities in their further course of study.

List of Experiments

1) Determination of Co-efficient of discharge of Mouth Piece
2) Determination of Co-efficient of discharge of Venturimeter
3) Determination of Co-efficient of Head loss due to Sudden Change in Section
4) Determination of Co-efficient of Head loss due to Friction in Pipe
5) Determination of Co-efficient of discharge of Rectangular Notch
6) Determination of Co-efficient of Impact of Jet on Vanes
7) Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
8) Study of Performance characteristics of Sump Pump (Centrifugal Pump)
9) Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
10) Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
11) Study of Performance characteristics of Pelton Turbine (Constant Speed method)
12) Study of Performance characteristics of Francis Turbine (Constant Head method)
13) Determination of Metacentric Height of a floating vessel (Demo Only)
14) Study on Flow through Open Channel (Demo Only)

Course Outcomes

1) Determine the properties of fluids, pressure and their measurements.
2) Measure flow in pipes and determine frictional losses.
3) Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits.
4) Develop Characteristics of pumps and turbines.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓				✓				
CO2	✓	✓				✓				
CO3	✓	✓				✓				
CO4	✓	✓				✓				

05CP308	CIRCUITS AND DEVICES LAB	L	T	P
		0	0	3

Course Objectives

- To understand the operation of basic electronic devices.
- To illustrate the concepts of RL and RC circuits.
- To solve circuits by applying theorems.

List of Experiments

1) Verification of Ohm's Law and Kirchoff's Laws.
2) Verification of Thevenin's and Norton's theorem.
3) Verification of Super position theorem and Verification of Maximum power transfer theorem.
4) Characteristics of Junction diode, Characteristics of Zener diode and Zener diode as a voltage regulator.
5) Half wave and full wave rectifiers with capacitor filter.
6) Characteristics of Transistors.
7) Characteristics of Field Effect Transistor.
8) Characteristics of UJT.
9) Characteristics of SCR.
10) Transistor Biasing Circuits.
11) Wave shaping circuits
12) Half wave and full wave rectifiers without capacitor filter.
13) Characteristics of LDR
14) Characteristics of Photo transistors
15) Study of RLC circuits
16) Series and parallel resonance circuits

Course Outcomes

1) Learn the application and characteristics of basic electronic devices.
2) Analyze RL and RC circuits.
3) Gain knowledge to troubleshoot various electronic circuits.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2		✓								
CO3		✓								

FOURTH SEMESTER

05BS401	PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS	L	T	P
		4	1	0

Course Objectives

- Be exposed to probability, random processes, and statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics using method of finite difference interpolation.
- To find numerical solution of algebraic and transcendental equations.
- To find the numerical solution of ordinary and partial differential equations.

Unit–I : Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution -marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

Unit–II : Random Processes

Classification of random processes – methods of description of a random process – special classes of random processes – Average values of random process - stationary –Autocorrelation function and its properties - cross correlation function and its properties.

Unit–III : Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

Unit–IV : Interpolation, Numerical Differentiation and Integration

Interpolation: Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval. Numerical differentiation: Using Newton's forward and backward interpolation formula.Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rule.

Unit–V : Solution of Algebraic, Transcendental and Ordinary Differential Equations

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton–Raphson method.

Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss – Seidel iteration method.

Solution of ordinary differential equations: Taylor series method, Runge–Kutta fourth order method, Milne's - Predictor corrector method.

Text Books

1) Kandasamy, P., Thilagavathy, K., and Gunavathy, K., Probability and Random Processes, S.Chand & Co. Ltd. 2006, New Delhi.

2) Veerarajan, T., Probability theory and Random Process, Tata McGraw Hill Co., Ltd., New Delhi, 2005.
3) Venkataraman, M.K., Numerical methods in Science and Engineering, National Publishing Co., Chennai - 2003.

Reference Books

1) Lipschutz, S., and Schiller, J., Schaums"s Outlines – Introduction to Probability and Statistics, McGraw Hill, New Delhi, 1998.
2) Kandasamy, P., Thilagavathy, K. and Gunavathy, K., Numerical Methods, S.Chand & Co. Ltd., New Delhi, 2004.

Course Outcomes

1) Acquire skills in handling situations involving random variables, random processes.
2) Ability to solve problems for engineers in using numerical methods.
3) Acquire skills in solving algebraic transcendental equations.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓				✓		✓		
CO2	✓	✓						✓		
CO3	✓	✓				✓		✓		

05ES402	MATERIAL SCIENCE	L	T	P
		4	0	0

Course Objectives

- To introduce the basic concepts of conducting materials.
- To understand the properties of semiconducting, magnetic and dielectric materials.
- To study the properties and applications of optical materials.
- To learn the new materials used in communication engineering.

Unit–I : Conducting Materials

Classical free electron theory - electrical conductivity - drawbacks of classical theory - quantum free electron theory of metals and its importance - density of energy states - Fermi-Dirac statistics - calculation of Fermi energy and its importance - concept of hole – energy bands in solids (qualitative treatment only) - effective mass of electron - high resistivity materials, superconductors-properties and applications.

Unit–II : Semiconducting Materials

Elemental and compound semiconductors and their properties - carrier concentration intrinsic semiconductors - carrier concentration in n-type and p-type semiconductors - variation of Fermi level and carrier concentration with temperature - Hall effect – applications.

Unit–III : Magnetic and Dielectric Materials

Different types of magnetic materials and their properties - domain theory of ferromagnetism - Heisenberg criteria - Hysteresis energy product of a magnetic material - merits and their applications - magnetic recording materials-metallic glasses - Dielectrics - Fundamental definitions - different types of electric polarization - dielectric loss – properties and different types of insulating materials - active and passive dielectrics and their applications - Ferro electrics – Piezo-electrics .

Unit–IV: Optical Materials

Optical properties of metals, insulators and semiconductors - phosphorescence and fluorescence - excitons, traps and colour centres and their importance - different phosphors used in CRO screens - liquid crystal as display material - Thermography and its applications - photoconductivity and photo conducting materials.

Unit–V : : New Engineering Materials

Metallic glasses as transformer core materials - Nano phase materials - Shape memory alloys - Bio-materials - Non-linear materials – Second harmonic generation - Optical mixing - Optical phase conjugation - Solitons - Nuclear engineering materials - IC packaging material.

Text Books

1) Arumugam, M., "Materials Science", *Anuradha Publications, 2010.*
2) Palanisamy, P.K., “Materials Science”, *Scitech publications, 2003.*

Reference Books

1) Dekker, A.J., “Electrical Engineering Materials” *Prentice Hall of India, 2006.*
2) Rajput, R.K., “Electrical Engineering Materials”, Laxmi Publications New Delhi, 1993.
3) Simon, S.M., "Physics of Semiconductor devices", 3rd Edition, *Wiley Eastern, 2007.*
4) Van Vlack, L.H., "Material Science for Engineers", *Addison Wesley, 2000.*

Course Outcomes

1) Understand the concept of conducting materials.
2) Realize the properties of semiconducting, magnetic, dielectric and optical materials.
3) Know the importance of optical materials in electrical engineering field.
4) Introduce new engineering materials in electrical engineering.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2		✓								
CO3	✓									
CO4		✓			✓					

05PC403	ELECTROMAGNETIC FIELDS	L	T	P
		4	0	0

Course Objectives

- To look back mathematical tools like vector calculus for investigating the physics of electric and magnetic fields.
- To understand the concepts of electrostatics, electric potential, energy density and their applications.
- To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and their applications.
- To understand Faraday's laws, time varying fields and Maxwell's equations.
- To explore the fundamentals of wave propagation, pointing theorem and its applications.

Unit–I : Introduction

Sources and effects of Electromagnetic Fields – Vector Fields – Introduction to Different coordinate systems– Vector Calculus – Gradient, Divergence and Curl – Divergence theorem – Stoke's theorem

Unit–II : Electrostatics

Coulomb's Law – Electric Field Intensity – Field due to point and continuous charges –Gauss's law and application – Electric Potential – Electric field - Electric flux density – Relation between potential gradient and electric field intensity – Dielectric Polarization – Dielectric strength – Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations – Capacitance – Energy density – conduction current, convection current and displacement current – Equation of continuity –Electrostatic induction in telephone lines.

Unit–III : Magnetostatics

Lorentz Law of force – Magnetic field intensity – Biot-Savart Law – Ampere's Circuital Law –Magnetic field due to straight conductors – Circular loop – Infinite sheet of current –Magnetic flux density (B) – Boundary conditions – Scalar and vector potential – Magnetic force - Forces acting on parallel current carrying conductors -Energy stored in magnetic field – Torque – Inductance – Energy density .

Unit–IV : Electrodynamic Fields

Faraday's laws – Induced EMF – Transformer and Motional EMF – Hysterisis loss and eddy current loss - Maxwell's Equations (differential and integral Forms) – Relation between Field theory and Circuit theory.

Unit–V : Electromagnetic Waves

Maxwell's wave equation – plane electromagnetic wave in free space – sinusoidal electromagnetic wave – Poynting vector and Poynting's theorem – Relation between electric field intensity and magnetic field intensity - Applications of the concepts of Poynting vector – Surge impedance of a line in terms of energy balance.

Text Books

1) J.A. Edminister, "Theory and Problems of Electromagnetics", 2nd Edition, Schaum Outlines Series, Tata McGraw Hill, 2007.

2) W.H. Hayt, and J.A. Buck, "Engineering Electromagnetics", 7th Edition, Tata McGraw Hill Edition, 2006.
3) K.A. Gangadhar, P.M. Ramanathan, Electromagnetic Field Theory Khanna Publishers, 2013, New Delhi.

Reference Books

1) Mathew, N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press Inc., 1st Indian Edition, 2007.
2) Ashutosh Pramanik, "Electromagnetism – Theory and Applications" Prentice Hall of India, 2006.
3) D. Sathaiah, and M. Anitha, "Electromagnetic Fields", Scitech Publications, 2012.

Course Outcomes

1) Understand vector calculus in investigating the physics of electric and magnetic fields.
2) Ability to explore the electrostatic applications and to solve problems with medium of different boundaries.
3) Familiarity in the applications of time varying field and wave propagation thereby making the students competent in electric, magnetic and time varying fields.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓	✓	✓							
CO2		✓	✓							
CO3				✓	✓					

05PC404	**ELECTRICAL MACHINES**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To learn the principle of energy conversion.
- To have a sound knowledge about different categories of electrical machines.
- To familiarize the students with the functioning of different types of DC, AC and special machines, their mountings and accessories apart from transformer.
- To provide basic knowledge about the applications of various machines and the basic principles of operation along with their Equivalent circuits and Phasor diagrams.
- To illustrate the different testing techniques available and obtain their characteristics.
- To analyze the different speed control schemes available for each category of machines.

Unit–I : D.C. Machines

Laws of Electromagnetism–Construction of DC Machines– DC Generator- EMF Equation – Methods of excitation – Types– Armature reaction – Commutation– Characteristics- DC Motor- Principle of operation–Types–Back EMF–Torque equation – Characteristics– Swinburne's test, Hopkinson's test -Starting and Speed control of D.C shunt and series motors.

Unit–II : Transformers

Constructional details – Principle of operation – Bucholtz relay, conservator and breather -EMF equation – Transformation ratio – Transformer on No-load and load – leakage reactance- phasor diagram - Equivalent circuit–Load test- Open circuit and Short circuit test– Voltage regulation - Parallel operation of single-phase transformer- Sumpner's test - Pseudo load test on three phase transformer - separation of core losses - Scott connection- No-load and on-load tap changing transformer- auto transformer- comparison of auto transformer with two winding transformer,

Unit–III : Three Phase Induction Motors

Constructional features, cage and slip ring rotors, principle of operation, synchronous rotation of gap flux, phasor diagram, equivalent circuit, expression for torque, torque-slip characteristic- condition for maximum torque and maximum power- load test- no-load and blocked-rotor tests- Pre-determination of motor performance on the basis of circle diagram- starting of slip-ring and cage motors- Speed control of induction motors- Variation of supply voltage- rotor resistance control.

Unit–IV : Single Phase Induction Motors

Double field revolving theory, cross field theory. Torque slip characteristic and its interpretation, split phase starting, resistance start, resistance start and run, capacitance start, capacitance start and run, typical performance characteristics, determination of constants of equivalent circuit, computation of performance from equivalent circuit.

Unit–V : Synchronous Machines

Constructional features of round rotor type and salient pole type machines, EMF equation, rotating magnetic field, armature reaction- synchronous reactance, phasor diagram- performance characteristics, predetermination of voltage regulation by synchronous impedance, ampere turn and potier methods- Parallel operation- Principle of operation of synchronous motor on infinite bus bars, phasor diagram, V curves and inverted V curves, hunting and its suppression- starting methods - Permanent magnet synchronous motors – Principle of operation and characteristics.

Text Books:

1) Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill Publishing Company Ltd, Fourth Edition, Fifth Reprint 2012.
2) Er. Rajput, R.K., Electrical Machines, Lakshmi Publications, New Delhi, First Edition 1992.
3) A.K. Theraja & B.L. Theraja, A Text Book of Electrical Technology, Vol.2, S. Chand Publishing, 2014.

Reference Books

1) A.E. Fitzgerald, Charles Kingsely Jr, Stephen D. Umans, Electric Machinery, McGraw Hill Books Company, Seventh Edition, 2013.
2) P.S. Bhimbhra, Electrical Machinery, Khanna Publishers, Seventh Edition, 2013.
3) Samarajit Ghosh, Electrical Machines, Pearson Education, Second Edition, 2012.

Course Outcomes

1) Understand the construction, working principles & operations of all types of machines.
2) Predict the performance of electrical machines from their equivalent circuit models.
3) Select suitable machine to meet specific application requirement.
4) Validate the theoretical concepts by conducting experiments in practical sessions.
5) Study the different testing techniques available to assess the performance of machine.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓						✓			
CO2		✓								
CO3		✓								
CO4			✓							
CO5						✓				

05PC405	DIGITAL ELECTRONICS	L	T	P
		4	0	0

Course Objectives

- To review the fundamental concepts relating to Number systems, codes and Boolean algebra.
- To explain the working and the characteristics of Logic families (RTL, DTL, HTL, TTL, ECL, MOS & CMOS) and Logic packages (SSI, MSI, LSI, VLSI & VVLSI).
- To bring out the function of logic gates, implementation of Boolean function using logic gates, simplification of Boolean Expression using K-map and implementation of various combinational circuits.
- To illustrate the function of various types of flip-flops and counters with the help of circuit diagram, truth table, state equation and timing diagram.
- To study the classification of semiconductor memories and programmable logic devices operation of A/D and D/A converters.

Unit–I : Boolean Algebra

Signed binary numbers - Binary arithmetic in computers - BCD arithmetic - Data representation - Fixed and floating point representation - Exponent representation of floating point binary numbers - Weighted and non weighted binary codes - Alphanumeric codes - Error detection and correction codes - Laws of

Boolean algebra - Boolean expressions and logic diagrams - Negative logic - Introduction to mixed logic.

Unit–II : Logic Families

Logic families - Specifications of a logic circuit - Operation and characteristics of RTL,DTL,HTL,TTL,ECL,MOS,CMOS and I^2L families - Comparison of logic families - Open collector, totem pole, Schottky and tristate TTL gates - Wire-ANDing, strobed gate, expanders, and expandable gates - Logic packages SSI,MSI,LSI,VLSI and VVLSI.

Unit–III : Combinational Logic

Combinational logic - Introduction - Min Terms and Max Terms - Truth tables and maps - Solving digital problems using maps - Sum of products and product of sums map reduction - Hybrid functions - Incompletely specified functions - Multiple output minimization - Tabular minimization - Implementation of Boolean expressions using AND, OR, NOT Logic gates and Universal gates - Multiplexer - Demultiplexer- Decoder - Code converter - Arithmetic functions.Fault diagnosis in combinational circuits - Classical methods - Boolean difference method.

Unit–IV : Sequential Logic Circuits

Sequential logic - Flip-flops - Counters - Types of counters - Ripple counter design - Type T, type D and type JK design - Design using state equations - Shift registers - Asynchronous sequential circuits - Fault diagnosis in sequential circuits (Qualitative treatment only)

Unit–V : Digital Integrated Circuits

Memory circuit and systems ROM, PROM, EPROM, EEPROM, RAM, DRAM - D/A converters - A/D converters - memory subsystems - PLA,PAL, series PLD's - FPGA - ASIC.

Text Books

1) Morris Mano “Digital Logic and Computer Design” Prentice Hall, Fourth Edition, 2013.
2) Fletcher, William I, “An engineering approach to Digital Design”, Prentice-Hall Of India Pvt Ltd, Fourth Edition, 1996.

Reference Books

1) Donald P. Leach, Albert Paul Malvino, Goutan Saha, “Digital Principles and Applications” Seventh Edition, 2010.
2) Zvi Kohavi and Niraj K. Jha, “Switching and Finite Automata Theory” Third Edition, 2011.
3) B. Holdsworth and Woods, “Digital Logic Design”, Fourth Edition, 2002.

Course Outcomes

1) Acquire knowledge in the basic concepts of digital systems and solve the problems related to number systems, Boolean algebra.
2) Understand the significance of various logic families and logic packages.
3) Develop the ability to identify, analyze and design combinational circuits.
4) Equip the capability to design Synchronous and Asynchronous sequential circuits.

5) Gather the operational theory of memory and programmable logic devices.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2					✓					
CO3	✓	✓								
CO4	✓	✓								
CO5					✓					

05PC406	ANALOG INTEGRATED CIRCUITS	L	T	P
		4	0	0

Course Objectives

- To investigate the static and dynamic characteristics of popular MOS and bipolar logic families, with emphasis on CMOS.
- To analyze, design and develop applications for modern analog circuits using integrated field effect transistor technologies.
- To study the basic principles, configurations, practical limitations and non-linear applications of op-amp.
- To analyze the operation of op-amp oscillators, single chip oscillators and frequency generators.
- To understand the operation of the most commonly used D/A and A/D converter types and its applications.
- To explain the characteristics and applications of active filters, including the switched capacitor filters.

Unit–I : Integrated Circuit Fabrication

Introduction- Classification- Fundamentals of Monolithic IC technology - Basic Planar Processes - Fabrication of a typical circuit – Fabrication of Active and Passive Components - Bipolar transistor fabrication - Fabrication of FET - Complementary MOSFET Fabrication - Thick and thin film technology.

Unit–II : Basics of Operational Amplifiers

Introduction – Fundamentals of Differential Amplifier –Current Sources – Voltage Source – Voltage References – Operational Amplifier and Terminals – Block Diagram representation of Operational Amplifier – Open loop Configuration of Operational Amplifier – Closed loop operation of Operational Amplifier - Characteristics of ideal and practical Operational Amplifiers.

Unit–III : Applications of Operational Amplifiers

Inverting Amplifier – Non-Inverting Amplifier – Phase shift circuit – Mathematical operations - slew rate model - Precision rectifier - Voltage regulator – Instrumentation amplifier- Log amplifier – V/I and I/V converter - Comparators – Zero crossing detectors.

Unit–IV : Op-Amp Multi-vibrators and Oscillators

Operational amplifier as an Astable, Bistable, Monostable multivibrators – Triangular Wave Generator – Saw Tooth Wave Generator - Schmitt Trigger . Oscillators - Phase shift – Wein bridge – Hartley - Collpitts and quadrature type – A/D and D/A converters – VCO – PLL – IC 555 timer applications.

Unit–V : Active Filters

Introduction to active filters – RC active filters – first order - second order low pass and high pass filters – Band pass filter – Narrow band pass filter – Wide band filter – Band reject filter – State variable filter – Switched capacitor filter – State variable switched capacitor filter IC.

Text Books

1) Gray Paul, R. and Meyer Robert, G., "Analysis and Design of Analog Integrated Circuits", 4th Edition, John Wiley, 2001.
2) Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th edition, Pearson education, 2002.
3) Ganesh Babu, T.R. and Suseela, "Linear Integrated Circuits", 6th edition, Scitech Publications (India) Pvt. Ltd., 2015.

Reference Books

1) Coughlin and Driscoll, "Operational-Amplifiers and Linear Integrated Circuits", 6th edition, Pearson education, 2001.
2) Sergio Franco, "Design with operational amplifier and analog integrated circuits", McGraw Hill, 2003.
3) Kang Sung-Mo and Leblebici Yusuf, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edition, McGraw Hill, 2005.

Course Outcomes

1) Introduce the principles of analog circuits and apply the techniques for the design of analog IC's.
2) Discuss the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications of op-amp.
3) Analyze and design basic op-amp circuits, particularly linear and non-linear circuits, active filters and signal generators.
4) Create awareness among the students about the need for lifelong learning to succeed in their professional career as Electrical and Electronics Engineers.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓	✓								
CO2	✓	✓								
CO3	✓	✓								
CO4										✓

05PC407	ELECTRICAL MACHINES LAB	L	T	P
		0	0	3

Course Objectives

- To understand practically the principle of energy conversion.
- To have a sound knowledge about different categories of electrical machines.
- To familiarize the students with the functioning of different types of DC, AC machines, their mountings and accessories apart from transformer.
- To illustrate the different testing techniques available for DC, AC machines and transformer and obtain their characteristics practically.
- To analyze the different speed control schemes available for each category of DC & AC machines.
- To expose the student to cut section models available in the lab.

List of Experiments Involving D.C. Machines

1) Open Circuit Characteristics of DC Shunt Generator
2) Internal & External Characteristics of DC Shunt &Compound Generators
3) a) Swinburne's Test
   b) Speed Control of DC Shunt Motor
4) Hopkinson's Test

List of Experiments Involving Transformers

1) a) Open Circuit & Short Circuit Tests on Single Phase Transformer
   b) Load Test on Single Phase Transformer
2) Load Test on 3 Phase Transformer
3) Separation of Losses in Single Phase Transformer
4) Parallel Operation of two Single Phase Transformers
5) Pseudo load test on Three Phase Transformer

List of Experiments Involving Single & Three Phase Induction Motors

1) Torque-Slip characteristics of double cage induction motor
2) Load test on 3 phase slip ring induction generator
3) Load test on 3 phase slip ring induction motor
4) Load test on 3 phase cage induction motor
5) Predetermination of equivalent circuit of 1 phase induction motor

List of Experiments Involving Synchronous Machines

1) Predetermination of voltage regulation of 3 phase alternator using
   a. EMF method
   b. MMF method
   c. ZPF method
2) V and inverted V curves of synchronous motor
3) Synchronization and parallel operation of two 3 phase alternators
4) Slip Test on salient pole 3 phase synchronous machine

Course Outcomes

1) Understand the construction, working principles & operations of DC machines and transformers, Induction motors and Synchronous machines.
2) Predict the performance of electrical machines from their equivalent circuit models.
3) Validate the theoretical concepts by conducting experiments in practical sessions.
4) Distinguish the various categories of electrical machines.
5) Study the different testing techniques available to assess the performance of machine.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓						✓			
CO2		✓								
CO3		✓								
CO4			✓							
CO5					✓					

05CP408	**ANALOG AND DIGITAL INTEGRATED CIRCUITS LAB**	**L**	**T**	**P**
		0	**0**	**3**

Course Objectives

- To understand the basic functions of operational amplifier and its applications.
- To illustrate the design of Combinational and Sequential logic circuits.

List of Experiments

1) Mathematical operations using OP-AMP (μA 741)
2) Zero crossing detector and Schmitt trigger using OP-AMP
3) Precision Rectifiers
4) R.C Phase Shift Oscillator using OP-AMP
5) a. Voltage to Current Converter
   b. Current to Voltage Converter
6) Instrumentation Amplifier
7) Design of Low Pass and High Pass Filters
8) Analog to Digital and Digital to Analog Converters
9) Karnaugh Map reduction
10) Parity generator and checker circuits
11) Multiplexer and Demultiplexer
12) a. Design of Half adder and full adder circuits
    b. Full adder circuit using Multiplexer
13) Code Converter
14) Design of Modulo Counters

15) Design of Non-Sequential Counter
16) Design of Sequence Generator

Course Outcomes

1) Understand the functional characteristics of linear IC as a rectifiers, converters and amplifiers.
2) Acquire the operating theory of combinational and sequential circuits.
3) Explore the use of digital logic in integrated circuit applications.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓			✓					
CO2		✓			✓					
CO3		✓			✓					

FIFTH SEMESTER

05PC501	ELECTRICAL MEASUREMENTS AND INSTRUMENTS	L	T	P
		4	1	0

Course Objectives

- To introduce the basic functional elements of instrumentation
- To introduce the fundamentals of electrical and electronic instruments
- To educate on the comparison between various measurement techniques
- To introduce various storage and display devices
- To introduce various recorders, transducers and the data acquisition systems

Unit–I : Measurement of Voltage and Current

Units and standards - Dimensional analysis - D'Arsonval Galvanometer - Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

Unit–II : Measurement of Power and Energy

Measurement of power in single phase and three phase circuits – Moving coil - DC potentiometer-Dynamometer type wattmeter - LPF wattmeter - compensated wattmeter, hall Effect wattmeter, thermal type wattmeter - Errors and compensation. Measurement of energy in single phase and three phase circuits - Induction type energy meter - Errors and compensation - Calibration.

Unit–III : Resistance and Impedance Measurements

Measurement of low, medium & high resistance – Ammeter, voltmeter method – Wheatstone bridge –A.C bridges – Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Schering bridge – Anderson bridge- Kelvin double bridge – Series and shunt type ohmmeter – High resistance measurement, Earth resistance measurement.

Unit–IV : Storage and Display Devices

Sampling - CRO dual trace and dual beam oscilloscope- applications- Digital storage oscilloscope and applications - XY Mode - Phase measurement using oscilloscope - Null balance method - Phase shift to pulse conversion method Magnetic disk and tape, digital plotters and printers- CRT display- digital CRO-LED-LCD.

Unit–V : Recorders, Transducers and Data Acquisition Systems

Recorders - XY recorders. Strip chart recorder - XY plotters - UV recorders - magnetic tape recording - FM digital recording - interference and screening - component impurities - electrostatic and electromagnetic interference - practical aspects of interference reduction. Introduction to automated measurement system IEEE 488 standard. Classification of transducers- Selection of transducers- Elements of data acquisition system- A/D, D/A converters - Smart sensors.

Text Books

1) A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, New Delhi, 2010.
2) E.W. Golding & F.C. Widdis, 'Electrical Measurements & Measuring Instruments', A.H. Wheeler & Co, 2001.

Reference Books

1) J.B. Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K. Kataria & Sons, Delhi, 2003.
2) S.K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill, 2nd edn., 2002.
3) R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, New Delhi, 2008.
4) M.M.S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009.
5) J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011.
6) Martin U. Reissland, 'Electrical Measurement – Fundamental Concepts and Applications', New Age International (P) Ltd., 2001.
7) Bouwens A.J., "Digital Instrumentation", Tata McGraw Hill Publishing Co. Ltd., New Delhi - 1997.

Course Outcomes

1) Ability to understand and apply basic science, circuit theory, control theory and signal processing concepts to engineering problems.
2) Acquire knowledge of display instruments, amplifier measurements and CRO
3) Distinguish recorders, transducers, data acquisition systems and display devices. frequency and period measurements.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1			✓		✓					
CO2										✓
CO3	✓					✓				

05PC502	**CONTROL SYSTEMS**	**L**	**T**	**P**

		4	**0**	**0**

Course Objectives

- To develop a mathematical model for physical systems – translational and rotational system block diagram reduction techniques and signal flow graph for obtaining transfer function.
- To study transient analysis of various standard inputs for first order and second order systems.
- To study frequency response analysis and frequency domain specification by bode plot and polar plot.
- To analyze stability of system.
- To introduce the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

Unit–I : System Modelling

Basic elements in control systems - Open loop & closed loop systems - Differential equation representation of physical systems - Transfer function - Modelling of translational and rotational systems- Block diagram reduction techniques - Signal flow graph.

Unit–II : Time Domain Analysis

Types of standard test inputs - Analysis of I order and II order systems - Time domain specifications - Steady state error - Generalized error coefficients –Stability analysis - Routh Hurwitz criterion - Root locus technique-Compensators – Design of Lag, Lead and Lag Lead networks using root locus approach.

Unit–III : Frequency Domain Analysis

Frequency response -Definition - Frequency domain specifications - Bode plot- Polar plot - Nyquist stability criterion - Compensators – Design of Lag, Lead and Lag Lead networks using bode plot.

Unit–IV : State Space Analysis

Introduction - State space formulation-State model of continuous time systems - State diagram - State space representation using physical, phase and canonical variables – Solution of state equation for step input – Transfer function decomposition – Transfer matrix – Pole··Zero cancellation and system properties – Controllability, observability and detectability.

Unit–V : Optimal and Adaptive Control

Introduction – Time optimal control of continuous time systems – Optimal control systems based on quadratic performance Indices, Direct Liapunov method for linear systems – Parameter optimization problems – Design with partial state feedback – Optimal linear regulator design – Introduction to Adaptive control-Functions of adaptive controllers.

Text Books

1) Nagrath, J. and Gopal, M., "Control System Engineering", New Age International (P) Ltd., New Delhi, Reprint, 2013.
2) William S. Levine, "The Control Handbook", CRC Press/IEEE Press, Jaico Publishing House, Delhi, Reprint 2012.

Reference Books

1) Benjamin C. Kuo, "Automatic Control Systems", PHI Learning Pvt, Ltd, Delhi, 2013.
2) Ogata, K., "Modern Control Engineering", Pearson Education – Asia, 4th Edition, New Delhi, 2012.
3) Richard C. Dorf, "Modern Control Systems", Eleventh Edition, Pearson Prentice Hall, New Delhi, 2012.
4) B.S. Manke, "Linear Control Systems", Khanna Publishers, Delhi, Reprint, 2013.
5) Arturo Locatelli, "Optimal Control-An Introduction", Birkhauser Verlag, Basel Boston, 2012.
6) R. Ananda Natarajan and P. Ramesh Babu, "Control Systems Engineering", Sci-Tech Publications (India) Pvt Ltd, Chennai, Reprint, 2013.

Course Outcomes

1) Understand the concept and implementation of various modern control schemes.
2) Distinguish between Modern, Adaptive and Optimal Control techniques.
3) Design / development of solutions for future control system components by adopting various modern tools.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2		✓	✓							
CO3			✓							

05PC503	POWER ELECTRONICS	L	T	P
		4	0	0

Course Objectives

- To introduce the basic theory of SCR and its practical application in the area power electronics.
- To explain the operating principle of AC-DC, DC-DC, DC-AC and AC-AC conversion circuits.
- To illustrate the usage of power converter circuits and systems in different application including electric drives.

Unit–I : AC to DC Converters

SCR – V-I and Gate characteristics – Protection circuits – Series and parallel connections –Single phase half wave and full wave thyristor converters with R, RL and Motor load – Estimation of average load voltage, current and input power factor

– Dual converters – Three phase half wave and full wave thyristor converters-Speed control of DC motor: separately excited and series motor.

Unit–II : AC to AC Converters

AC voltage controllers – Single phase full wave controller with R and RL load – Estimation of RMS load voltage, current and input power factor – Qualitative Treatment of Three phase AC voltage controller – Single phase AC chopper – Cycloconverter – Types – AC circuit breakers.

Unit–III : DC to DC Converters

DC chopper using devices other than thyristors – Step up and step down operation – Time Ratio Control – Current Limit Control – single quadrant DC chopper with R, RL and Motor load – Estimation of average load voltage and load current – Two quadrant and four quadrant DC choppers – DC Circuit Breakers-Chopper fed speed control of DC motors: separately excited and series motor.

Unit–IV : DC to AC Converters

Inverters using devices other than thyristors – types of inverters – voltage source and current source inverters – Single and three phase bridge inverters – Control of AC output voltage – PWM techniques for inverters – Thyristorised series and parallel inverters – HVDC system – UPS.

Unit–V : AC Motor Drives

Speed control of Induction Motors – Variable voltage and frequency operation – Rotor resistance and slip power recovery schemes – synchronous motors – modes of operation – Adjustable frequency operation – controlled current operation – voltage source and current source inverter fed synchronous motor drive – PWM inverter fed synchronous motor drives – Special Machine Drives– Principle of operation and torque-speed characteristics of Switched reluctance, BLDC and Permanent Magnet Synchronous Motor drives.

Text Books

1) Rashid, M.H., “Power Electronics: Circuits, Devices and Applications”, PHI New Delhi, 2014.
2) Bimbhra, P.S., “Power Electronics”, Khanna Publishers, 2014.

Reference Books

1) Daniel W. Hart, “Power Electronics”, McGraw Hill Education (India) Pvt. Ltd., 2011.
2) Sen, P.C., “Principles of Electric Machines and Power Electronics”, 3rd Edition, Wiley, 2014.
3) Robert W. Erickson, Dragan Maksimovic, “Fundamentals of Power Electronics”, 2nd Edition, Springer, 2012.
4) Randall Shaffer, “Fundamentals of Power Electronics with MATLAB”, Charles River Media, 2013.
5) G.K. Dubey, “Fundamentals of Electric Drives”, Alpha Science International Ltd., 2001.
6) Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education Asia, 2003.

Course Outcomes

1) Understand the AC/DC power converter circuits.
2) Explore different applications for the power converter circuits.
3) Establish the suitability of converter interfaces for solid state drives.
4) Suggest the applicability of converters for HVDC systems and the architecture for UPS.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2		✓	✓							
CO3			✓							
CO4						✓				

05PC504	TRANSMISSION AND DISTRIBUTION	L	T	P
		4	0	0

Course Objectives

- To develop expressions for the computation of transmission line parameters.
- To improve the voltage profile of the transmission system by determining voltage regulation and efficiency.
- To analyze the voltage distribution in insulator strings and cable for improving voltage profile.
- To understand the operation of different types of distribution systems.

Unit–I : Determination of Line Parameters

Fundamentals of power systems: Single phase transmission - Three phase transmission - complex power - Load characteristics. Inductance of a single phase two wire line - Inductance of composite conductor lines - Inductance of three phase lines - Inductance of double circuit three phase lines - Bundled conductors - Skin effect and proximity effect.

Capacitance of a two-wire line - Capacitance of a three phase line with equilateral spacing - Capacitance of a three phase line with unsymmetrical spacing - Capacitance of a double circuit line - Effect of earth on transmission line capacitance.

Unit–II : Performance of Transmission Lines

Characteristics and performance of transmission lines : Representation of lines - Short lines - Medium length lines - Solution by nominal T and π methods - Calculation of sending and receiving end voltages and current - Regulation and efficiency of a transmission line - Long transmission line - Hyperbolic form of equations for long lines - ABCD constants - Ferranti effect - Tuned power lines - Equivalent circuit of a long line.

Voltage control: Methods of voltage control-shunt capacitors, series capacitors, tap changing transformers and booster transformers-Sending end and receiving end power circle diagrams.

Unit–III : Mechanical Characteristics of Transmission Lines

Mechanical characteristics of transmission lines: Sag in overhead lines - the catenary curve – calculation of sag with supports at different levels - Effects of wind

and ice loading - Stringing chart-Sag template-Equivalent span - Stringing of conductors-vibration and vibration dampers.

Corona: Theory of formation – Factors affecting corona - Critical disruptive voltage - Visual critical voltage - Corona loss - Advantages and disadvantages of corona-Methods of reducing corona effect-Radio interference-Inductive interference between power and communication lines.

Unit–IV : Insulators

Overhead line insulators - Types of insulators-Potential distribution over a string of suspension insulators - Methods of equalizing potential - Causes of failure of insulators.

Underground cables-Types of cables-capacitance of single core cable-Grading of cables- Power factor and heating in cables-Capacitance of three core cable.

Unit–V : Distribution Systems

Feeders, distributors and service mains: D.C. distributors - Singly fed and doubly fed two wire and three wire systems, with concentrated and uniformly distributed loads. A.C. distributor - Single phase and three phase -Division of load between lines in parallel.

Effect of Working voltage on the size of feeders and distributors - Effect of system voltage on economy - Voltage drop and efficiency of transmission-Distribution systems: Types of distribution systems - Section and size of feeders - Primary and secondary distribution - Distribution substations - Qualitative Treatment of Rural distribution and Industrial distribution

Text Books

1) Wadhwa, C.L., “Electrical Power Systems”, Wiley Eastern, 2015.
2) Nagrath, I.J. and Kothari, D.P., “Power System Engineering” Tata McGraw Hill Publishing Company Limited, New Delhi, 2015.

Reference Books

1) Soni, Gupta, Bhatnagar and Chakrabarthi, “A Text Book on Power system Engineering” Dhanpat Rai and Co; 1998.
2) Stevenson, W.D., “Elements of Power System Analysis”, McGraw Hill, 1985.
3) Ashfaq Husain, “Electrical Power Systems”, CBS Publications & Distributors, 2006.
4) V.K. Mehta and Rohit Mehta, “Principles of Power System”, S.Chand Publishers, Fourth Revised Edition, 2008.

Course Outcomes

1) Able to determine the line parameters and analyze the performance of transmission lines
2) Acquire knowledge of mechanical characteristics of transmission lines
3) Analyze the concepts of distribution systems

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1			✓							
CO2					✓					
CO3		✓								

05CP507	MEASUREMENTS AND INSTRUMENTS LAB	L	T	P
		0	0	3

Course Objective

- To provide the students simple hands-on experience in the basic aspects of various types of electrical measurements, error correction and fault detection schemes.

List of Experiments

1) Determination of B-H curve of a given ring specimen using Ballistic Galvanometer.
2) Determination of B-H loop in a transformer core using CRO
3) Measurement of Inductance using
   a. Anderson's bridge
   b. Hay's bridge
4) Measurement of Resistance using
   a. Kelvin's double bridge
   b. Wheatstone bridge
5) Measurement of Capacitance using
   a. Schering bridge
   b. Desauty bridge
6) Calibration of ammeter, voltmeter and wattmeter using DC potentiometer
7) Calibration of single phase Energy meter
8) Calibration of Three phase Energy meter
9) Calibration of three phase four wire Energy meter
10) Determination of B-H curve using permeameter
11) Measurement of Earth Resistance
12) Measurement of ABCD constants in a short transmission lines
13) Cable fault detection
14) Measurement of Induction using three ammeter, three voltmeter method
15) Reactive power measurement.
16) RLC Transients
17) Single phase voltage and frequency control UNIT for magnetic measurements.
18) Lissajous measurements
19) Separation of iron loss in the given Lloyd Fisher Magnetic Square.

Course Outcomes

1) Develop skills to generate error correction schemes.
2) Acquire knowledge in the detection of faults.
3) Understand the characteristics of basic electrical instruments.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1			✓					✓		
CO2						✓				✓
CO3					✓					

05CP508	POWER ELECTRONICS AND DRIVES LAB	L	T	P
		0	0	3

Course Objectives

- To train the students about the operation of simple power electronic circuits.
- To explain the uses of power electronics in drive applications.

List of Experiments

1) Performance evaluation of three phase semi and full converters.
2) Speed control of separately excited dc motor using single phase semi converter.
3) Load test on DC drive unit.
4) Switching characteristics of IGBT and MOSFET.
5) Time ratio control of IGBT based single and two quadrant DC chopper.
6) Frequency control using single phase mid-point Cyclo converter.
7) Firing angle control of single phase AC voltage controller.
8) Modulation index control of single phase MOSFET based PWM inverter.
9) Load test on AC drive unit.
10) PWM pulse generation using Digital Signal Processor.
11) PSPICE/MATLAB simulation of power control circuits.
12) Series and Parallel resonant converters.
13) Performance evaluation of single phase converters
14) Speed control of universal motor
15) Closed loop control of PMDC motor
16) Forced commutated DC-DC chopper
17) PWM pulse generation using FPGA

Course Outcomes

1) Acquire the characteristics of simple power electronic circuit.
2) Develop the skill to generate triggering pulses for power switches.
3) Evolve control schemes for converter fed electric motors.
4) Experience the platform for simulation of PE circuits.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2		✓	✓							
CO3					✓					
CO4	✓									

05PC601	ELECTRICAL MACHINE DESIGN	L	T	P
		4	0	0

Course Objectives

- To provide sound knowledge about constructional details and design of various electrical machines.
- To study about mmf calculation and thermal rating of various types of electrical machines.
- To learn about the various materials used in electrical machines, heating and cooling of electrical machines.

Unit–I : Basic Aspects of Design

Major considerations in Electrical Machine Design – limitations- Review of properties of materials used in electrical machines – estimation of mmf-Carter's coefficient – Real and apparent flux densities- types of enclosures – ratings- heating and cooling curves - calculations of temperature rise and fall - cooling and ventilation of rotating machines - cooling methods employed in transformers.

Unit–II : DC Machine Design

Design of dc machines: standard specifications -output equation - output coefficient - choice of specific magnetic and electric loadings - choice of number of poles - length of air gap - design of armature winding and armature core - choice of number of armature slots - dimensions of pole - design of field windings - design of commutator and brushes - design of interpole and its winding- Design examples.

Unit–III : Transformer Design

Design of Transformers - standard specification - EMF per turn - output equation - window space factor - specific loadings - dimensions of core and yoke - design of winding - cooling of transformers - design of tank with cooling tubes - estimation of no- load current of transformer - change of parameters with change of frequency- Design examples.

Unit–IV : Induction Motor Design

Design of three phase induction motor - output equation - choice of specific loadings - main dimensions - design of stator windings and core - length of air gap - design of cage rotor - design of wound rotor- Design examples.

Design of single phase induction motor - output equation - design of main winding – design of auxiliary winding – performance calculations- Design examples.

Unit–V : Synchronous Machine Design

Design of synchronous machines: standard specifications - output equation - choice of specific loadings - design of salient pole machines - short circuit ratio - length of air gap - armature design - design of rotor - design of damper winding - design of turbo alternator - Design examples.

Text Books

1) Sawhney, A.K., A Course in Electrical Machine Design, Dhanpat Rai & Co, 2015.
2) Agarwal, R.K., Principles of Electrical Machine Design, Kataria, S.K. & Sons, 2010.

Reference Books

1) Clayton, A.E. & Hancock, H.H., The Performance and Design of DC Machines, CBS, 2004.
2) Say, M.G., The Performance and Design of AC Machines, CBS, 2005.
3) Shanmugasundram, A., Gangadhar, G. and Palani, R., Electrical Machine Design Data Book, New Age International, 2015.
4) Rai, H.M., Principles of Electrical Machine Design, Sathya Prakashan, 2010.
5) Mittle, V.N. and Mittal, A., Design of Electrical Machines, Standard Publishers, 5th edition, 2012.

Course Outcomes

1) Design various electrical machines for given specifications.
2) Appreciate the importance of magnetic, electric and thermal loadings.
3) Analyze the performance of electrical machines with changing parameters and constraints.
4) Improve analytical skills with the help of numerical problems.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓			✓		✓			✓
CO2		✓	✓		✓		✓			
CO3	✓	✓			✓		✓			
CO4	✓	✓	✓							✓

05PC602	POWER SYSTEM ANALYSIS	L	T	P
		4	0	0

Course Objectives

- To introduce the formation of bus impedance and bus admittance matrices.
- To introduce different techniques of dealing with sparse matrices for large scale power systems.
- To impart in-depth knowledge on different methods of power flow solutions.
- To perform short circuit fault analysis and understand the consequence of different type of faults.

Unit–I : Modelling of Power Systems Components

Representation of power system components : Single phase solution of balanced three phase networks - One line diagram - Impedance or reactance diagram - Per unit system - Per unit impedance diagram - Complex power - representation of loads.

Review of symmetrical components - Transformation of voltage, current and impedance (conventional and power invariant transformations) - Phase shift in star-delta transformers - Sequence impedance of transmission lines - Sequence impedance and sequence network of power system components (synchronous machines, loads and transformer banks) - Construction of sequence networks of a power system.

Unit–II : Bus Impedance and Admittance Matrices

Development of network matrix from graph theory - Primitive impedance and admittance matrices - Bus admittance and bus impedance matrices – Properties - Formation of bus admittance matrix by inspection and analytical methods.

Bus impedance matrix: Properties - Formation using building algorithm - addition of branch, link - removal of link, radial line - Parameter changes.

Unit–III : Power Flow Analysis

Sparsity - Different methods of storing sparse matrices - Triangular factorization of a sparse matrix and solution using the factors - Optimal ordering - Three typical schemes for optimal ordering - Implementation of the second method of Tinney and Walker.

Power flow analysis - Bus classification - Development of power flow model - Power flow problem - Solution using Gauss Seidel method and Newton Raphson method - Application of sparsity based programming in Newton Raphson method - Fast decoupled load flow- Comparison of the methods.

Unit–IV : Fault Analysis

Short circuit of a synchronous machine on no load and on load - Algorithm for symmetrical short circuit studies - Unsymmetrical fault analysis - Single line to ground fault, line to line fault, double line to ground fault (with and without fault impedances) using sequence bus impedance matrices - Phase shift due to star-delta transformers - Current limiting reactors - Fault computations for selection of circuit breakers.

Unit–V : Short Circuit Study Based on Bus Admittance Matrix

Phase and sequence admittance matrix representation for three phase, single line to ground, line to line and double line to ground faults (through fault impedances) - Computation of currents and voltages under faulted condition using phase and sequence fault admittance models - Sparsity based short circuit studies using factors of bus admittance matrix.

Text Books

1) Nagrath, I.J., Kothari. D.P., “Power System Engineering”, TMH, New Delhi; 2007.
2) Wadhwa, C.L., “Electric Power Systems”, Wiley Eastern, 2007.

Reference Books

1) Pai, M.A., “Computer Techniques in Power System Analysis”, TMH, 2007.
2) Stagg and El-Abiad, “Computer Methods in Power System Analysis”, McGraw Hill International, Student Edition, 1968.
3) Stevenson, W.D., “Element of Power System Analysis”, McGraw Hill, 1975.
4) Ashfaq Husain, “Electrical Power Systems”, CBS Publishers & Distributors, 1992.
5) Haadi Saadat, “Power System Analysis”, Tata McGraw Hill Edition, 2002.
6) Gupta, B.R., “Power System Analysis and Design, Third Edition”, A.H. Wheeler and Co Ltd., New Delhi, 1998.
7) Singh, L.P., “Advanced Power System Analysis and Dynamics, Fourth Edition, New Age International (P) Limited, Publishers, New Delhi, 2006.

Course Outcomes

1) Ability to understand and analyze power system.
2) Apply load flow analysis to an electrical power network and interpret the results of the analysis.
3) Analyze a network under symmetrical and unsymmetrical fault conditions and interpret the results.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2			✓							✓
CO3			✓							✓

05CP607	CONTROL SYSTEMS LABORATORY	L	T	P
		0	0	3

Course Objective

- To provide the students simple hands-on-experience in the basic aspects of various control scheme's implementation to various control system components.

List of Experiments

1) Potentiometer Error Detector
2) D.C Position Control System
3) D.C Speed Control System
4) PID Controller
5) Linear System Simulator
6) Temperature Control System
7) Compensation Design
8) Stepper Motor Study
9) Relay Control System
10) Digital Control System
11) Electronic PID Controller
12) AC Servo motor Position Controller

Course Outcomes

1) Use basic tools of designing various controllers for various control system components.
2) Experience with various control schemes for electrical motors, process control equipments.
3) Develop skill to implement various compensating schemes for improved output response of various control system components.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓								
CO2	✓									
CO3		✓								

05CP608	POWER SYSTEM SIMULATION LAB	L	T	P

		0	**0**	**3**

Course Objective

- To have hands on experience on various system studies and different techniques adapted for power system planning, operation and control.

List of Experiments

1) Modeling of transmission lines and computation of their parameters
2) Formation of bus admittance matrix
3) Formation of bus impedance matrix
4) DC load flow analysis
5) Solution to load flow problem using Gauss-Siedel method
6) Economic load dispatch without losses
7) Single area load frequency control
8) Power flow analysis of radial distribution systems
9) Solution to load flow problem using Newton- Raphson approach
10) Fast Decoupled method for the solution of load flow problem
11) Symmetrical Short circuit analysis
12) Unsymmetrical Short circuit analysis
13) Economic load dispatch with losses

Course Outcomes

1) Familiar with analyzing the load flow problems.
2) Capable of analyzing load frequency problem.
3) Capable of performing short circuit studies.
4) Capable of performing transient stability studies.
5) Ability to perform economic load dispatch.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓					✓				
CO2			✓				✓			
CO3			✓				✓			
CO4		✓	✓				✓			
CO5	✓			✓						

SEVENTH SEMESTER

00HS701	ETHICS IN ENGINEERING	L	T	P
		4	0	0

Course Objectives

- To understand the moral and ethical dimensions in engineering..
- To take balanced decisions.

Unit–I

Senses of "Engineering Ethics" Variety of Moral issues –Types of Inquiry- Moral Dilemmas – Moral Autonomy - Kohlberg's Theory - Gilligan's Theory – Consensus and Controversy- Professions and Professionalism – Professional Ideals and Virtues- Uses of Ethical Theories.

Unit–II

Engineering as Experimentation- Engineers as Responsible Experimenters – Research Ethics – Codes of Ethics - Industrial Standards - A balanced outlook on law – The Challenger Case Study.

Unit–III

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis- Reducing Risk- The Government Regulators Approach to Risk-Chernobyl and Bhopal Case Studies.

Unit–IV

Collegiality and Loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional rights - Employee Rights- Intellectual Property Rights (IPR)- Discrimination.

Unit–V

Multinational Corporations-Business Ethics- Environmental Ethics- Computer Ethics- Role in Technological Development – Weapons Development- Engineers as Managers - Consulting Engineers - Engineers as Expert Witness and Advisers – Honesty- Moral Leadership- Sample Code of Conduct.

Text Books

1) Govindarajan, M., Natarajan, S., Senthil Kumar, V.S., “Professional Ethics and Human Values”, PHI Learning, New Delhi, 2013.
2) Mike Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New York, 2005.

Reference Books

1) Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, Boston, 2013.
2) Charles D. Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, 1999.
3) John R. Boatright, “Ethics and the Conduct of Business”, Pearson Education, Chennai, 2003.
4) Edmund G. Seebauer and Robert L. Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Chennai, 2001.
5) David Ermann and Michele S Shauf, “Computers, Ethics and Society”, Oxford University Press, Chennai, 2003.

Course Outcomes

1) Understand the relationship between the engineering and the society.
2) Learn the importance of codes in engineering practice.
3) Acquire knowledge on the legal, moral and ethical aspects in engineering.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓								
CO2				✓						
CO3				✓			✓			

05PC702	PROTECTION SWITCHGEAR AND UTILIZATION	L	T	P
		4	0	0

Course Objectives

- To understand the functional characteristics of protective relays and circuit breakers.
- To discuss protection schemes for various power components.
- To explore the utilisation of electrical energy for lighting, heating and welding.

Unit–I : Protective Relaying Schemes

Functional characteristics of a protective relay - operating principles of relays - over current relays - instantaneous and time over current relays - definite time and inverse time characteristics -Direct over current relay - Directional over current relay - universal torque equation - performance characteristics of distance relays - differential relays - under frequency and over frequency relays - translay scheme - HRC fuses for relays.

Unit–II : Circuit Breakers

Circuit breakers - Arc in oil - Arc interruption – Current chopping - Bulk oil and minimum oil circuit breaker - Air circuit breakers - Air blast circuit breakers - Vacuum circuit breakers - SF6 circuit breakers -Rating of circuit breakers - Testing of circuit breakers - Auto reclosure. HVDC circuit breakers - Energy consideration in breaking - HVDC system - commutating principle - control of di/dt and dv/dt - surge suppression - main circuit breakers for HVDC switching.

Unit–III : Protection Schemes

Feeder protection - distance protection - alternator protection - short circuit protection of stator windings by percentage differential relays - protection against turn to turn faults in stator winding - field ground fault protection - protection of stator windings by overvoltage relays - protection against stator open circuits, loss of synchronism, loss of excitation, rotor overheating - protection of transformers - typical schemes- motor protection- Bus bar protection schemes.

Unit–IV : Illumination

Visible region of the spectrum - laws of illumination - polar curves of different types of sources - determination of MHCP and MSCP - Design of lighting schemes for factories, auditoriums, offices, hospitals and residences - incandescent lamps -

Gaseous and discharge lamps - sodium vapors lamp - mercury vapor lamp - Arc lamps - Electric luminescence - street lighting.

Unit–V : Electric Heating and Welding

Advantage of electric heating - methods - Dielectric heating- induction heating - High frequency eddy current heating - Efficiency and losses - choice of frequency - Heating of buildings Resistance ovens - Induction furnaces - Types of melting furnaces - Arc furnaces. Electric arc welding - comparison between D.C and A.C welding - submerged arc welding - Gas shielded arc welding - atomic hydrogen arc welding - resistance welding - types - control of welding time.

Text Books

1) Sunil S. Rao, "Protection and Switchgear", Khanna Publishers, New Delhi, 2006.
2) Wadhwa, C.L., "Generation, Distribution and Utilisation of Electrical Energy", New Academic Science, New Delhi, 2011.

Reference Books

1) Rabindaranath, B., Chander, M., "Protective System Protection and Switchgear", New age International, New Delhi, 1997.
2) Uppal, S.L., Rao, S., "Electrical Power Systems", Khanna Publishers, New Delhi, 2009.
3) Wadhwa, C.L., "Electrical Power Systems", New Age International, New Delhi, 2005.

Course Outcomes

1) Understand the principle of operations of various protective relays and circuit breakers.
2) Familiarize with the components protection schemes of power components.
3) Ability to design energy efficient lighting, heating and welding schemes.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2			✓							
CO3	✓		✓							

05CP706	ELECTRICAL ESTIMATION AND CADD LAB	L	T	P
		0	0	3

Course Objective

- To provide the students simple hands-on-experience in the basic aspects of electrical engineering diagrams using CADD.

Electrical Estimation

Exercises in estimating the materials and cost of materials required for pump room, industry and house wiring.

List of Experiments

1) Principles of estimation
2) Types of wiring system

3) Pump room wiring layout
4) Industrial wiring layout
5) Residential wiring layout
6) Substation layout
7) Office lighting

CADD

Use of CADD tools, vice, line, poly line, circle, ellipse, arc, break, text, hatch, etc – Simple drawing exercises relevant to electrical engineering.

List of Experiments

1) Symbols
2) Earthing
3) Insulators
4) Lamps
5) SF6 circuit breaker
6) Towers
7) Three phase four wire energy meter

Course Outcomes

1) Understand basic tools of CADD.
2) Able to estimate of the materials required.
3) Capable of calculating transient stability studies.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1									✓	
CO2	✓									
CO3							✓			

EIGHTH SEMESTER

05PV803	**PROJECT WORK AND VIVA-VOCE**	**L**	**T**	**P**
		0	**0**	**15**

Course Objectives

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

Method of Evaluation

- The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.
- A project report is required at the end of the semester.

- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Course Outcomes

1) On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.
2) Carrying out any experimental works.
3) Understand the modelling, analysis and design.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓			✓			✓	
CO2	✓	✓	✓			✓			✓	✓
CO3	✓	✓	✓			✓			✓	✓

PROFESSIONAL ELECTIVES

05PExxx	EMBEDDED SYSTEMS	L	T	P
		4	0	0

Course Objectives

- To provide knowledge of fundamental embedded systems, design paradigms, architectures, possibilities and challenges, both with respect to software and hardware.
- To introduce students to the modern embedded systems and to show how to and program such systems using a concrete platform built around.

Unit–I : Overview of Embedded Systems

Embedded system concept – Embedded hardware devices – overview of 8085 Microprocessor –Architecture – memory organization – flash memory – peripheral interfacing with input / output devices – LED –LCD – Keyboard – ADC/DAC.

Unit–II : 8051 Architecture

Architecture (8051) – memory organization – addressing modes – instruction set – Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication. Assembly language programming: Arithmetic Instructions – Logical Instructions – Single bit Instructions – Timer Counter Programming – Serial Communication Programming. Derivative Architecture 89C51.

Unit–III : PIC Microcontroller

PIC 16C74A Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly language – I/O port, Data Conversion, RAM & ROM Allocation, Timers – Interrupts, I/O Ports- I^2C bus-A/D converter-UART–Flash and EEPROM memories.

Unit–IV : Arm Architecture and Programming

RISC Machine – Architectural Inheritance – Core & Architectures -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processor - Instruction set – Thumb instruction set – Instruction cycle timings -– ARM Assembly Language.

Unit–V : Operating System Overview

Introduction to OS – Function of OS – Defining an RTOS – Differences in Embedded Operating Systems – Introduction to Kernel – Resources – Shared Resources- Task – Multitasking- Task Management Functions – Scheduling and Scheduling Algorithms – Implementation of scheduling and rescheduling.

Text Books

1) R.S. Gaonkar, "Microprocessor Architecture Programming and Application", Penram International (P) Ltd., Mumbai, 5th edition, 2008.
2) Muhammad Ali Mazidi, Janice Gillispie Mazidi, "8051 Microcontroller and Embedded Systems", Second Edition, PHI, 2000.
3) Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey 'PIC Microcontroller and Embedded Systems using Assembly Language", Pearson Prentice Hall, 2008.
4) Steve Furber, 'ARM System on Chip Architecture', 2nd Edition Addision Wesley, 2000.
5) Raymond J.A. Bhur, Donald L. Bailey, "An Introduction to Real Time Systems", PHI, 1999.

Reference Books

1) Dijasio, Wilmshurst, Ibrahim, John Morton, Martin P. Bates, Jack Smith, Smith, D.W., "PIC Microcontrollers", Newnes, Elsevier, 2008.
2) Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3) Arnold, Berger, S., "Embedded System Design- An Introduction to Processes, Tools and Techniques, CMP Books- 2002.
4) Kenneth Ayala, "The 8051 Microcontroller", Thomson, 2005.
5) Shibu, K.V., "Introduction to Embedded Systems", Tata McGraw Hill, 2009.
6) Rajkamal, "Embedded System-Architecture, Programming, Design", TMH, 2011.
7) Peckol, "Embedded System Design", John Wiley & Sons, 2010.

Course Outcomes

1) Understand the architecture and its programming aspects.
2) Distinguish between the general computing system and embedded system.
3) Design real time embedded systems using the concepts of RTOS.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2						✓				
CO3	✓									

05PExxx	**RISC AND CISC PROCESSORS**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To impart a sound knowledge of RISC and CISC Processors.
- To teach the features of advanced processors.
- To teach the architecture of CISC processors.
- To teach the implementation of arm architecture.
- To teach the Arm Programming.

Unit–I : Features of Advanced Processors

Instruction set - Data formats - Instruction formats - Addressing modes - Memory Hierarchy - register file - Cache - Virtual memory and paging – Segmentation. Pipelining : The instruction pipeline - pipeline hazards - Instruction level parallelism. Reduced instruction set - Computer principles - RISC versus CISC - RISC properties - RISC evaluation - On-chip register files versus cache evaluation.

Unit–II : Architecture of CISC Processors

PENTIUM: The software model - functional description - CPU pin descriptions - CISC concepts - bus operations - Super scalar architecture - pipe lining - Branch prediction- Instruction and data caches - Floating point unit - protected mode operation - Segmentation - paging -Protection – Multi-tasking - Exception and interrupts - Input/output - Virtual 8086 model -Interrupt processing - Instruction types - Addressing modes - Processor flags - Instruction set - Basic programs.

Unit–III : Arm Architecture

ARM: architecture - organization and implementation - instruction set - The thumb instruction set - Arcon RISC Machine – Architectural Inheritance – Core & Architectures - CPU cores.

Unit–IV : Arm Programming

Basic Assembly language program -The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors – Instruction cycle timings

Unit–V : Arm Application Development

Handling – Interrupts – Interrupt handling schemes- Firmware and boot loader – Example: Standalone - Embedded Operating Systems – Fundamental Components – Memory protection and management-Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-Page Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.

Text Books

1) Barry B. Brey, "The Intel Microprocessors: Architecture, Programming and Interfacing", PHI, 2002.
2) James L. Antonakos, "The Pentium Microprocessor", Pearson Education, 1997.
3) Steve Furber, 'ARM system on chip architecture', Second Edition, Addision-Wesley Professional, 2001.
4) William Hohl, 'ARM Assebly Language' Fundamentals and Techniques. ARM Architecture Reference Manual, CRC Press, Taylor and Francis Group, Second Edition, 2009.

Reference Books

1) Gene H. Miller, "Micro Computer Engineering", Pearson Education, 2003.

2) James L. Antonakos, "An Introduction to the Intel family of Microprocessors", Pearson Education, 1999.
3) Dananjay V. Gadre, "Programming and customizing the AVR microcontroller", Tata McGraw Hill, 2001.
4) Trevor Martin, 'The Insider's Guide to the Philips ARM7-Based Microcontrollers, an Engineer's Introduction to the LPC2100 Series', First Edition, Hitex (UK) Ltd., 2006.
5) Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield, 'ARM System. Developer's Guide Designing and Optimizing System Software', Morgan Kaufmann Publishers, Elsevier, 2007.
6) James L. Antonakos, "An Introduction to the Intel Family of Microprocessors", Pearson Education, 1999.
7) ARM Architecture Reference Manual, LPC213x User Manual 7. WWW.Nuvoton.com/Websites on Advanced ARM cortex Processors.

Course Outcomes

1) Identify the major components of CISC and RISC architectures, and explain their purposes and interactions.
2) Simulate the internal representation of data, and show how data is stored and accessed in memory.
3) Explain the relationships between hardware architecture and its instruction set, and simulate micro-programs.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2						✓				
CO3	✓									

05PExxx	SIGNALS AND SYSTEMS	L	T	P
		4	0	0

Course Objectives

- Coverage of continuous and discrete-time signals and systems, their properties and representations and methods that is necessary for the analysis of continuous and discrete-time signals and systems.
- Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc.
- Knowledge of frequency-domain representation and analysis concepts using Fourier analysis tools, Z-transform.
- Concepts of the sampling process.

Unit–I : Continuous Time (CT) And Discrete Time (DT) Signals

Classification of signals – Signal Energy and Power – Properties - Periodic signals – Even and Odd signals – CT complex exponential and sinusoidal signals – DT complex exponential and sinusoidal signals – CT unit impulse and unit step function – DT unit impulse and unit step sequence– Random signals – Random processes.

Unit–II : Continuous Time Systems

Properties of continuous time systems – Representation of continuous time Linear time invariant (LTI) systems using differential equations – Block diagram representation – Analysis of continuous time LTI systems – Transfer function model – Block diagram reduction – Continuous time unit impulse response – Convolution integral – unit step response of LTI system – Frequency response – Singularity function – Analysis of LTI systems using Laplace transform.

Unit–III : Fourier Analysis

Fourier series representation of continuous time periodic signals – Properties of continuous time Fourier series - Harmonic analysis of LTI systems – Convergence of Fourier series – Representation of a periodic signals – Continuous time Fourier transform – Properties of continuous time Fourier transform – Analysis of continuous time LTI systems using Fourier transform.

Unit–IV : DTFT and DFT

Discrete time Fourier transform (DTFT) – Properties of DTFT – Time and frequency shifting – Conjugation – Parseval's relation - Discrete Fourier transform (DFT) – Properties of DFT – DFT Frequency response characteristics – Weighting function - Circular Convolution – Correlation – Auto Correlation.

Unit–V : Discrete Time Systems

Properties of Discrete time systems – Representation of discrete time systems using difference equation – Block diagram representation - Z Transform and its properties – Inverse Z transform – Solution of Difference equations - Pole-Zero representation – Bounded Input and Bounded Output(BIBO) stability – Solution using Z transform – State variable equation – State space model.

Text Books

1) Alan V. Oppenheim, Alan Wilskey, S. and Hamid Nawab, S., "Signals and Systems", Second Edition, Prentice Hall India, 2006.
2) Simon Haykin, Barry Van Veen, "Signals & Systems". John Wiley & Sons (ASIA) Private Limited, 2001.

Reference Books

1) Gabel, R.A. and Richard, R.A., "Signals and Linear Systems", John Wiley and Sons, 1987.
2) Gordan E. Carlson, "Signals and Linear Systems Analysis", Allied Publishers, New Delhi, 1993.
3) Rodger Ziemer, E., William Tranter, H. and Ronald Fannin, D., Signals and Systems, Maxwell MacMillman, Canada, 1993.
4) Ramesh Babu, P. and Ananda Natarajan, R., "Signals and Systems", 4th Edition, Sci-Tech Publications, Chennai, 2011.

Course Outcomes

1) Characterize and analyze the properties of CT and DT signals and systems.
2) Analyze CT and DT systems in Time domain using convolution.
3) Represent CT and DT systems in the Frequency domain using Fourier analysis tools like CTFS, CTFT, DTFS and DTFT.

4) Conceptualize the effects of sampling a CT signal.
5) Analyze CT and DT systems using Z Transformation.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2			✓							
CO3					✓					
CO4								✓		
CO5	✓									

05PExxx	SPECIAL MACHINES	L	T	P
		4	0	0

Course Objectives

- To familiarize the constructional features, working principle, basic equations governing the performance of special electric motors.
- To study its operation when fed from power electronic circuits.
- To realize how the inherent characteristics of the new electric motors can be modified and gain an insight to innovate new industrial applications for them.

Unit–I : Introduction to Drives and Control

Introduction to motion control system - Structure of an electric drive system - Need for adjustable speed drive - Different types of motors suitable for drives - Newer technologies in the control of electrical drives. Basic controllers for drives and their characteristics - Selection of controllers for drive systems - Electronic controllers - Actuators.

Unit–II : Stepper Motors and their Control

Stepping motors - Constructional features - Different types - Variable reluctance stepping motor - Permanent magnet stepping motor - Hybrid stepping motor - Principle of operation - Modes of excitation - Torque production – Dynamic characteristics-Drive characteristics - Control principles - Open loop control and closed loop control of stepping motor - Servo control of VR type stepping motor - Microprocessor based controller.

Unit–III : Power Controllers

Switched reluctance motors - Constructional features - Principle of operation - Torque production - Torque speed characteristics - Current regulation - Commutation - Power controllers - Microprocessor based controller.

Unit–IV : Commutation in DC and AC Motors

Commutation in DC motors - Difference between mechanical and electronic commutators - Evolution of brushless DC motors from the classical AC and DC motors - Advantages and disadvantages of brushless excitation - Square wave permanent magnet brushless DC motors - Multiphase brushless DC motors - Magnetic circuit analysis in open circuit - Torque and EMF equations - Torque speed characteristics - Performance and efficiency - Controllers for permanent magnet brushless DC motor.

Unit–V : Synchronous Motor Control Schemes

Permanent magnet synchronous motors - Principle of operation - Open circuit emf - Magnetic flux density and operating point - Steady state phasor diagram -

Current control techniques - UPF operation - Constant flux linkages - Power input and Torque expressions - Circle diagram – Torque speed characteristics - Controllers - Self -control and vector control schemes.

Text Books

1) E.G. Janardanan, "Special Electrical Machines", PHI Learning Pvt Ltd., 2014.
2) K. Venkatraman, "Special Electrical Machines", CRC Press, 2009.

Reference Books

1) Miller, T.J.E., 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
2) Kenjo, T. and Nagamori, S., 'Permanent Magnet and Brushless DC Motors', Clarendon Press, Oxford, 1985.
3) Kenjo, T., 'Stepping Motors and their Microprocessor Control', Clarendon Press, Oxford, 1984.
4) Murphy, J.M.D. and Turnbull, F.G., 'Thyristor Control of AC Motors', Pergamon Press, Oxford, 1988.

Course Outcomes

1) Understand the constructional features, working principle, basic equations governing the performance of special electric motors.
2) Study of its operation when fed from power electronic circuits.
3) Selection of motors based on the inherent characteristics to innovate new industrial applications.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2			✓							
CO3						✓				

05PExxx	INDUSTRIAL CONTROL AND AUTOMATION	L	T	P
		4	0	0

Course Objectives

- To familiarize the students about the industrial control and automation.
- To provide basic knowledge about PLC and its applications.
- To provide the significance of control concepts.

Unit–I : Process Modelling

Mathematical modelling of a process - Process Identification - Open loop identification - First order and second order model - without and with pure delay - Closed loop identification method - Identification of unstable systems - Self regulation characteristics - Inverse response - Tuning theory – Anti-reset windup technique.

Unit–II : Controllers

Transfer function of control equipments - ON OFF control - Time proportional control - Proportional plus integral control - Derivative control - PID controller - Electronic controller - Ratio control systems - Split range control - Cascade control - Selective control - Inverse derivative control - Feedback control - feed forward control - bumpless automatic control - Typical process - PID algorithms - design for load changes.

Unit–III : Digital Control Strategies

Introduction – Basics of a digital control system -Sampling - Sample and hold circuits - Discrete time signal - Linear discrete time systems - Pulse transfer functions - Analysis of digital control system using Z transform - Stability analysis - Jury's stability criterion.

Unit–IV : Programmable Logic Controllers

Evolution of modern day PLC - relay based PLC - microprocessor based PLC - input and output UNITs - other functional elements - personal computer as PLC - Programming the PLC - ladder logic diagram - Boolean language - on line and off line programming aids - communication in PLC - typical applications of PLC - PID control capability in programmable controllers.

Unit–V : Distributed Control Systems

Evolution of DCS - Factors to be considered in selecting a DCS – Typical architecture - local control unit (LCU) and architecture - LCU languages - LCU - process inte7rfacing issues - communication system requirements - architectural issues - protocol issues - communication media - message security - communication system standards - field bus, HART. Operation interface - requirements - display - alarms and alarm management - engineering interface – requirements - Comparison of DCS with direct digital control and supervisory control

Text Books

1) George Stephanopoulos, “Chemical Process Control, An Introduction to the theory and Practice”, Prentice Hall International Inc., 2001.
2) Gopal.M, "Digital control and state variable methods” TMH, Second Edition,2002
3) 3. Michal P Lucas., "Distributed Control Systems" Van Noster and Reinhold Co., 1986.

Reference Books

1) Donald R Coughanowr,” Process System and Control, Second Edition” , McGraw Hill 2006.
2) F.D Petruzella., “Programmable Logic Controllers” McGraw Hill 2006.
3) Thomas Hughes, "Programmable Controller" Instrument Society of America, 1992.

Course Outcomes

1) Understand the practical significance of Industrial control systems.
2) Familiarize PLC and its programming.
3) Understand the various industrial control configurations.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2	✓									
CO3	✓									

05PExxx	ENERGY MANAGEMENT AND AUDIT	L	T	P
		4	0	0

Course Objectives

- Knowledge of Need Based Energy Management, different data communication systems and distribution automation.
- Demand side management, implementation issues and strategies.
- Electric heating, lighting, motors and Adjustable speed drives.
- Principles of energy audit and energy audit of electrical systems.

Unit–I : Distribution Automation

Introduction – Need Based Energy Management (NBEM) – advantages – conventional distribution network – automated system – Distribution Automation System (DAS) – communication interface – PLCC – different data communication systems – distribution SCADA – distribution automation – load management in automated distribution system – RTU – substation automation – feeder automation – consumer side automation

Unit–II : Demand Side Management

Introduction – scope of demand side management (DSM) – evolution of DSM concepts – DSM planning and implementation – load management as DSM strategy – application of load control – end use of energy conversion – tariff options for DSM – customer acceptance – implementation issues – implementation strategies – DSM environment – international experience with DSM.

Unit–III : Energy Management in Electric Utilities

Industrial heating – resistance heating, induction heating, arc heating, dielectric and micro wave heating – Radiant heating – cost of electrical energy – lighting – lamp life time – efficient lighting – motive power and power factor improvement – capacitor rating – siting of capacitors – effects of power factor improvement – temperature measurement – optimum start control – efficient use of electrical energy in air conditioning – Motors and Adjustable speed drives – high efficiency motors – rewinding electric motors – Motor drives and controls – other factors in motor system efficiency – Utility rebates for motor and drives.

Unit–IV : Energy Audit

Basic principles of energy audit – definition of energy auditing – objectives – energy flow diagram – strategy of energy audit – comparison with standards – energy management team – considerations in implementing energy with conservation programmes – periodic progress review– energy audit concept – reduced line loss – power quality – differed capital expenses – energy cost reduction – optimal energy use – improved reliability.

Unit–V : Energy Audit of Electrical Systems

Instruments for energy audit – energy audit of heating, ventilation and air conditioning systems – energy audit of compressed air systems – energy audit of buildings – energy audit of steam generation, distribution and utilization systems – energy audit of electric drive utilities – economic analysis.

Text Books

1) Gupta, B.R., 'Generation of Electrical Energy', S.Chand & Co. Ltd, New Delhi, 8th Edition, 2008.

2) Rai, G.D, 'Non Conventional Energy Sources', Khanna Publishers, New Delhi, 3rd Edition, 1999.

Reference Books

1) Murphy, W.R., McKay G., "Energy Management", Butterworths Publications, London, 1982.
2) Trivedi, P.R., Jolka, B.R., "Energy Management", Common Wealth Publishers, New Delhi, 1997.
3) A. Chakrabarti, "Energy Engineering and Management", PHI, Jan 2011.

Course Outcomes

1) Provide comprehensive idea about Need Based Energy Management, different data communication systems and distribution automation.
2) Analyze the scope of demand side management, implementation issues and strategies.
3) Understand about electric heating, lighting, motors and adjustable speed drives.
4) Understand about principles of energy audit and energy audit of electrical systems.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2		✓								
CO3					✓					
CO4								✓		

05PExxx	DIGITAL SIGNAL PROCESSING	L	T	P
		4	0	0

Course Objectives

- To study Discrete Fourier Transform and its computation
- To study the design structures of digital filters and Z-transform
- To study the design of Digital Infinite Impulse Response filters
- To study the design of Digital Finite Impulse Response filters
- To study the fundamentals of digital signal processors.

Unit–I : Discrete Fourier Transform

Discrete Signals and Systems – A Review – Introduction to Discrete Fourier transform (DFT) –Properties of DFT – Circular convolution – Comparison between Linear convolution and Circular convolution – Filtering long duration sequences: Overlap-save method, Overlap-add method – Fast Fourier Transform (FFT): Decimation-in-time (DIT) algorithm – Decimation-in-frequency algorithm – FFT radix-2 DIT, DIF implementation — IDFT using Direct FFT Algorithm.

Unit–II : Digital Filter Structures

Definition of digital filters – Properties of digital filters – Z transform - Definition –Properties – Region Of Convergence(ROC) – Transfer function – Poles and Zeros –

Z-Transforms and Frequency response relationships – Inverse Z-Transform – Realization of digital filters- direct form- Transposed form – Canonic – Cascade-Parallel and Ladder form - Quantization noise introduced by analog-to-digital conversion - – Finite register length effects in the realization of IIR and FIR digital filters and in DFT computation.

Unit–III : Digital Infinite Impulse Response (IIR) Filter Design

Design of IIR filters: Analog filter approximation, Butterworth, Chebyshev and Elliptic filters – Frequency band transformation – Digital filter design equations low pass, high pass, band pass and band stop – Impulse Invariant technique for IIR filter – Impulse Invariant pole mapping – Bilinear transformation – Bilinear transformation pole mapping.

Unit–IV : Digital Finite Impulse Response (FIR) Filter Design

Structures of FIR filters - Linear Phase FIR digital Filters – Minimizing design criteria (Fourier design technique) – Filter design using Windowing technique (Rectangular, Hamming, Hanning Window) – Kaisar Window - Finite register length effects in digital Filters: Errors, Limit Cycle, and Noise Power Spectrum.

Unit–V : Digital Signal Processors

Generic DSP Architecture – Architecture of TMS 320 F 2407 and TEXAS 5416 processor – memory and I/O Organization – CPU –Program control – Addressing modes – Assembly Language Instructions – On chip peripherals – Clock, watch dog and real time Interrupt, event manager units – Interface units – Simple Programs.

Text Books

1) Proakis, J.G., Manolakis, D.G., “Digital Processing” Principles, Algorithms and Applications, Second Edition, Prentice Hall of India, 4th Edition, 2006.
2) Toliyat A. Campbell, “DSP Based Electromechanic Motion Control”, CRC Publications, Texas, 2004.

Reference Books

1) Oppenheim, A.V. and Schaffer, R.W,, "Digital Signal Processing", Prentice Hall, 1987.
2) Johnson, J.R., “Introduction to Digital Signal Processing”, Prentice Hall of India, New Delhi, 1994.
3) Simon Haykin, Barry Van Veen, “Signals & Systems”, John Wiley & Sons (ASIA) Private Limited, 1999.
4) Venkatramani, B. and Bhaskar,M., “Digital Signal Processors”, TMH, 2002.
5) Mitra, S.K., “Digital Signal Processing, A computer Based Approach, Second Edition”, Tata McGraw Hill, 3rd Edition, 2004.
6) Ramesh Babu, P., “Digital Signal Processing’, SciTech Publishers, Fifth Edition, 2014.

Course Outcomes

1) Understand the principles of digital signal processing.
2) Distinguish between FIR and IIR filters.
3) Select suitable digital signal processor to produce a new component.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1						✓				
CO2		✓								
CO3							✓			

05PExxx	REAL TIME OPERATING SYSTEMS	L	T	P
		4	0	0

Course Objectives

- To expose the students to the fundamentals of interaction of OS with a computer and user computation.
- To teach the fundamental concepts of creating process and controlled with OS.
- To study the programming logic of modeling process based on range of OS features.
- To compare types and functionalities in commercial OS and to discuss the application development using RTOS.

Unit–I : Review of Operating Systems

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks-Distributed scheduling - Fault & recovery.

Unit–II : Overview of RTOS

RTOS Task and Task state – Multithreaded Premptive scheduler - Process Synchronisation - Message queues – Mail boxes - pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks.

Unit–III : Real Time Models and Languages

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements- Introduction to PYTHON language.

Unit–IV : Real Time Kernel

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

Unit–V : RTOS Application Domains

Case studies - RTOS for Image Processing – Embedded RTOS for Network communication – RTOS for fault-Tolerant Applications – RTOS for Control Systems.

Text Books

1) Silberschatz, Galvin, Gagne, "Operating System Concepts", 6th Edn., John Wiley, 7th Edition, 2003.

2) D.M. Dhamdhere, "Operating Systems, A Concept-Based Approach", TMH, 2nd Edition, 2008.
3) Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2011.
4) Herma K., "Real Time Systems – Design for Distributed Embedded Applications", Kluwer Academic, 1997.

Reference Books

1) Charles Crowley, "Operating Systems - A Design Oriented Approach", McGraw Hill, 1997.
2) C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill, 1997.
3) Raymond, J.A. Bhur, Donald L. Bailey, "An Introduction to Real Time Systems", PHI 1999.
4) Mukesh Sighal and N.G. Shi, "Advanced Concepts in Operating System", McGraw Hill 2000.
5) K.V.K.K. Prasad, "Embedded Real Time Systems: Concepts, Design and Programming", Dream Tech Press, 2005.
6) Sriram V. Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGraw hill, 2004.

Course Outcomes

1) Distinguish a real-time system from other systems.
2) Identify the functions of operating systems.
3) Evaluate the need for real-time operating system.
4) Implement the real-time operating system principles.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2	✓									
CO3		✓								
CO4					✓					

05PExxx	VLSI DESIGN	L	T	P
		4	0	0

Course Objectives

- To provide an understanding of VLSI Design process and to bring both system and circuit view on design together.
- To familiarize the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit. .
- To learn transistor level CMOS logic design and to understand NMOS and CMOS fabrication process.
- To impart knowledge about designing digital circuits like adders and multipliers.
- To study programming technologies and architectures of FPGAs and understand the concepts of modeling a digital system using VHDL.

Unit–I : VLSI Design Concepts

Evolution of VLSI – VLSI design flow--Design domains Behavioral, Structural and Physical design – Concept of Regularity, Modularity and Locality-Layout styles: Full custom - Semi custom approaches.MOS structure- MOS current equation – channel length modulation-Body effect –MOSFET capacitance-CMOS Logic Design: Static characteristics of CMOS Inverter, Dynamic behavior of CMOS inverter-static and dynamic power dissipation in CMOS – Basic and Complex gates realization in CMOS-Transistor sizing-Sheet resistance and area capacitance of layers-Wiring capacitance-Driving large capacitive loads.

Unit–II : VLSI Fabrication Techniques

An overview of wafer fabrication, Wafer Processing – Oxidation – Patterning – Diffusion – Ion Implantation – Deposition – Silicon gate NMOS process – CMOS processes – N-well, P-well- Twin tub, Silicon on insulator – CMOS process enhancements – Interconnects, Circuit elements-CMOS latch up.Design Rules-Need for Design Rules-CMOS lambda based design Rules-Stick diagram and layout for CMOS inverter.

Unit–III : Analog VLSI

Introduction to analog VLSI - Analog circuit building blocks – Switches- active resistors - Current sources and sinks - Current mirrors/amplifiers –Voltage and Current References-- CMOS inverting amplifiers - CMOS Differential Amplifiers - CMOS Two stage op-amp - Modulators and Multipliers-Switched capacitor filter.

Unit–IV : Digital VLSI

Logic design: Switch logic and Gate logic - Dynamic CMOS logic - Structured design examples: Simple combinational logic and Clocked sequential design. Sub-system design: Design of shifters, Design of Adders: Ripple carry adders, Carry select adder, carry save adder, Manchester carry –chain adder, Carry Look- ahead adder, Design of Multipliers: Serial, Parallel and pipelined multiplier arrays, Booth multiplier, Wallace tree multiplier.

Unit–V : Programmable ASCIS and VHDL

Architecture and Programming technologies of ROMs, EPROMs, PLA, PAL, Gate arrays, CPLD and FPGA – Xilinx FPGA's LCA , I/O block and interconnect –Programming technology. VHDL overview- Hardware modeling issues –VHDL code structure: Library declaration, Entities and Architectures –Data types- Operators-Concurrent and Sequential statements-Signals and Variables-Packages and Libraries - Introduction to behavioral, dataflow and structural modeling-simple VHDL code examples.

Text Books

1) Neil, H.E. Weste, David Money Harris, "CMOS VLSI Design": A Circuits and Systems Perspective, Pearson Education India, 3rd edition, 2012.
2) Wayne Wolf, "Modern VLSI Design", Ip-Based Design, Pearson Education India, 4th edition, 2009.

Reference Books

1) Deepak Garg, VLSI Design, S.K. Kataria & Sons; 1st edition, 2013.
2) R. Sakthivel, "VLSI Design", S.Chand & Company Ltd, 4th edition, 2008.
3) Sarita Chauhan, "VLSI Design" S.K., Kataria & Sons; edition, 2012.

4) Sharat C. Prasad Kaushik Roy, "Low-Power CMOS VLSI Circuit Design", Wiley Publications, 2009.
5) AL. Visalatchi, B. Priya, S. Pravenaa, "Modern VLSI Design", Anuradha Publications, 1st edition, 2010.
6) Douglas. A. Puknell and Kamran Eshraghian, "Basic VLSI Design", PHI, 3rd Edition, 2005.

Course Outcomes

1) Provide comprehensive idea about the techniques of chip design using programmable devices.
2) Analyze VLSI systems, VHDL and MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit.
3) Design and analyze digital circuits like multipliers, adders and understand the architecture and programming technologies of FPGA.
4) Model a simple digital system using VHDL.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2		✓			✓					
CO3		✓								
CO4	✓				✓					

05PExxx	**REAL TIME SYSTEMS**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To familiarize the student about real time systems by introducing the fundamentals of real time Communication.
- To teach the fundamentals of Scheduling and features of programming languages and motivate them to apply in real time systems.
- Study the data management system for real time and teach the different algorithms and techniques used for real time systems.

Unit–I : Fundamentals of Real Time Computing

Introduction - issues in real time computing - structure of a real time system - task classes - performance measures for real time systems - estimating program run times - task assignment and scheduling - classical uni-processor scheduling algorithms – Uni-processor scheduling of IRIS tasks - tasks assignment - mode changes - fault tolerant scheduling.

Unit–II : Programming Languages and Tools

Language features - desired language characteristics - data typing - control structures - facilitating hierarchical decomposition - package - run-time error handling - overloading and generics – multi-tasking - low level programming - task scheduling - timing specifications - programming environments - run-time support – code generation.

Unit–III : Real Time Databases

Real time database - basic definition - real time Vs general-purpose database - main memory databases - transaction priorities - transaction aborts - concurrency control issues - disk scheduling algorithms - two-phase approach to improve predictability - maintaining serialization consistency - databases for hard real time systems.

Unit–IV : Real Time Communication

Communications media - network topologies - protocols – buffering data – synchronization – dead lock – mail boxes and semaphores - fault tolerance techniques - fault types - fault detection - fault error containment - redundancy - data diversity - reversal checks - integrated handling.

Unit–V : Evaluation Techniques

Reliability evaluation techniques - reliability models for hardware redundancy - software error models – response time calculation – interrupt latency – time loading and its measurement – reducing response times – analysis of memory requirements – reducing memory loading.

Text Books

1) C.M. Krishna and Kang G. Shin, "Real-Time Systems", McGraw Hill International Editions, 2010.
2) Phillip A. Laplante, "Real-Time Systems Design and Analysis" - An Engineers Hand Book 2nd edition, IEEE Press, 2001.
3) Peter D. Lawrence," Real Time Micro Computer System Design - An Introduction", McGraw Hill, 1988.

Reference Books

1) S.T. Allworth and R.N. Zobel, "Introduction to Real-Time Software Design", Macmillan, II Edition, 2013.
2) Stuart Bennett, "Real Time Computer Control - An Introduction", PHI, 1st Edition, 1988.
3) Jane. W.S. Liu, "Real Time Systems", Prentice hall, Second Edition, 2000.

Course Outcomes

1) Get a complete knowledge about real time system.
2) Learn the data structure programming languages and tools which are applicable in real time system.
3) Attain a deep knowledge on real time communication systems.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓				✓				✓	
CO2			✓							✓
CO3							✓			

05PExxx	NON CONVENTIONAL ENERGY	L	T	P
		4	0	0

Course Objectives

- To elucidate the fundamentals of various sources of Non Conventional Energy such as Wind, Solar, Biomass, Geo thermal and other renewable energy sources.
- To impart a thorough knowledge about the application of different types of Non Conventional Energy systems.
- To inculcate the students on feasibility and limitations of various Non Conventional Energy Systems.

Unit–I : Wind Energy

Introduction to energy sources-Renewable and non renewable energy sources – energy consumption as a measure of Nation's development – Strategy for meeting the future energy requirement – Global and national level energy scenarios – Prospects of renewable energy sources. Basic principles of wind energy conversion – site selection consideration – types of wind mills – basic components of wind energy conversion systems (WECS) – types of WECS – applications of wind energy – safety system – environmental aspects.

Unit–II : Solar Energy

Solar radiation - Physical principles of conversion of solar radiation into heat – Solar constant – Solar energy collectors - flat plate collector – collector efficiency – concentrating collector: focusing type – advantages of focusing collectors – cylindrical parabolic concentrating collector – selective absorber coatings – central receiver tower solar power plant – solar energy storage systems –types – solar driers – solar water heaters - principle of solar photo voltaic cell – solar photo voltaic power generation – MPPT (Maximum Power Point Tracking) – solar pump – solar hydrogen energy.

Unit–III : Energy from Bio-mass

Bio mass conversion technologies - Bio gas generation principle – types of bio-gas plants – applications of bio-gas plants – bio-mass as a source of energy – energy plantation – thermal gasification of bio mass – energy from agricultural waste – agro thermal power plant – Bio gas-based cogeneration programme – integrated waste management – advantages and disadvantages.

Unit–IV : Geo-Thermal and Ocean Energy

Nature of geo-thermal energy – geo-thermal sources – prime movers for geo-thermal energy conversion – advantages and disadvantages of geo-thermal energy – application of geo-thermal energy. Principle of ocean thermal energy conversion (OTEC) – open cycle OTEC system – closed cycle – hybrid cycle – prospects of OTEC in India -applications – basic principle and components of tidal power plant – single basin and double basin tidal power plants -site requirements – storage – advantages and limitations of tidal power generation – ocean wave energy conversion devices.

Unit–V : Other Energy Sources

Basic principle and components of a fuel cell – types of fuel cell –conversion efficiency of fuel cell - advantages and disadvantages of fuel cell – conversion energy

and application of fuel cell – basic battery theory – batteries applied for bulk energy storage. Hydrogen fuel – hydrogen production – methods - storage – transportation and utilization – hydrogen as alternative fuel for motor vehicle – safety management.

Text Books

1) Rai, G.D., 'Non Conventional Energy Sources', Khanna Publishers, New Delhi, 4th Edition, 2004.
2) Gupta, B.R., 'Generation of Electrical Energy', S.Chand & Co. Ltd, New Delhi, 5th Edition, 2014.

Reference Books

1) Agarwal, M.P., 'Future Sources of Electrical Power', S.Chand & Co. Ltd, New Delhi, 1999.
2) Hassan and D.K. Sharma 'Non Conventional Energy Resources, S.K. Kataria and Sons Ltd, 2009
3) S.P. Sukhatme, 'Solar Energy: Principles of Thermal Collection and Storage,' Tata McGraw Hill, 2015.
4) B.K. Bansal 'Non Conventional Energy Resources' Vikas Publishing Ltd, 2014.

Course Outcomes

1) Learn fundamentals of various non-conventional energy Systems.
2) Acquire design knowledge of Biomass and Geothermal energy sources
3) Obtain the basics of other Non conventional energy sources.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓		✓							
CO2			✓							
CO3			✓							

05PExxx	COMPUTER AIDED POWER SYSTEM ANALYSIS	L	T	P
		4	0	0

Course Objectives

- To study the economic operation of power system.
- To learn optimal power flow and unit commitment.
- To illustrate different numerical integration methods in transient stability analysis.
- To model power-frequency dynamics and to design load-frequency controller.
- To examine the concept of transient stability in the power system.

Unit–I : Economic Load Dispatch

System constraints - Economic dispatch neglecting losses - Optimum load dispatch including transmission losses - Exact transmission loss formula - Modified co-ordination equations – hydro-thermal scheduling

Unit–II : Optimal Load Flow

Reactive Power Control for Loss Minimization- Gradient Method for Optimal Load Flow- Non - Linear Programming- Lagrange Function for Optimal Load Flow-

Computational Procedures- Conditions for Optimal Load Flow- Implementation of optimal conditions.

Unit–III : Unit Commitment

Cost Function Formulation- Constraints for Plant Commitment Schedules- Priority - List Method- Dynamic Programming- Unit Commitment by Dynamic Programming.

Unit–IV : Load Frequency Control

Necessity of maintaining frequency constant- Load Frequency Control (Single Area Case)-Turbine Speed Governing System-Model of Speed Governing System-Turbine Model-Generator-Load Model-Block Diagram model of LFC-Steady State Analysis-Dynamic Response-Control Area Concept-Proportional plus Integral Control-Optimal Control-State variable model of single area and two-area power systems

Unit–V : Transient Stability Studies

Transient stability - Power angle curve and swing equation of single machine connected to infinite bus - Equal area criterion - Numerical solution of swing equation of single-machine system by point by point method - Factors affecting transient stability - Multi machine transient stability - solution techniques using modified Euler and Runge Kutta methods

Text Books

1) Murty. PSR., "Power System Operation and Control", CRC Press, 2011.
2) Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, Delhi, 2007.

Reference Books

1) Wadhwa, C.L., "Electrical Power Systems", New Age, 2010.
2) Elgerd, O.I., "Electric Energy Systems Theory - An Introduction", TMH, 2006.
3) Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, "Power Generation, Operation, and Control, Wiley Publications, Third Edition, 2013.
4) Haadi Saadat, "Power System Analysis" PSA publishing, 2011.
5) M.A. Pai, "Computer Techniques in Power System Analysis", Tata McGraw Hill Publishing Company, New Delhi, 2003.

Course Outcomes

1) Able to understand and analyze power system operation, stability and control.
2) Gain knowledge in economic load dispatch, load frequency control and transient stability studies that are useful for day-today operation of power system.
3) Study the concept of optimal load flow and unit commitment.
4) Gain knowledge from contemporary issues.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓	✓		✓	✓				✓	
CO2	✓	✓	✓	✓	✓		✓			✓
CO3	✓	✓	✓	✓	✓					
CO4	✓	✓				✓	✓	✓		✓

05PExxx	HIGH VOLTAGE TRANSMISSION SYSTEMS	L	T	P
		4	0	0

Course Objectives

- To study HVAC and HVDC for overhead and underground transmission systems and factors governing the choice of them.
- To learn about the properties of bundle conductors for reducing the corona effects.
- To introduce the problems of EHVAC transmission at power frequency.
- To introduce modern developments in HVDC transmission and FACTS.
- To learn about the overvoltage problem in extra high voltage system.

Unit–I : Introduction to EHVAC and HVDC Transmission

EHVAC and HVDC transmission -Comparison between HVAC and HVDC overhead and underground transmission scheme - Standard transmission voltages - Factors concerning choice of HVAC and HVDC transmission - Block diagram of HVAC and HVDC transmission schemes.

Unit–II : Corona

Properties of bundled conductors - Inductance and capacitance of EHV line - Surface voltage gradient on single, double, and more than three conductor bundles -Corona effects - Power loss - Increase in radius of conductors - Charge-voltage diagram - Qualitative study of corona pulses, their generation and properties.

Unit–III : EHVAC Transmission

Problems of EHVAC transmission at power frequency - Generalised constants - Power circle diagram and its use - Voltage control using compensators - High phase order transmission.

Unit–IV : DC Transmission

Review of rectification and inversion process -Constant current and constant extinction angle modes of operations - Analysis of DC transmission systems - Harmonics on AC and DC sides and filters for their suppression - Multiterminal DC transmission systems -Parallel operation of AC and DC transmission - Modern developments in HVDC transmission/Introduction to FACTS.

Unit–V : Overvoltage in EHV Systems

Origin and types - Ferro resonance overvoltage - switching surges, reduction of switching surges on EHV systems. Introduction to EHV cable transmission, electrical characteristics of EHV cables, properties of cable insulation materials. EHV insulators - characteristics and pollution performance -Protection of HVAC and HVDC systems.

Text Books

1) Rakosh Das Begamudre "Extra High Voltage AC Transmission Engineering", New Age International Publishers, Reprint 2014.
2) K. R. Padiyar "HVDC Power Transmission Systems: Technology and System Interactions", New Age International, 1990.

Reference Book

Rao. S "EHV_AC and HVDC Transmission & Distribution Engg.- 3rd edition", Khanna Publication-2007.

Course Outcomes

1) Understand the factors governing the choice of HVAC and HVDC for overhead and underground transmission system.
2) Learn properties of bundled conductors.
3) Analyze the DC transmission system in case of harmonics and as well as multi terminal DC transmission system.
4) Knowledge about the EHV cables and insulating materials.
5) Learn about protection of HVAC and HVDC systems.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										✓
CO2					✓					
CO3	✓	✓								
CO4							✓			
CO5					✓					✓

05PExxx	POWER QUALITY STUDIES	L	T	P
		4	0	0

Course Objectives

- To introduce the definition of power quality disturbances along with cause, detrimental effects and mitigation methods.
- To learn the aspects of power quality in distribution system and various indices.
- To introduce the harmonic sources, active filters and standards.

Unit–I : Fundamentals of Power Quality

Characterization of Electric Power Quality: Transients- short duration and long duration voltage variations Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

Unit–II : Analysis of Single Phase and Three Phase System

Single phase linear and non linear loads – single phase sinusoidal, non sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying non linear loads – concept of pf.

Unit–III : Conventional Load Compensation Methods

Principle of load compensation and voltage regulation – classical load balancing problem : open loop balancing – closed loop balancing, current balancing – harmonic reduction and voltage sag reduction – analysis of unbalance – instantaneous of real and reactive powers – Extraction of fundamental sequence component from measured values.

Unit–IV : Load Compensation Using DSTATCOM

Compensating single phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode

Unit–V : Series Compensation of Power Distribution System

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

Text Books

1) Arindam Ghosh, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002.
2) Dugan, R.C, McGranaghan, M.F., Santoso, S. and Wayne Beaty, H, "Electrical Power System Quality", McGraw Hill publishers, Second Edition, 2008.

Reference Books

1) Barry W. Kennedy, "Power Quality Primer", The McGraw Hill Companies, 2000.
2) Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, "Power Quality: Problems and Mitigation Techniques", Wiley Publications, 2014.
3) Heydt, G.T., "Electric Power Quality", Stars in a Circle Publications, 1994, 2nd edition.
4) Derek A. Paice, "Power Electronic Converter Harmonics", John Wiley & Sons, 1999.
5) Arrillga, A.J. and Neville R. Watson, "Power System Harmonics", John Wiley publishers, Second Edition, 2003.

Course Outcomes

1) Describe power quality issues in a power system.
2) Know the severity of power quality problems.
3) Compute the concept of improving the power quality to sensitive load by various mitigating methods.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓	✓	✓		✓					
CO2	✓						✓			
CO3									✓	✓

05PExxx	**STATIC RELAYS**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To impart knowledge on the basics of static relays.
- To impart knowledge on various types of Comparators.
- To introduce over current, differential, pilot wire relays and their applications.

Unit–I : Comparators

Phase and amplitude comparators - Duality between them- Types - Direct and integrating, rectifier bridge, circulating current, opposed voltage coincident type phase comparator, direct or block spike phase comparator, phase splitting technique, integrating type phase comparator with transistor AND gate. Hybrid comparator - Hall Effect type and magneto resistivity type, vector product type - Zener diode phase comparators - Multi-input comparators - Three input coincidence comparator/phase sequence detector.

Unit–II : Over-Current and Distance Relays

Basic principle of instantaneous and time over current relays - Definite time and inverse time characteristics-Principle and practical circuits for time over current relay, direct over current relay- Static directional relay - Directional over current relay- Performance characteristics of distance relays - Realization of different characteristics using rectifier bridge amplitude comparator and transistorized phase comparator - Methods of achieving circular, quadrilateral and conic characteristics. Static frequency relays – Under frequency and over frequency relays.

Unit–III : Frequency and Differential Relays

Static frequency relays - under frequency and over frequency relays - Static differential relays - Basic principle - Operating characteristics, restraining characteristics - Types of differential relays - Analysis of static differential relays - Application of static differential relays.

Unit–IV : Protection Schemes

Brief introduction to pilot wire and carrier current protective schemes - Digital protection techniques - Introduction - advantages – algorithms - microprocessor based protection schemes.

Unit–V : Power System Apparatus Protection

Transformer protection - Biased differential transformer protection, differential relay C.T.connection-Relay solutions to inrush current problem-Protection using harmonic restraint feature-Duo bias transformer protection - Generator protection - Stator protection, protection of rotor winding- Bus zone protection and motor protection.

Text Books

1) Madhava Rao. T.S., “Power System Protection - Static Relays with Microprocessor Applications”, Tata McGraw Hill Publishing Co., New Delhi, 2007.
2) Sunil S. Rao, “Switchgear and Protection” Khanna Publishers, New Delhi, 2007.

Reference Books

1) Badri Ram & Viswakarma “Power System Protection and Switchgear”, Tata McGraw Hill, 2006.
2) Ravindranath, B. Chander, M., “Power System Protection and Switchgear”, Wiley Eastern Ltd., 1977.

Course Outcomes

1) Enable the students to gain a vast knowledge about the power system protection with reference to the static relay.
2) Acquire knowledge about comparators and functional characteristics of protective relays.
3) Able to design different protection schemes.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2		✓			✓					
CO3			✓				✓			

05PExxx	BIOMEDICAL ELECTRONICS AND INSTRUMENTATION	L	T	P
		4	0	0

Course Objectives

- To give an exposure to various systems of human body.
- To learn the various types of biological transducers used in medical engineering field for signal acquisition.
- To familiarize the students about the bio-potential electrodes and amplifiers used in biomedical engineering.
- To focus on various cardiovascular, respiratory therapy equipments used in medical field.
- To familiarize the students about recent trends in medical imaging.

Unit–I : Electrophysiology

Brief review of physiology and anatomy – Cell structure- Resting potential - Action potential - Propagation of action potentials - Bioelectric potentials - Cardiovascular dynamics - Electrode theory –Microelectrodes-Types of microelectrodes- Depth/Needle electrodes-Bipolar and unipolar electrodes - Surface electrodes –Transducers for bio-medical applications.

Unit–II : Bioelectric Signal Acquisition

Biomedical Instrumentation-Classification-design factors of biomedical instrumentation-Bio potential amplifiers - Instrumentation amplifier – Carrier amplifiers - Chopper amplifiers - Microprocessor / Microcontroller based instrumentation - Telemetry - Safety of biomedical equipments.

Unit–III : Bioelectric Potential and Cardiovascular Measurements

Electrocardiograph - Phonocardiography - Vector cardiography – Blood Pressure -Blood flow - Cardiac output - Plethysmography -Impedance cardiology - Cardiac arrhythmias - Pacemakers - Defibrillators – Electroencephalograph - Evoked potential response - Electromyograph - Fetal monitor.

Unit–IV : Respiratory, Pulmonary Measurements and Rehabilitation

Physiology of respiratory system - respiratory rate measurement - Temperature - Pulmonary function measurement - Oximeter –Audiometers-types- Hearing aids -

Functional neuromuscular stimulation - Physiotherapy - Diathermy -Nerve simulator/pain killer.

Unit–V : Recent Trends in Medical Imaging

Medical imaging - LASER applications in medical field - Ultrasound scanner - Echo cardiography - CT scan - Magnetic Resonance Imaging (MRI) –X-Ray imaging using special techniques- Holter monitoring.

Text Books

1) Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall of India, New Delhi, 2006.
2) R. Anandanatarajan, "Biomedical Instrumentation and Measurements", PHI Learning Private Limited, Delhi-110092, 2013.

Reference Books

1) G.S. Sawhney, Biomedical Electronics and Instrumentation, I.K. International Pvt. Ltd, 1st Edition, 2012.
2) R.S. Khandpur, Handbook of Biomedical Instrumentation, Third Edition, McGraw Hill Education (India) Private Limited, 2014.

Course Outcomes

1) Provide idea about different types of physiological transducers used in medical engineering which can be used to acquire biological signals from the human body.
2) Explain the anatomy and physiology of various subsystems of human body.
3) Understand the principles of cardiovascular, respiratory and therapeutic assisting devices used in bio-medical field.
4) Describe the recent trends used in medical imaging.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2			✓							
CO3		✓								
CO4	✓	✓								

05PExxx	**SOLID STATE DRIVES**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To enable the students to acquire a thorough knowledge about the electrical drives, techniques for controlling the drives and their applications in industries.
- To impart a wide knowledge about the modern electric drives and its latest developments and also its industrial applications.

Unit–I : Performance of Electric Drives

Electric Drives – Types of electric drives - Characteristics of Electric Drives - Advantages of electric drives - speed torque characteristics of various types of loads

and drive motors - Joint speed torque characteristics - Selection of power rating for drive motors based on thermal limits, overload capacity and load variation factors.

Unit–II : Phase Controlled DC Drives

Solid state Drives : Introduction - comparison between solid state and conventional drives - open loop and closed loop speed control - DC motor transfer function - speed and current control loops - converter fed DC drives (using thyristors) - single, two and four quadrant operations - Reversible drives - Armature and field current reversal - Dynamic and regenerative braking.

Unit–III : Chopper Controlled DC Drives (Using Devices other than Thyristors)

Principles of chopper operation - chopper configuration - chopper fed D.C. motors, analysis and performance characteristics - Dynamic and regenerative braking of chopper controlled drives - regenerative reversals.

Unit–IV : Induction Motor Drives (Using Devices other than Thyristors)

Speed control of three phase induction motor - stator voltage and frequency control – V/F control - Rotor control - static control of rotor resistance using DC chopper - slip power recovery scheme – Static Kramer and Scherbius drives.

Unit–V : Synchronous Motor and Special Machine Drives

Speed control of synchronous motors - modes of operation - Adjustable frequency operation - controlled current operation - voltage source inverter and current source inverter fed synchronous motor drive - PWM inverter fed synchronous motor drives – cyclo converter fed synchronous motor drives Special Machines Drives (qualitative treatment) – Principle of operation, Torque speed characteristics of Switched reluctance, Brush less DC and Permanent Magnet Synchronous Motor drives.

Text Books

1) Dubey, G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, 2004.
2) P.C. Sen., “Thyristor DC Drives”, John Wiley and Sons, New York, 1981.
3) Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education Asia 2003.

Reference Books

1) Pillai, S.K., “A First course on Electric Drives”, Wiley Eastern Ltd, Bombay, 1988.
2) Vedam Subramanayan, “Electric Drives - Concepts and Applications”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2007.
3) Murphy, J.M.D. and Turnbull, F.G., “Power Electronic Control of A.C. Motors”, Pergamon Press, Oxford.
4) Miller, T.J.E., “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
5) Gopal K. Dubey, “Power Semi Conductor Controlled Drives”, Prentice Hall New Jersey, 1989.

Course Outcomes

1) Acquire knowledge about various electric drives with their characteristics that are used in the industries.
2) Able to choose a particular motor to suit a particular application.
3) Learn about the modern electric drives, its latest developments and their industrial applications.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2			✓							
CO3			✓			✓			✓	

05PExxx	POWER PLANT ENGINEERING	L	T	P
		4	0	0

Course Objectives

- To enable the students to acquire a thorough knowledge in conventional & non - conventional sources of energy for power generation.
- To impart a wide knowledge about the principle and operation of hydro, thermal and Nuclear power plants.
- To provide a sound knowledge in deciding of location, type and capacity of power plants from the economic point of view.

Unit–I : Sources of Energy

Historical background - power development and growth of power industry in India - sources of energy - conventional sources of energy - hydro - steam and nuclear energy - non - conventional sources of energy - solar energy - wind energy - geo thermal energy - energy from wastes - Magneto Hydro Dynamic (MHD) generation - sources of energy in India.

Unit–II : Hydroelectric Power Plant

Layout of hydroelectric power plant - essential elements of hydroelectric power plant - selection of site for a dam - the power house and equipment - classification of hydroelectric power plants - advantages of hydroelectric power plant - draft tube - surge tanks - safety measures in hydro power station - hydraulic turbines – Kaplan- Pelton- Francis turbines-Factors governing the choice of hydro turbines - performance of water turbine - site selection - comparison of hydro electric power plant and steam power plant - applications of hydro power plant.

Unit–III : Steam Power Plant

Essentials of steam power plant equipment- principle of steam power plant – Layout of steam power plant – selection of site for steam power plant-characteristics of steam power plant - coal handling - ash disposal - smoke and dust removal - draught - comparison of forced and induced draughts - chimney - methods of burning fuel oil - slag removal - economizer and air preheater - super heater - advantages of super-heated steam - feed water treatment - feed water heater - steam condensers - types of steam condensers - selection of condenser - steam turbines – factors governing the choice of steam turbine performance - steam turbine generators

- boilers - type of boilers - boiler mountings and accessories - factors affecting steam plant design-advantages and disadvantages of steam power plant.

Unit–IV : Nuclear Power Plant

Introduction– layout of nuclear power plant- choice of site of nuclear power plant- radioactive isotopes- nuclear reaction – nuclear fusion-nuclear fission - nuclear reactors - types - homogeneous and heterogeneous reactors - fast breeder reactor - gas cooled graphite moderated reactor - ordinary and heavy water reactor - fuel materials - Moderators and coolants - reactor control - control rods – effects of radiation-radiation shielding-advantages and disadvantages of nuclear power plant.

Unit–V : Power Plant Economics

Comparison and selection of thermal power plants - load curves - load duration curves - effects of variable load on power plant design and operation -Selection of prime movers - Comparison and selection of different types of power plants - diesel, gas turbine, hydro, steam and nuclear plants. Economics of power generation - capital - interest - depreciation – methods of calculating depreciation- tariffs – types of tariffs- need for different tariffs and basis.

Text Books

1) Nagpal, G.R., "Power Plant Engineering", Khanna Publishers: 2008.
2) R. K. Rajput, A Text Book of Power Plant Engineering, Laxmi Publications, Fifth Edition, 2016.

Reference Books

1) Uppal, S.L., "Electrical Power", Khanna Publishers, 2007.
2) Arora, S.C. and Domakundwar, S., "A Course in Power Plant Engineering", Dhanpat Rai & Co (P) Ltd., Delhi, 2005.
3) Singhai, D.K., "Fundamentals of Nuclear Power Engineering", Khanna Publishers, 2007.

Course Outcomes

1) Acquire knowledge about various types of renewable and non-renewable energy sources.
2) Learn about the effects of variable load on power plant design and operation.
3) Learn about the modern electric power plants, its latest developments and the factors governing the choice of a particular power plant.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓		✓							
CO2					✓					
CO3									✓	

05PExxx	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P
		4	0	0

Course Objectives

- To discuss the need for controllers and basic varieties of compensators.
- To study the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
- To bring the emergence of FACTS controller and its superior performance.
- To study the techniques for co-ordination of the different FACTS controllers and algorithm for their effective operation.

Unit-I : Classification of Compensators

Reactive Power Control in AC Transmission lines –Uncompensated transmission line – Need for Controllers –Basic types of Controllers - shunt compensated controller– series compensated controller – Thyristor controlled voltage regulator – comparison of HVDC and FACTS technologies.

Unit–II : Static VAR Compensators (SVC)

Objectives of shunt compensation - Methods of controllable Var Generation - Merits of Hybrid compensators - General control scheme of static Var compensator – VI and VQ Characteristics of SVC – Voltage control by SVC – Influence of SVC on system voltage –Design of SVC voltage regulator.

Unit–III : Static Series Compensators (SSC)

Objectives of Series Compensation – Variable impedance type Series Compensators – Modeling and operating control schemes of TSSC,TCSC – Variable reactance model –Switching Converter type Series Compensators – Model and Operating Control scheme of SSSC – Capability to provide real power Compensation.

Unit–IV : Emerging Facts Controllers

Static Synchronous Compensator (STATCOM) –Transfer function model – Dynamic performance –Capability to exchange real power – Operation in unbalanced ac systems – Comparison between STATCOM and SVC – Special purpose FACTS Controller – NGH-SSR Damping Scheme – Thyristor Controlled Braking resistor.

Unit–V : Coordination of FACTS Controllers

Controller interactions –SVC – SVC interaction – Unified Power Flow Controller(UPFC) –Independent real and reactor Power flow Control – Control Schemes for P and Q Control – Interline Power flow Controller(IPFC) – Control Structure - Design of FACTS Controllers .

Text Books

1) Narain G. Hingorani, Laszio. Gyugy, Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems, Standard Publishers Distributors, New Delhi, 2001.
2) Mohan Mathur, R., Rajiv K. Varma, Thyristor Based FACTS Controller for Electrical transmission Systems, IEEE Press, John Wiley and Sons, 2002.

Reference Books

1) Singh, S.N., Electric Power Generation Transmission and Distribution, PHI, New Delhi, 2003.
2) Narain G. Hingorani, High power Electronics and Flexible AC Transmission Systems, IEEE High Power Engineering Review, 1998.

Course Outcomes

1) Describe the need for controllers and basic varieties of compensators.
2) Learn the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
3) Build an enhanced knowledge of how to realize control strategies to ensure a smooth transfer of power with improved performance indices.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1		✓	✓							
CO2		✓								
CO3					✓	✓				

05PExxx	**RESTRUCTURED POWER SYSTEMS**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To understand the fundamentals of restructured power systems
- To learn the significance of Independent System Operator
- To know about transmission pricing and ancillary services
- To study about the power system analysis under market environment

Unit–I : Introduction to Restructuring

Reasons for restructuring of power industry-Vertically Integrated Utilities and Power Pools-Different Entities involved-Market models-Benefits from a Competitive Electricity Market-Worldwide Movement of Power Industry Restructuring

Unit–II : Power System Operation in Competitive Environment

Role of the Independent System Operator (ISO)- Operational Planning Activities of ISO- The ISO in Pool Markets- The ISO in Bilateral Markets- Operational Planning Activities of a Genco- The Genco in Pool Markets- The Genco in Bilateral Markets- Market Participation Issues- Competitive Bidding.

Unit–III : Transmission Open Access and Pricing

Power Wheeling- Transmission Open Access- Types of Transmission Services in Open Access- Cost Components in Transmission- Pricing of Power Transactions- Embedded Cost Based Transmission Pricing- Incremental Cost Based Transmission Pricing.

Unit–IV : Ancillary Services Management

General Description of Some Ancillary Services-Frequency control-Reserves services-Reactive power and voltage control service-Black start capability service-Scheduling and Dispatch Services- Synchronous Generators as Ancillary Service Providers.

Unit–V : Power System Analysis in Market Environment

Electricity Price Forecasting- Issues of Electricity Pricing and Forecasting- Factors Considered in Price Forecasting- Performance Evaluation of Price Forecasting- Price Based Unit Commitment (PBUC)- PBUC Formulation- System Constraints- Unit Constraints- PBUC Solution- Electricity Market Analysis using AC Optimal Power Flow and Economic Load Dispatch.

Text Books

1) K. Bhattacharya, M. Bollen, J.E. Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001.
2) S.C. Srivastava and S.N. Singh, "Operation and Management of Power System in Electricity Market", Alpha Science, 2015.

Reference Books

1) Mohammad Shahidehpour and Muwaffaq Alomoush, "Restructured Electric Power System Operation Trading and Volatility", Marcel Dekker Inc., 2001.
2) Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd, England, 2001.
3) Xiao-Ping Zhang, "Restructured Electric Power Systems: Analysis of Electricity Markets with Equilibrium Models", John Wiley & Sons, 2010.

Course Outcomes

1) Understand the difference between traditional and restructured power systems
2) Acquire knowledge about various entities involved in power markets.
3) Familiarize with electricity pricing and ancillary services
4) Learn about the new dimensions associated with the power system analysis under market environment.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1				✓	✓	✓				
CO2	✓			✓						
CO3			✓							
CO4	✓			✓	✓	✓				

05PExxx	**ELECTRICAL SAFETY ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To expose the students to electrical hazards
- To impart knowledge on prevention of electrical shocks
- To create awareness about various first aid methods
- To study about safety management

Unit–I : Introduction

General Background-Objectives of safety and security measures-Hazards associated with electric current and voltage-principles of electrical safety- Approaches to Prevent Accidents- Fire Prevention and Fire Fighting-Objectives and scope of IE act and IE rules-General requirements for electrical safety as per IE rules

Unit–II : Electrical Shocks and their Prevention

Primary and Secondary Electric Shocks- Occurrence of Electric Shock -Shocks Due to Flashovers/Spark-overs- Lightning Strokes on Overhead Transmission Lines and Outdoor Substations - Safety Precautions in Small LV Installations, Residential Buildings, Shops -Safety Procedures in Electrical Plant Installation and description of Earthing System- Equipment Earthing - Substation Earthing.

Unit–III : First Aid

Introduction- Removal of Contact with Live Conductor- First Principles of Actions after Electric Shock - Artificial Respiration - Schafer's Prone Pressure Method- Silvester's Method- Nielson's Arm-lift Back-pressure Method- Mouth to Mouth Method- Use of Artificial Resuscitator- External Cardiac Massage- Cardiac Pulmonary Resuscitation-First aid treatment of Heat Exhaustion and heat stroke.

Unit–IV : Electrical Safety in Hazardous Areas

Introduction-Classification of Hazardous zones-causes of sparks and flashovers in electrical plants and machines-functional requirements of electrical equipment and installations for hazardous area/zones-classification of equipment/enclosure for hazardous locations.

Unit–V : Electrical Safety Management

Introduction-Principles of safety management-management's safety policy-safety organization-organization charts for construction phase of a project, maintenance mode of a plant and for safety department – safety auditing-training and supervision-annual reports - motivation to managers, supervisors and employees.

Text Books

1) S. Rao and H.L. Saluja, "Electrical Safety, Fire Safety and Safety Management", Khanna Publishers, 2012.
2) W.F. Cooper, "Electrical Safety Engineering", Butterworth and Company, London, 1998.

Reference Books

1) J. Cadick, D. Neitzel and A. Winfield, "Electrical Safety Hand Book", McGraw Hill Education, 2012.
2) J. Maxwell Adams, "Electrical Safety- A Guide to the Causes and Prevention of Electric Hazards", The Institution of Electric Engineers, 3rd Reprint, 2009.
3) Martha J. Boss and Gayle Nicoll, "Electrical Safety - Systems, Sustainability and Stewardship", CRC Press, 2015.

Course Outcomes

1) Learn about Electrical safety, IE act and IE rules
2) Acquire knowledge about various first aid measures.
3) Familiarize with electrical safety in hazardous areas.
4) Get introduced to safety management.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1			✓				✓			
CO2			✓				✓			
CO3			✓				✓	✓		✓
CO4			✓	✓					✓	✓

PROFESSIONAL ELECTIVE LABS

05EPxxx	EMBEDDED SYSTEMS LAB	L	T	P
		0	0	3

Course Objectives

- To provide theoretical and practical introduction to Microprocessor and Microcontrollers.
- To explain assembly language programming techniques.
- To explain the design of hardware interfacing circuits, Microcontroller and Microprocessor system design considerations.

List of Experiments

1) Study of 8085 Microprocessor
2) CRO Interface using 8085 Microprocessor
3) Micro Power - II
4) Study of 8097 Microcontroller
5) Study of DAC and ADC in 8097 Microcontroller
6) Study of PLC
7) PLC Programs
8) Study of Digital Signal Processor-TMS320C50
9) Study of 8051 Microcontroller
10) Code Conversion Using 8051 Microcontroller
11) Seven Segment LED Display Using 8051 Microcontroller
12) Stepper Motor Control Using 8051 Microcontroller
13) Programmable Peripheral Interface-8255
14) Keyboard Display Interface 8279 Using 8051 Microcontroller
15) Single character Transmission and Reception Using 8051 Microcontroller
16) Serial Data Transmission-Kit to Kit Transfer using 8051 Microcontroller

Course Outcomes

1) Understand the architecture and operation of Microprocessors and Microcontrollers.
2) Identify and explain the operations of peripherals and memories typically interfaced with Microprocessors and Microcontrollers.
3) Analyze instruction sets of 8085, 8086 Microprocessors and 8051, 8097 Microcontrollers.
4) Gain hands-on experience in doing experiments on Microprocessors and Microcontroller by using hardware kit in the laboratory and present the report.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2						✓				
CO3	✓									
CO4		✓								

05EPxxx	SIGNALS AND SYSTEMS LABORATORY	L	T	P
		0	0	3

Course Objectives

- To provide an exposure for the analysis of continuous and discrete-time signals and systems.
- To introduce and analyze continuous and discrete-time signals using Fourier analysis tools, Z-transform.
- To familiarize the concepts of sampling process.

List of Experiments

1) Basic plotting of signals.
2) Smoothing data and Difference equations of LTI systems.
3) Complex poles of LTI systems.
4) Frequency response of Casual Discrete-time LTI system.
5) Determination of Fourier Series Coefficient using Periodic Signal.
6) Time domain system analysis.
7) Fourier analysis of Discrete-time systems.
8) Analysis of *z*-Transform.
9) Analysis of Transfer Function in continuous time Systems.
10) State Space representation of Discrete Time Signals.
11) Analysis of Difference Equations using *z*-Transform.
12) Design of Recursive Digital Filters.

Course Outcomes

1) Understand the properties of continuous and discrete-time signals and systems.
2) Analyze the continuous and discrete-time signals using convolution.
3) Represent continuous and discrete-time systems in the Frequency domain using Fourier analysis tools like CTFS, CTFT, DTFS and DTFT.
4) Conceptualize the effects of sampling a continuous time signal.
5) Acquire knowledge continuous and discrete-time systems using Z Transformation.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2	✓									
CO3			✓							
CO4		✓								
CO5						✓				✓

05EPxxx	SYSTEM DESIGN LAB	L	T	P

		0	**0**	**3**

Course Objective

- To provide the students on practical experience in basic aspects of embedded system applications

List of Experiments

1) Study of 89C51 Microcontroller
2) Applications of 89C51 Microcontroller
   a) Frequency measurement
   b) Boolean algebra
3) Stepper Motor Control Using 89C51 Microcontroller
4) Seven Segment LED Display Using 89C51 Microcontroller
5) Study of PIC Microcontroller 16F877
6) Applications of PIC Microcontroller 16F877
   (a) Seven Segment LED Display
   (b) Analog to Digital Converter
   (c) Pulse Width Modulation
7) Realization of Real Time Clock Using PIC Microcontroller 16F877A
8) Analog to Digital conversion Using ARM7 Processor.
9) Seven Segment LED Display Using ARM7 Processor
10) Realization of Real Time Clock Using ARM7 Processor
11) Study of TMS320 Digital Signal Processor
12) Programming of TMS320 Digital Signal Processor- I
13) Programming of TMS320 Digital Signal Processor- II
14) Waveform Generation using TMS320 Digital Signal Processor
15) Analog to digital conversion using TMS320 Digital Signal Processor

Course Outcomes

1) Understand hardware and programming concepts.
2) Acquire knowledge in controlling the programmable device using PC.
3) Develop skill to analyze the problem and design suitable program.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓				✓					
CO2					✓					✓
CO3	✓		✓							

05EPxxx	**VLSI DESIGN LAB**	**L**	**T**	**P**

		0	**0**	**3**

Course Objectives

- To gain expertise in design, development and simulation of digital circuits with VHDL.
- To implement digital circuits on FPGA/CPLD devices.

List of Experiments

1) Design and testing of Half adder and Full adder/ Half subtractor and Full subtractor.
2) Design and testing of BCD adder.
3) Design and testing of multiplexer and demultiplexer.
4) Design and testing of four bit magnitude comparator.
5) Design and testing of array multipliers.
6) Design and testing of flip-flops.
7) Design and testing of synchronous counters.
8) Design and testing of scrambler and descrambler.
9) Design and testing of 4-bit adder/subtractor.
10) Design and testing of Shifters.
11) Design and testing of ripple counters.
12) Design and testing of sequence generator.

Tools: Xilinx software

Course Outcomes

1) Develop architecture of digital circuit for various applications.
2) Analyze VHDL model for digital circuits.
3) Implement digital circuits on FPGA/CPLD devices.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1					✓					
CO2	✓				✓					
CO3					✓					

05EPxxx	**ENERGY CONVERSION LAB**	**L**	**T**	**P**
		0	**0**	**3**

Course Objectives

- To explain the characteristics of solar PV module.
- To examine the performance of solar PV system under different operating status.
- To obtain the characteristics of wind turbine.
- To illustrate the performance of WECS in terms of its quality of power.

List of Experiments

1) I-V and P-V Characteristics of single PV module with varying temperature and irradiation.
2) Performance characteristics of solar PV system under partial shading.
3) Performance characteristics of solar PV system for various tilt angles.

4) Maximum power point tracking of PV system by varying resistive load across the panel.
5) Maximum power point tracking of PV system by varying the duty cycle of converter.
6) Performance evaluation of PV system with bypass and blocking diodes.
7) Evaluation of cut-in speed and cut-off speed of wind turbine.
8) I-V characteristics of wind turbine at different wind speeds.
9) Calculation of voltage, power and frequency output of wind generator.
10) Maximum power point tracking of WECS by varying duty cycle of back-to-back converter.
11) Evaluation of power output and its quality for different load and wind speeds.
12) Evaluation of power quality of AC output of the WECS.

Course Outcomes

1) Acquire the characteristics of solar PV modules.
2) Develop the skill to operate solar PV system.
3) Obtain the characteristic curves of wind turbine.
4) Erudite the performance of WECS.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓									
CO2				✓						
CO3	✓									
CO4				✓						

05EPxxx	ADVANCED CONTROL SYSTEMS LABORATORY	L	T	P
		0	0	3

Course Objective

- To provide the students simple hands-on-experience in the basic aspects of various control schemes implementation to various control system components using Mat Lab.

List of Experiments

1) Transient response analysis in state space approach for various input signals (Step input, Ramp input, Impulse input, Arbitrary input)
2) Unit step response curves for Second / higher order systems with various damping factors
3) Time response plots for forward path / closed loop transfer function by adding poles / zeros
4) Root Locus plot for the given control system.
5) Estimation of % Peak Overshoot for a control system with delay using second order approximation method.

6) Computation of forward path gain and tachometer feed constant for a unity feedback control system (to have 25% maximum overshoot and peak time 0.1sec).
7) State variable response of an armature controlled DC Motor and Field Controlled DC Motor
8) Compensator design for the dominant closed loop poles location.
9) Closed loop stability of the of the control system using Nyquist criterion
10) Closed loop frequency response of control system from M and N – circles
11) Closed loop frequency response of a control system with unity feedback using Nichols chart.
12) Design of a PID control system with constant control input
(To damp out in 2 to 3 seconds in terms of 2% settling time).
13) Control System representation of a system
    a. State space in phase variable form
    b. State space in modal form
14) Transfer function representation of the system expressed in state space version.
15) Bode diagram and Nyquist plots for a system defined in state space
16) Pulse transfer function for the given control system.
17) Root Locus Plot of the Z transfer function added with ZOH
18) Root location and root locus plot on Z plane for a second order system
19) Stability and limit cycles of the given nonlinear control system
20) Transient response of the linear system with dead zone and hysteresis. (Obtain the limit cycles on the phase plane)
21) Nichol's plot for the nonlinear control system using describing function approach
22) Stability characteristics of the system without and with a relay using Isocline Method and Phase plane studies

Course Outcomes

1) Use basic tools of designing various controllers for various control system components using Mat Lab.
2) Experience with various control schemes for electrical motors, process control equipments using Mat Lab.
3) Develop skill to implement various compensating schemes for improved output response of various control system components using Mat Lab.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2		✓								
CO3		✓								

OPEN ELECTIVE THEORY

00OExxx	COMMUNICATION ENGINEERING	L	T	P
		4	0	0

Course Objectives

- To give an exposure of different types of analog modulation techniques and their significances in communication systems.
- To familiarize the students about digital modulation techniques in communication systems.
- To introduce the concepts of Pulse Code Modulation techniques and multiple access techniques used in communication systems for enhancing the number of users.
- To focus on various media for digital communication and future data communication.

Unit–I : Linear Modulation / Demodulation

Need for modulation - Amplitude modulation - Power spectrum - Power relation - Different types of modulation - Double sideband suppressed carrier (DSB/SC), Single sideband suppressed carrier (SSB) and Vestigial sideband (VSB) generation. AM transmitters - Block diagram - Amplitude demodulation - Detection of DSB, SSB signals - Receiver characteristics - Super heterodyne reception - Automatic volume control.

Unit–II : Angle Modulation

Principle of frequency and phase modulation - Generation of FM and PM signals - Direct and indirect methods - FM transmitters - Block diagram – Pre-emphasis circuit - Frequency demodulation - Detection of FM and PM signals - Automatic frequency control - De-emphasis circuit.

Unit–III : Pulse Modulation

Analog and digital communication systems and techniques: Pulse modulation systems - Sampling theorem - Pulse amplitude modulation - Channel bandwidth - Detection of PAM signals - Cross talk in PAM signals - Pulse time modulation - Generation of PDM and PPM - Conversion of PDM to PPM - Detection of PTM signals - Cross talk in PTM signals.

Unit–IV : Pulse Code Modulation Systems

Quantization - Compounding - Pulse code modulation - Sampling and digitizing - Aliasing - Sample and hold circuit - Practical implementation of sampling and digitizing - Equalization - Multiplexing - Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) - Data communications - Serial synchronous, asynchronous communication protocol - Hardware USARTS - Software USART.

Unit–V : Wireless Communication Systems

Evolution of generations (1G, 2G, 2.5, 3G, 4G and beyond 4G), - GSM and CDMA systems-cellular structure-frequency reuse-Handoff-Bluetooth and UWB network-Wi-Fi and Wi-Max. (Quantitative treatment only)

Text Books

1) Herbert Taub, Donald L. Schiling & Gautam Saha "Principles of Communication Systems", Tata McGraw Hill Education Pvt. Ltd., Third Edition, 2008.
2) Bernard Davis & George Kennedy, "Electronic Communication Systems", Tata McGraw Hill Education Pvt. Ltd., Fifth Edition, 2011.

Reference Books

1) K.N. Hari Bhat & Ganesh Rao, "Analog Communications", Pearson Publications, 2nd Edition, 2008.
2) Anokh Singh, "Principles of Communication Engineering", 6th Reprint, S. Chand & Company Ltd., 2006.
3) Sanjay Sharma, "Analog and Digital Communication", S.K. Kataria and Sons Publications, 2013.
4) Bernard Sklar & Pabitra Kumar Ray, "Digital Communications - Fundamentals and Applications", Pearson Publications, Second Edition, 2010.

Course Outcomes

1) Provide idea about modulation and demodulation techniques employed in communication systems.
2) Explain the concepts of pulse modulation systems and multiple access techniques used in communication field applications.
3) Understand the various broadband communication systems and recent advancements in communication systems.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2		✓								
CO3		✓								

00OExxx	**DATA STRUCTURES AND C++**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To learn the methodical way of solving problems
- To understand the different methods of organizing large amounts of data
- To efficiently implement the different data structures
- To efficiently implement solutions for specific problems
- To learn to program in C++

Unit–I : Linear Data Structures

Introduction to data structures, Primitive and non-primitive data structures, Arrays In C -types, Structures in C, Stack-implementation, operations, Queues-operations-Lists-Linked list-types, Applications.

Unit–II : Non Linear Data Structures

Tree - Binary tree-representation - Tree traversal techniques- Graph-representation, traversal-Sorting- Selection Sorting, Insertion sorting, Merge sorting, Radix sorting, Searching -techniques - Hashing.

Unit–III : Object Oriented Programming

Object Oriented Programming concepts- Objects- classes – methods and message passing, encapsulation, abstraction, inheritance, polymorphism and dynamic binding-characteristics of OOPS-benefits of object orientation. Introduction to C++ and data types-Operators in C++.

Unit–IV : Objects and Classes

Objects and class -defining a class –defining member functions-Private and public member function–accessing class members, creating objects, object as function arguments- Array fundamentals - array within a class - array of objects. Constructors and destructors- Function overloading - Inline function - Virtual function.

Unit–V : Operations

Operator overloading – over loading unary, binary and relational operators-type conversion, Inheritance- derived class and base class-visibility mode-public, private and protected–various forms of inheritance. C++ graphics - text mode graphics functions- graphics mode graphics functions - colors –drawing shapes- Address and pointers-Files and streams.

Text Books

1) John R. Hubbard, "Programming with C++", Tata McGraw Hill, New Delhi, 1988.
2) Jean - Paul Tremblay and Paul Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw Hill, 1988.
3) E. Balagurusamy, “Object Oriented Programming with C++”, 6th Edition, Tata McGraw Hill, 2014.

Reference Books

1) R.F. Gilberg, B.A. Forouzan, “Data Structures”, Second Edition, Thomson India Edition, 2005.
2) Sahni, “Data Structures Using C++”, Tata McGraw Hill, 2006.

Course Outcomes

1) Understand basic data structures such as arrays, linked lists, stacks and queues.
2) Apply algorithm for solving problems like sorting, searching, insertion and deletion of data.

3) Able to use object oriented programming language like C++ and associated libraries to develop object oriented programs.
4) Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓				✓					
CO2		✓								
CO3			✓							
CO4									✓	

00OExxx	JAVA PROGRAMMING	L	T	P
		4	0	0

Course Objectives

- To impart a vast knowledge on internet and Java.
- To study about Internet, Core java, Applets and java data base connectivity.
- To illustrate the concepts of java and programming techniques.

Unit–I : Introduction to Java Programming

Object Oriented Programming - Genesis of Java - Overview of Java - Data types, Variables and Arrays - Operators – Control Statements - Introducing Classes - Methods and Classes - Overloading - Understanding static, final - Nested and Inner Classes - String class - Command Line Arguments - Inheritance - I/O Basics - java.io - File - Byte Streams – Character Streams.

Unit–II : Multithreaded Programming

Packages and Interfaces - Exception Handling - Multithreaded Programming: Multi-threaded Programming – Java Thread Model - Creating Multiple Threads - Thread Priorities - Synchronization - Inter thread communication - Suspending, Resuming and Stopping threads.

Unit–III : Applets and Abstract Windowing Tool Kit

Applets: Fundamentals - Applet class - Applet Skeleton - Event Handling - Event classes – Event Listener Interfaces - Adapter Classes - Inner Classes.

AWT: AWT – Window Fundamentals – Working with Frame Windows, Graphics, colors and Fonts – Using AWT controls.

Unit–IV : Remote Method Invocation and Networking

RMI: Layout managers and Menus – Control Fundamentals - Understanding Layout Managers - Java RMI.

Networking: Basics - Networking Classes and Interfaces – Internet Address - TCP/IP Socket, Server Socket classes – Unigram Data Protocol- Datagram Socket - Datagram Packet classes.

Unit–V : Java Database Connectivity

Database Systems – Introduction - Structured Query Language - Installing and setting up JDBC Basic, JDBC Programming concepts - Populating a database - Executing Queries -Scrollable and Updateable Result Sets.

Text Books

1) Herbert Schildt, "The Complete Reference JAVA 2", Tata McGraw Hill, 5th Edition, 2002.
2) E. Balagurusamy, "Programming with Java", McGraw Hill Publishing Company, 2009.

Reference Books

1) Harvey M. Deitel, Paul J. Deitel, "JAVA: How to Program", Deitel & Associates Inc., 7th Edition, 2006.
2) Peter Norton & William Stanek, "Peter Norton's Guide to JAVA Programming", Techmedia, 1997.
3) Yashavant Kanetkar, "Let Us Java", BPB Publications, 2012.

Course Outcomes

1) Acquire knowledge of Internet facilities like E–mail, FTP, Modem and World Wide Web.
2) Understand basic concepts of JAVA programming language used for networking.
3) Understand the state- of- the- art technology of object- oriented programming.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2		✓								
CO3			✓							

00OExxx	**SOFT COMPUTING TECHNIQUES**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- To familiarize the students with the various architectures and learning methods of Artificial Neural Network.
- To enable the students to acquire knowledge on Fuzzy logic, Fuzzy logic controllers and Neuro Controllers.
- To introduce the concept of genetic algorithm and its operators.

Unit–I : Artificial Neural Networks

Motivation for the development of neural networks- biological neural networks- artificial neural networks – Fundamental Concepts - weights – biases and thresholds - common activation functions. McCulloch-pitts neuron: Architecture, algorithm - Hebb

Net- Architecture - algorithm - Perceptron – Architecture- algorithm- applications- Linear separability - Perceptron learning rule convergence theorem - Delta rule.

Unit–II : Neural Network Architecture and Algorithms

Back propagation Neural Net: Standard back propagation - architecture - algorithm - number of hidden layers - Discrete Hopfield neural net- architecture - algorithm – Competitive Neural Networks -Fixed-weight competitive nets – Kohonen self-organizing Maps – Adaptive Resonance Theory- Basic architecture - Algorithm - Introduction to Neuro controllers - Case Studies.

Unit–III : Fuzzy Logic

Fuzzy sets - Properties of Classical and Fuzzy sets- Operations on Fuzzy sets- Fuzzy relations- Linguistic variables - Linguistic Hedges- Fuzzy statements- Assignment statements- Conditional statements- unconditional statements- Fuzzy rule base- Canonical rule formation- Decomposition of compound rules.

Unit–IV : Fuzzy Logic Controller

Fuzzy logic controller: Functional diagram - Fuzzification - Membership value assignments using intuition - Membership functions- Defuzzification: Max-Membership principle - centroid method – weighted average method - Inference Engine – Knowledge Base -Rule base –Case studies

Unit–V : Genetic Algorithm

Optimization – Traditional optimization methods – Concept of Evolutionary Algorithm – Genetic Algorithm – encoding and decoding of variables – GA operators – reproductions – Cross over – mutation – fitness function –fitness scaling.

Text Books

1) Lawrene Faussett, "Fundamental of Neural Networks", Prentice Hall, 2004.
2) Rajasekaran and Vilyalakshmi Pai G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Sysnthesis and Apllications”, Prentice Hall, 2015.
3) David Goldberg, E., “Genetic algorithms in search optimization and machine learning,” Addison Wesley, Pearson Education, Asia, 2001.

Reference Books

1) Driankov, Hellendoornarow, D.H. Reinfrank, M., "An Introduction to Fuzzy Control”, Narosa Publishing Co., New Delhi, 2006.
2) Ross, T.J., "Fuzzy Logic with Engineering Applications", McGraw Hill, Newyork, 2005.
3) Sivanandham, S.N. and Deepa, S.N., “Neural Networks with Matlab”, TMH 2007.

Course Outcomes

1) Recognize the feasibility of applying Artificial Neural Networks for a particular problem.
2) Apply Fuzzy Logic and reasoning to handle uncertainty and solve engineering problems.

3) Identify and apply Neuro controller and Fuzzy Logic Controller for the solution of engineering problems.
4) Apply genetic algorithms to combinatorial optimization problems.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓				✓				✓
CO2	✓					✓				✓
CO3		✓	✓			✓				✓
CO4		✓				✓				✓

00OExxx	QUANTITATIVE MANAGEMENT TECHNIQUES	L	T	P
		4	0	0

Course Objectives

- To familiarize the students in the functioning of different types of resource allocation and evolve inventory control strategies.
- To apply the basic business financial management concepts and tools of analysis such as valuation, risk-return relationships, decision making etc,

Unit–I : Introduction to Management

Development of scientific management - Application of operations research – Classification of operation Research(OR)models – Procedures to obtain optimum solution – Scope of OR - Management information systems (MIS)- Classification of MIS - Cost volume and profit(CVP)analysis - Relationships - Various approaches – Limitation of CVP analysis.

Unit–II : Decision Making

Decision making: Analysis for decision making - Cautions about use of decision making under uncertain future conditions - Review of probability techniques and applications - Calculation of conditional and expected profits - Expected value with perfect information -Use of marginal analysis- Probability distributions -Normal distribution and cost, volume, profit analysis - Unit monetary values with probability distribution - Decision tree analysis.

Unit–III : Inventory Decisions

Inventory decisions - Selective approach to management inventory - EOQ - Different models - Application of EOQ to production process. Reordering - Determination of optimum level - Optimal level of safety stock - Joint ordering - Reordering with planned stock outs - discounts.

Unit–IV : Linear Programming

Introduction - Simplex method - Maximization and minimization - Duality in linear programming - Transportation method - Unbalanced problem - Degeneracy - Assignment method - Application.

Unit–V : Network Replanning and Adjustment

Introduction - Definition of Program Evaluation and Review Technique (PERT) - Network replanning and adjustment – Critical Path Method (CPM) - Time estimate - PERT cost analysis - Control of project cost - Network scheduling - Maximal flow problem – Limitation of PERT and CPM.

Text Books

1) Sundaresan, V., Ganapathy Subramanian, K.S., Ganesan, K., "Resource Management Techniques (Operation Research)", A.R. Publications, 2011.
2) Panneerselvam, "Operations Research", Prentice Hall of India, 2012.

Reference Books

1) Chidambaram, I.A., Sridhar, N.D. and Paramasivam, B., "Quantitative Management Techniques", Sci Tech Publications 2009.
2) B. Mahadevan, "Operations Management: Theory and Practice", Second Edition, Pearson, 2010.
3) Dipak Kumar Bhattacharya, "Production and Operations Management", Universities Press, 2012.
4) Prof.L.C. Jhamb, "Production Operations Management", 18th edition, Everest Publishing House, 2013.
5) J.K, Sharma, "Operations Research", Macmillian, 2013.
6) K. Ashwathappa, Sreedhar Bhat, "Production and Operations Management", HPH, 2012.

Course Outcomes

1) Understand the role of short-term financial management and techniques used to manage cash, accounts receivable and inventory.
2) Identify the major sources of short-term financing available and working capital management of the firm.
3) Identify relevant cash flows for capital budgeting projects and apply various methods to analyze projects.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2			✓							
CO3								✓		

00OExxx	**COMPUTER NETWORKS**	**L**	**T**	**P**

		4	**0**	**0**

Course Objectives

- To study about data transmission basics and Protocols.
- To explore issues and challenges in designing MAC and TCP Protocols in the context of wireless networks.
- To know about Wireless LAN and advanced network architectures.
- To understand the importance of communication network and information security.
- To introduce the different types of attacks.

Unit–I : Transport Protocols

Connection Oriented Transport Protocol - Reliable Networks Services - Unreliable Network Services - ISO/OSI model - TCP Services-Header format -TCP Mechanisms - TCP Policy options - Congestion Control - Retransmission Timer Management - Window Management - Quality of service - User Datagram Protocol (UDP).

Unit–II : Local Area Networks

Background - Topologies and Transmission Media - LAN standards IEEE 802 Reference Model - Logical Link Control - Medium Access Control - IEEE 802.3 Medium Access Control - Ethernet - Fast Ethernet - Gigabit Ethernet - Token Ring and FDDI - IEEE 802.5 Transmission Medium Options. Fiber Channel Elements - Fiber Channel Protocol Architecture - Fiber Channel Physical Media and Topologies - Bridge Protocol Architecture - Fixed routing - Spanning tree approach - Virtual LANs - Router and Three layer switches - Connecting Remote LANs - Wireless LANs - IEEE 802.11 - Architecture and Services - Medium Access Control - Physical layer.

Unit–III : Internet Working

Principle - Requirements - Architectural approaches - Connectionless Internetworking - Routing techniques - Dynamic routing - Internet Protocol (IP) - Internet Control Message Protocol (ICMP) - IPV4 Vs IPV6 structure - Address and Header Formats - ICMPV6 - Unicast and Multicast Routing - Autonomous Systems - Unicast Routing Protocol OSPF - Internet Group Management Protocol (IGMP) - Border Gateway Protocol.

Unit–IV : Information Security

Passive and Active Attacks – Encryption Algorithms - Traffic padding - Message Authentication - Hash function - Public-key Encryption - RSA Public key Encryption Algorithm - Key Management. Secure Socket layer and Transport layer Security - SSL Architecture - SSL Record Protocol - Change Cipher Spec Protocol - Alert Protocol.

Unit–V : Network Security

Handshake Protocol - IP level Security IPSEC - Application layer Security PGP - Firewall - Virtual Private Networks. Electronic Mail - Simple Mail Transfer Protocol (SMTP) - Multipurpose Internal Mail Extension (MIME) - Client Server Model - Socket Interface - Socket Programming - File Transfer - Simple Network

Management Protocol (SNMP) - Hypertext Transfer Protocol (HTTP) overview - World Wide Web (WWW) - HTML - Common Gateway Interface (CGI).

Text Books

1) Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", Fifth Edition, Prentice Hall, 2011.
2) James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach: International Edition, 6th Edition, Pearson Higher Education, 2012.
3) Behronz A. Fehronzan, "Data Communication and Networking", McGraw Hill, 3rd Edition, 2014.

Reference Books

1) Douglas E. Comer, "Computer Networks and Internets with Internet Applications", 5th Edition, Pearson, 2009.
2) Sanjay Sharma, "Introductory Concepts of Computer Networks", First Edition S.K. Kataria and Sons, Publisher of Engineering & Computer Books, 2010.
3) Larry L. Peterson, Bruce S. Davie, "Computer Networks, Fifth Edition: A Systems Approach 5th Edition", Morgan Kaufmann, 2011.

Course Outcomes

1) Understand the fundamental principles of computer networking.
2) Outline the terminology and concepts of the OSI reference model and the TCP-IP reference model.
3) Point out issues in local area networks and wide area networks.
4) Analyze Wireless networking concepts, contemporary issues in networking technologies, network tools and network programming.
5) Able to select the most appropriate networking architecture and technologies.
6) Acquire knowledge about network security including the need for privacy.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2	✓									
CO3			✓		✓					
CO4			✓		✓					

00OExxx	**ENTERPRISE RESOURCE PLANNING**	**L**	**T**	**P**
		4	**0**	**0**

Course Objective

- To understand the business process of an enterprise and grasp the activities of enterprise resource planning project management cycle.

Unit–I : Introduction

Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology.

Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

Unit–II : ERP Solutions and Functional Modules

Overview of ERP software solutions - Small, medium and large enterprise vendor solutions, BPR, and best business practices - Business process Management, Functional modules.

Unit–III : ERP Implementation

Implementation Challenges – Strategies - Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work - Training – Data Migration. People Organization in implementation - Package selection – Project Teams – Process Definitions – Consultants, Vendors and Employees.

Unit–IV : Post Implementation

Maintenance of ERP - Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

Unit–V : Emerging Trends on ERP

Extended ERP systems - CRM, SCM, Business analytics - Future trends in ERP systems - web enabled, Wireless technologies, cloud computing.

Text Books

1) Alexis Leon, ERP Demystified, Second Edition, Tata McGraw Hill, 2008.
2) Alexis Leon, Enterprise Resource Planning, Second Edition, Tata McGraw Hill, 2008.

Reference Books

1) Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System, Wiley India, 2012.
2) Jagan Nathan Vaman, ERP in Practice, Tata McGraw Hill, 2008.
3) Mahadeo Jaiswal and Ganesh Vanapalli, ERP, Macmillan India, 2009.
4) Vinod Kumar Grag and N.K. Venkitakrishnan, ERP Concepts and Practice, Prentice Hall of India, 2006.

Course Outcomes

1) Knowledge of ERP implementation cycle in an organization.
2) Acquire knowledge of ERP software solutions.
3) Understand emerging trends on ERP.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓					✓		✓	✓	
CO2			✓	✓						
CO3					✓					

00OExxx	**SUPPLY CHAIN MANAGEMENT**	**L**	**T**	**P**

		4	**0**	**0**

Course Objective

- To provide an insight on the fundamentals of supply chain networks, tools and techniques and understand the importance of it.

Unit–I : Introduction

Supply Chain –Fundamentals – Evolution - Role in Economy -Importance - Decision Phases - Supplier – Manufacturer - Customer chain - Enablers/ Drivers of Supply Chain Performance. Supply chain strategy - Supply Chain Performance Measures.

Unit–II : Strategic Sourcing

Role of sourcing supply chain supplier selection assessment and contracts - Design collaboration - sourcing planning and analysis - supply chain coordination - Bull whip effect – Effect of lack of coordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

Unit–III : Supply Chain Network

Role of Distribution in Supply Chain – Factors influencing Distribution network design–Design options for Distribution Network Distribution Network in Practice - Role of network Design in Supply Chain – Framework for network decisions.

Unit–IV : Planning Demand, Inventory and Supply

Managing supply chain cycle inventory. Uncertainty in the supply chain – Analyzing impact of supply chain redesign on the inventory - Risk Pooling - Managing inventory for short life - cycle products - multiple item -multiple location inventory management. Pricing and Revenue management.

Unit–V : IT in Supply Chain

The role IT in supply chain - The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E Business in supply chain.

Text Books

1) Janat Shah, Supply Chain Management Text and Cases, Pearson Education, 2009.
2) Sunil Chopra and Peter Meindl, Supply Chain Management Strategy Planning and Operation, PHI Learning/Pearson Education, 2007.

Reference Books

1) Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 5th Edition, 2007.
2) David Simchi Levi, Philip Kaminsky, Edith SimchiLevi, Designing and Managing the Supply Chain: Concepts, Strategies, and Cases, Tata McGraw Hill, 2005.
3) Altekar Rahul, V., Supply Chain Management Concept and Cases, PHI, 2005.
4) Shapiro Jeremy, F., Modeling the Supply Chain, Thomson Learning, Second Reprint, 2002.
5) Joel D. Wisner, G. Keong Leong, Keah Choon Tan, Principles of Supply Chain.

Course Outcomes

1) Ability to build and manage a competitive supply chain using strategies, models, techniques and information technology.
2) Understand models, techniques in supply chain management.
3) Acquire knowledge about the role of IT in supply chain.

Mapping with Programme Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓				✓		✓	✓	
CO2	✓		✓							
CO3	✓		✓							

00OExxx	CLOUD COMPUTING	L	T	P
		4	0	0

Course Objectives

- To understand the principles of cloud computing and cloud service models
- To identify the various technological drivers of cloud computing paradigm
- To understand the basics of virtualization
- To familiarize about the programming models available in cloud
- To get an insight on some of the advanced topics in cloud.

Unit–I : Fundamentals

Motivation -Definition-Principles of Cloud computing-Cloud Ecosystem-Requirements for Cloud Services-Cloud Application-Benefits and Drawbacks.

Cloud Architecture-Anatomy of the Cloud-Network Connectivity in Cloud Computing-Applications on the Cloud-Managing the Cloud-Migrating Application to Cloud.

Unit–II : Cloud Deployment Models and Service Models

Private Cloud-Public Cloud-Community Cloud-Hybrid Cloud-Cloud Service Models -Infrastructure as a Service- Platform as a Service- Software as a Service-Other Cloud Service Models.

Technological Drivers for Cloud Computing-SOA and Cloud- SOA and SOC - Benefits of SOA - Technologies Used by SOA - Similarities and Differences between SOA and Cloud Computing.

Unit–III : Virtualization

Introduction- Virtualization Opportunities- Processor Virtualization- Memory Virtualization Storage Virtualization - Network Virtualization - Data Virtualization Application Virtualization -Approaches to Virtualization- Full Virtualization – Para virtualization - Hardware-Assisted Virtualization -Types of Hypervisors- From Virtualization to Cloud Computing- IaaS- PaaS- SaaS.

Unit–IV : Programming Models for Cloud Computing

Existing and Extended Programming Models for Cloud- BSP Model- MapReduce Model- MapReduce --Model- Cloud Haskell- MultiMLton- Erlang- SORCER: Object-Oriented Programming- Programming Models in Aneka- New Programming Models Proposed for Cloud- Orleans- BOOM and Bloom- GridBatch- Simple API for grid applications.

Unit–V : Networking for Cloud Computing

Overview of Data Center Environment- Networking Issues in Data Centers- Transport Layer Issues in DCNs- TCP Enhancements for DCNs- Cloud Service Providers- EMC- Google- Amazon Web Services- Microsoft- IBM- SAP Labs- Salesforce- Rackspace- VMware- Manjrasoft- An Overview of Open Source in Cloud Computing- Advanced Concepts in Cloud Computing-Inter cloud- Cloud Management- Mobile Cloud- Media Cloud- Cloud Governance- Green Cloud- Cloud Analytics.

Text Books

1) K. Chandrasekaran, "Essentials of Cloud Computing", CRC Press, 2015.
2) Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

Reference Books

1) Dan C. Marinescu, "Cloud Computing: Theory and Practice, Morgan Kaufmann, 2013.
2) San Murugesan, Irena Bojanova, "Encyclopedia of Cloud Computing", Wiley-IEEE Press, 2016.
3) Derrick Rountree, Ileana Castrillo, "The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice", Syngress, 2013.

Course Outcomes

1) Understand the basic ideas and motivation for cloud computing
2) Discuss the suitability of each programming model to different kinds of application
3) Understand the general classification of data centers
4) Know cloud services offered by the companies

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓					✓				
CO2		✓	✓							
CO3	✓					✓		✓		
CO4			✓	✓		✓				

00OExxx	INTERNET OF THINGS	L	T	P
		4	0	0

Course Objectives

- To get an idea on the application areas where Internet of Things can be applied
- To understand the middleware for Internet of Things
- To understand the concepts of Web of Things
- To understand the concepts of Mobile cloud computing
- To understand the IOT protocols

Unit–I : Introduction

Definitions- Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT– Main IoT Applications – Four Pillars of IoT – DNA of IoT - Toolkit Approach for End-user Participation in the Internet of Thing; Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security.

Unit–II : IOT Protocols

Standardization of Protocol for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security.

Unit–III : Web of Things

Web of Things Vs Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

Unit–IV : IOT Models

Integrated Billing Solutions in the IOT Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects - Network Dynamics: Structural Models - Cascading Behavior in Networks - The Small-World Phenomenon.

Unit–V : Applications

The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronization and Software Agents. Applications - Smart Grid – Electrical Vehicle Charging.

Text Books

1) Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
2) Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011.

Reference Books

1) David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, 2010.

2) Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012.
3) Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

Course Outcomes

1) Identify new models for market strategic interaction
2) Design business intelligence and information security for WoB
3) Analyze various protocols for IoT
4) Design a middleware for IoT
5) Analyze and design different models for network dynamics.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓	✓				✓				
CO2		✓	✓		✓					
CO3	✓	✓								
CO4		✓				✓				
CO5	✓	✓				✓	✓			

00OExxx	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**
		4	**0**	**0**

Course Objectives

- The course acts as a bridge between engineering and biology to provide basic understanding of biological mechanisms of living systems from engineering perspective.
- It will illustrate the many possible means to utilize living things' relevance to engineering principles.
- With substantial knowledge and continuing interest will make a student into a specialist in the technical diversity.

Unit–I : Requirements of Biological Systems

Biological Units Need Water; Biological Units Need the Right Amount of Oxygen; Biological Units Need Food and Nutrients; Biological Units Become Ill in the Presence of Wastes; Biological Units Need Heat Sources and Sinks.

Unit–II : Behavior of Biological Systems

Biological Units Adapt to Their Environments; Biological Units Modify Their Environments; Adaptations Require Extra Energy and Resources; Biological Units, If Possible, Move to Friendlier Environments; Biological Units Evolve under Environmental Pressures.

Unit–III : Response to Stress by Biological Systems

Crowding of Biological Units Produces Stress; Biological Units Are Affected by Chemical Stresses; Biological Units Respond to Mechanical Stresses; Optimization

Is Used to Save Energy and Nutrient Resources; Biological Units Alter Themselves to Protect against Harsh Environments.

Unit–IV : Existence of Biological Systems

Biological Units Cooperate with Other Biological Units; Biological Units Compete with Other Biological Units; Biological Units Reproduce; Biological Units Coordinate Activities through Communication; Biological Units Maintain Stability with Exquisite Control; Biological Units Go through Natural Cycles; Biological Units Need Emotional Satisfaction and Intellectual Stimulation; Biological Units Die.

Unit–V : Scaling Factors and Biological Engineering Solutions

Allometric Relationships from Evolutionary Pressure; Dimensional Analysis; Golden Ratio; Fractal Scaling within an Organism; Self-Similarity for Tissues and Organs; Self-Similarity in Populations; Systems Approach; Relationships between Engineering and Biology; The Completed Design.

Text Book

Arthur T. Johnson, "Biology for Engineers", CRC Press, 2010.

Reference Books

1) Aydin Tözeren, Stephen W. Byers, New Biology for Engineers and Computer Scientists, Pearson/Prentice Hall, 2004.
2) S. Thyaga Rajan, N. Selvamurugan, M.P. Rajesh, R.A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M.K. Jaganathan, "Biology for Engineers," Tata McGraw Hill, New Delhi, 2012.

Course Outcomes

1) Understand the information known about familiar living systems.
2) Anticipate the properties of an unfamiliar group of living things from knowledge about a familiar group.
3) Demonstrate the relevance of engineering to biological systems.
4) Knowledge about the biological responses and its scaling with respect to scientific principles that cannot be related back.
5) Knowledge of biological principles and generalizations that can lead to useful products and processes and the ability to avoid or mitigate unintended consequences of dealing with any and all living system.

Mapping with Programme Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	✓									
CO2	✓									
CO3	✓		✓							
CO4	✓		✓							
CO5	✓		✓							

00OExxx	DISASTER MANAGEMENT	L	T	P
		4	0	0

Course Objective

This course helps in providing the basic concepts of disasters and also gives a thorough knowledge and experience to reduce disaster risks.

Unit–I

Introduction – Disaster- Characteristics and types of Disasters- Causes and effects of Disaster -Risk- Vulnerability – Preparedness- Disaster mitigation and disaster management- Classification of mitigation measures-Vulnerability Analysis-Observation and Perception of Vulnerability- Socio-Economic Factors of Vulnerability- Vulnerability in India- Disaster related policy goals of UNDP UNDRO and Govt. of India- Appraising disaster needs- Needs for technical expertise- Role of various Agencies in Disaster Management and Development -Disaster risk reduction planning- Role of Developmental Planning for disaster Management

Unit–II

Earthquake - Cause of Earthquake- General characteristics- Measuring Earthquakes- Distribution pattern of Earthquakes in India- Earthquake prone areas- case studies of important Indian earthquakes - Forecasting techniques and risk analysis- Possible risk reduction measures- earthquake resistance buildings and re-engineering techniques in India.

Unit–III

Tsunamis- Causes of a Tsunami- General Characteristics- Tsunami warning system-Distribution pattern of Tsunami in India- Possible risk reduction measures-Integrated coastal zone management.

Landslides- Rock falls- Avalanches- Mud flows and glaciers- Landslides and rock falls- landslide hazard zonation- Instrumentation and monitoring- Techniques for reducing landslide hazards.

Unit–IV

Tropical cyclones- Structure of tropical cyclones- Nature of tropical cyclones-Cyclone experience in India and Tamilnadu- Preparedness- Tropical cyclones and their warning systems- Tropical cyclone warning strategy in India special nature of the problem in the region- Classification- Protection of buildings from cyclones of India- Precautions during and before cyclones.

Unit–V :

Coastal floods- Intensification of hazards due to human interference-Management-River and coastal floods- Temperature extremes and wild fires-Physiological hazards- Flood forecasting-mitigation- planning- management- flood prone areas the Indian scenario- Flood experience in India and Tamilnadu.

Environmental hazards- Typology- Assessment and response- Strategies -The scale of disaster-Vulnerability- Disaster trends- Paradigms towards a balanced view- Chemical hazards and toxicology-Biological hazards- Risk analysis- Other technological disasters.

Text Books

1) David R. Godschalk (Editor), Timothy Beatiey, Philip Berke, David J. Browt:r, Edward J. Kaiser Charles C. Boh, R. Matthew Goebel, Natural Hazard Mitigation: Recasting Disaster Policy and Planning Island Press; (January 1999), ISBN) 559636025.
2) Sinha, P.C. Wind & Water Driven Disasters, 1998, 250pp, Anmol Publications.

Reference Books

1) Davide Wikersheimer Windstorm Mitigation Manual for Light Frame Construction, DIANE Publishing Co: (Paperback-May 1997)
2) Brown D Redevelopment After the Storm: Hazard Mitigation Opportunities in the Post Disater Setting. (Paperback – June 1985) Publisher: John Wiley & Sons ISBN:047191505X
3) Sinha, P.C. Technological Disasters, 1997, 516 pp Anmol Publications Trivedi.

Course Outcomes

1) Develop an understanding of the key concepts, definitions key perspectives of all Hazards Emergency Management.
2) Develop a basic under understanding of Prevention, Mitigation, Preparedness, Response and Recovery.

00OExxx	ENTREPRENEURSHIP	L	T	P
		4	0	0

Course Objectives

- Develop an entrepreneurship sprit
- Help to identify business opportunities within an organization or independently
- Initiate action on the business plan from the prospective business through EDC

Unit–I

Meaning – Characteristics of management – Nature of management – Process of management – Functional areas of management – Management and administration – Role of management – Level of management – Evolution of management.

Unit–II

Meaning - Nature of planning – Importance of planning – Types of planning – Steps in planning – Decision making – Meaning and definition of organizing – Steps in organizing – Nature of organization – Organization structure – Purpose of organization – Principles of organization – Delegation of authority – Nature and importance of staffing.

Unit–III :

Meaning and nature of direction – Principles of directing – Leadership and leadership style – Motivation – Communication – Need and feedback in communication – Importance of communication – Channels of communication – Types of communication – Forms of communication.

Unit–IV

Evolution of concept of entrepreneur – Concept of entrepreneur – Characteristics of entrepreneur – Distinction between entrepreneur and manager – Technical entrepreneur – Charms of being an entrepreneur – Types of entrepreneur – Role of entrepreneurship in economic development – Barriers in entrepreneurship.

Unit–V

Meaning of project – Project classification – Project identification – Meaning and significance of project report – Contents of a project report – Formulation of project report – Planning commission guidelines – Identification of opportunity – Project feasibility study.

Text Books

1) Veerabhadrappahavinal, Management and entrepreneurship, New age International, New Delhi, 2008.
2) Peter F. Drucker, Innovation and entrepreneurship, Butterworth–Heinemann, London, 1985.

Reference Books

1) "Creativity, Innovation, Entrepreneurship and Enterprise in Construction and Development", University of Reading, Alan Barrell – Entrepreneur in Residence Entrepreneur in Residence, University of Xiamen, Xiamen, 2012.
2) "Entrepreneurship Studies", National University Commission (Nigerian University System), 2010.

Course Outcome

At the end of this course the student should have an understanding about entrepreneurship. The students should have knowledge about the principles of business plan.

00OExxx	NATIONAL SERVICE SCHEME	L	T	P
		4	0	0

Course Objectives

- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving
- Develop capacity to meet emergencies and natural disasters
- Practice national integration and social harmony and
- Utilize their knowledge in finding practical solutions to individual and community problems.

Unit–I : National Service Scheme

A) History and its Objectives
B) Organizational structure of N.S.S. at National, State, University and College Levels

C) Advisory committee and their functions with special reference to college principal, Programme officer, N.S.S. group leader and N.S.S. volunteers in the implementation.

Unit–II : National Integration

A) Need of National integration

B) Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc.

Unit–III : Special Programme

A) Legal awareness

B) Health awareness

C) First-aid

D) Career guidance

E) Leadership training - cum - Cultural Programme

F) Globalization and its Economic Social Political and Cultural impacts.

Unit–IV : Special Camping Programme

A) Nature and its objectives

B) Selection of camp site and physical arrangement

C) Organization of N.S.S. camp through various committees and discipline in the camp.

D) Activities to be undertaken during the N.S.S. camp.

E) Use of the mass media in the N.S.S. activities.

Unit–V : N.S.S. Regular Activities

A) Traffic regulation

B) Working with Police Commissioner's Office

C) Working with Corporation of Chennai

D) Working with Health Department

E) Blind assistance

F) Garments collection

G) Non-formal education

H) Environmental Education, Awareness and Training (EEAT)'

I) Blood donation

Reference Books

1) National Service Scheme Manual, Government of India, 2006.

2) Training Programme on National Programme scheme, TISS.

3) Orientation Courses for N.S.S. Programme officers, TISS.

4) Case material as Training Aid for field workers, Gurmeet Hans.

5) Social service opportunities in Hospitals, Kapil K.Krishan,TISS.

6) Social Problems in India, Ram Ahuja.

00OExxx	HUMAN RIGHTS	L	T	P
		4	0	0

Course Objective

- At the end of this course the student is expected to understand what is human rights, how to obey the rights, what is the role of a human being in making a good society for the future generations.

Unit–I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

Unit–II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U.N.O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Convenant on Economic, Social and Cultural Rights and Optional Protocol.

Unit–III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

Unit–IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments -European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

Unit–V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment. Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

Text Books

1) Desai, A.R., Violation of Democratic Rights in India, Sage Publishers, 1986.
2) S. Hick, E. Halpin and E. Hoskins, Human Rights and the Internet, Springer Publishers, 2000.

Reference Books

1) International Bill of Human Rights, Amnesty International Publication, London, 1988.
2) Human Rights, Questions and Answers, UNESCO, 1982
3) Mausice Cranston- What is Human Rights
4) Timm. R.W. - Working for Justice and Human Rights.
5) Human Rights, A Selected Bibliography, USIS.
6) Cheous K (Ed) - Social Justice and Human Rights (Volumes 1-7).
7) Devasia, V.V. - Human Rights and Victimology.