ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. Electrical and Electronics Engineering

Regulations & Curriculum – 2018

HAND BOOK
2018

DEPARTMENT OF ELECTRICAL ENGINEERING

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. (Four Year) Degree Program (FULL–TIME)

Choice Based Credit System (CBCS)

REGULATION 2018

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree Programs shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as courses 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 Tamil Nadu 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 Program in Engineering of the State Board of Technical Education, Tamil Nadu (listed in Annexure-I) will be eligible for admission to the second year of the four-year degree Program in B.E. under the lateral entry scheme provided they satisfy other conditions.

2. Branches of Study in B.E.

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

3. Courses of Study and Scheme of Examinations

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

4. 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 Program are 166 (124 for lateral entry students).

5. 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

5.1 Earn a minimum of 166 credits (124 for lateral entry students).

5.2 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)

Enrol 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, IEEE, SAE, ASHRAE, CSI and IWS

5.3 B.E (Honours) Degree

A student shall be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. Thus, the total credits are 186. Out of 186 credits (144credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure-II) in sixth, seventh and eighth semesters. These additional 20 credits could be acquired through the MOOC courses of SWAYAM portal also.

5.4 B.E Degree with Minor Engineering

A student shall be eligible to get Under Graduate degree with additional Minor Engineering, if he/she completes an additional 20 credits. Out of the 186 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure-II) in the Faculty of Engineering and Technology in sixth, seventh and eighth semesters. These additional 20 credits could be acquired through the MOOC courses offered in SWAYAM portal also.

6. Assignment of Credits for Courses

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

7. Duration of the Program

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

8. 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 enrol 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 166 (124 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:

8.1 Slow Learners

The **slow learners** may be allowed to withdraw certain courses with the approval by the 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.

8.2 Advance Learners

The **advance learners** may be allowed to take up the open elective courses 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.

9. Mandatory Internship (Industrial Training)

To promote industrial internship at the graduate level in technical institutes and also to enhance the employability skills of the students passing out from Technical Institutions, the internship for the students at different stages of the Program, is included in the curriculum. The student has to undergo the internship during the summer vacation, after the II semester / IV semester/ VI semester of the Programs per the details outlined below. Further the student

has to submit a report on completion of the internship during the subsequent Odd semester that is in the III / V / VII semesters respectively.

9.1 During the summer vacation, after the II Semester,

The student must get involved in any of the following **Inter/ Intra Institutional**

Activities for **4 weeks** duration:

(i) Training with higher Institutions; Soft skill training organized by Training and Placement Cell.
(ii) Contribution at incubation/ innovation /entrepreneurship cell of the institute.
(iii) Participation in conferences/ workshops/ competitions.
(iv) Learning at Departmental Lab/ Institutional workshop.
(v) Working for consultancy/ research project within the University.
(vi) Participation in activities like IPR workshop /Leadership Talks/ Idea/ Design/ Innovation/ Technical Expos.'

9.2 During the summer vacation, after the IV Semester and also after the VI Semester,

The student may choose any of the following **Internship / Innovation /**

Entrepreneurship related activities for **4 weeks** duration:

(i) Work on innovation or entrepreneurial activities resulting in start-up

(ii) Undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises

(iii) Undergo internship with National Employment Enhancement Mission (NEEM) Facilitator.

10. 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.

11. Mandatory Induction program

A 3-week long induction program for the UG students entering the institution, right at the start is proposed. Normal classes start only after the induction program is over. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

- Physical Activity
- Creative Arts
- Imparting Universal Human Values
- Literary Activities
- Conduct of crash courses on soft skills
- Lectures by Eminent People
- Visits to Local Area
- Familiarization to Dept./Branch & Innovative practices

12. Electives

The elective courses fall under two basic categories: Professional Electives and Open Electives.

12.1 Professional Elective courses

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.

12.2 Open Elective courses

Apart from the various Professional elective courses, a student must study three open elective courses two of which offered by the Department concerned and the other open elective course offered by any other Department in the Faculty of Engineering & Technology during either sixth or seventh or eighth semester of study, with the approval of the Head of the Department and the Head of the Department offering the course.

12.3 MOOC (SWAYAM) Courses

Further, the student can be permitted to earn not more than 20 % of his total credits (that is 32 credits) by studying the Massive Open Online 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 to the professional elective and/or open elective courses. Thus, the credit earned through MOOC courses can be transferred and considered for awarding Degree to the student concerned.

12.4 Value added courses (Inter Faculty Electives)

Of the four open elective courses, a student must study one value added course that is offered by other Faculties in our University either in sixth or seventh semester of the B.E Program.

12.5 One Credit Courses

One credit course shall be offered by a Department with the prior approval from the Dean, Faculty of Engineering and Technology.

12.5.1 Industry Expert

For one credit courses, a relevant potential topic may be selected by a committee consisting of the 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 courses. A separate mark sheet shall be issued for one credit courses.

12.5.2 NSQF Courses A student can be permitted to acquire additional credits not more than two by undergoing any two of the one credit courses conducted under the auspices of National Skills Qualification Framework (NSQF). NSQF is a nationally integrated education and competency-based skill and quality assurance framework that will provide for multiple pathways, horizontal as well as vertical, including vocational education, vocational training, general education and technical education, thus linking one level of learning to another higher level. This will enable a student to acquire desired competency levels, transit to the job market and at an opportune time, return for acquiring additional skills to further upgrade their competencies.

13. Assessment

13.1Theory Courses

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

First assessment	: 10 marks
Second assessment (mid semester test)	: 10 marks
Third Assessment	: 05 marks
End Semester Examination	: 75 marks

13.2 Practical Courses

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

First assessment (test)	: 15 marks
Second assessment (test)	: 15 marks
Maintenance of record book	: 10 marks

End Semester Examination : 60 marks

13.3 Project Work

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.

13.4 Industrial Internship

After attending the internship during the summer vacation of even semester (II / IV / VI semester), the student has to present a report at the start of the subsequent odd semester (III / V / VII semester) to the committee which will assess and award marks out of 100. The committee is constituted with an Internship Coordinator and a minimum of two members nominated by the Head of the Department for each class.

14. 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.

15. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic Program, 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.

16. 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 the 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 ofI & II Semester) for approval and transmission to the Controller of Examinations.

17. 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.

18. 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.

If a student wishes to apply 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 Program within the maximum period of seven years.

19. Procedure for withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire Program 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' will appear in the mark sheet for such candidates.

20. 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 in the mark sheet must reappear for the examination of the courses except for Honours courses.

A student who obtains letter grade 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-valuation of one or more of his examination answers 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.

21. Awarding Degree

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

21.1 Honours Degree

To obtain **Honours Degree** a student must earn a minimum of **186 credits** within four years (144credits within three years for lateral entry students) from the time of admission, pass all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.2 First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 166 Credits within four years (124 credits within three years for lateral entry students) from the time of admission, by passing all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.3 First Class

To obtain B.E Degree First Class, a student must earn a minimum of 166 credits within ***five*** years (124 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 courses from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

21.4 Second Class

For Second Class, the student must earn a minimum of 166 credits within **seven** years (124 credits within **six** years for lateral entry students) from the time of admission.

21.5 B.E Degree with Minor Engineering

For Minor Engineering, the student must earn a minimum of 186 credits within four years (144 credits within three years for lateral entry students) from the time of admission, pass all the courses. The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class will be applicable for this also.

22. Ranking of Candidates

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

The candidates who are eligible to get the B.E. degree in First Class with Distinction will be ranked next after those with Honours on the basis of CGPA for all the courses 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 courses 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.

23. 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.

Annexure-I

Diploma Programs Eligible for the B.E (Lateral Entry) Programs offered in FEAT (from 2019-2020)

Sl.No.	Branches of Study	Eligible Diploma Program (FT / PT / SW)
1.	**Chemical Engineering**	i. Petrochemical Engineering ii. Chemical Engineering iii. Environmental Engineering and Pollution Control iv. Leather Technology (Footwear) v. Leather Technology vi. Plastic Technology vii. Polymer Technology viii. Sugar Technology ix. Textile Technology x. Chemical Technology xi. Ceramic Technology xii. Petro Chemical Technology xiii. Pulp & Paper Technology xiv. Petroleum Engineering
2.	**Civil Engineering**	i. Civil Engineering ii. Civil Engineering (Architecture) iii. Environmental Engineering and Pollution Control iv. Architectural Assistantship v. Civil Engineering (Rural Tech.) vi. Civil and Rural Engineering vii. Agricultural Engineering
3.	**Civil and Structural Engineering.**	
4.	**Computer Science and Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics (Robotics) viii. Mechatronics Engineering
5.	**Electrical and Electronics Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering (Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering
6.	**Electronics and Communication Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics (Robotics) viii. Mechatronics Engineering ix. Electrical and Electronics Engineering x. Electronics and Instrumentation Engg

Sl.No.	Branches of Study	Eligible Diploma Program (FT / PT / SW)
7.	**Electronics and Instrumentation Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering (Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering
8.	**Information Technology**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
9.	**Mechanical Engineering**	i. Mechanical Engineering ii. Mechanical and Rural Engineering iii. Mechanical Design and Drafting iv. Production Engineering v. Production Technology vi. Automobile Engineering vii. Automobile Technology viii. Metallurgy ix. Mechatronics Engineering x. Machine Tool Maintenance and Repairs xi. Tool and Die making xii. Tool Engineering xiii. Tool Design xiv. Foundry Technology xv. Refrigeration and Air Conditioning xvi. Agricultural Engineering xvii. Agricultural Technology xviii. Marine Engineering xix. Mechanical Engineering (Production) xx. Mechanical Engineering (Tool &Die) xxi. Mechanical Engineering (Foundry) xxii. Mechanical Engineering (R & A.C.) xxiii. Electronics (Robotics) xxiv. Mining Engineering xxv. Agricultural Engineering and Farm Machinery xxvi. Equipment Technology
10.	**Mechanical Engineering** **(Manufacturing Engineering)**	

Annexure-II

S.No.	Branch of Study in B. E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
1.	Chemical Engineering	1. Chemical Engineering 2. Pharmacy 3. Electronics and Instrumentation Engineering	1. Civil Engineering 2. Mechanical Engineering 3. Electronics and Instrumentation Engg 4. Information Technology 5. Civil and Structural Engg 6. Electrical Engineering 7. Electronics and Communication Engg 8. Mechanical (Manufacturing) Engg 9. Computer Science and Engineering
2.	Civil Engineering	1. Civil Engineering 2. Civil and Structural Engg.	1. Mechanical Engineering 2. Electrical Engineering 3. Chemical Engineering 4. Computer Science and Engineering 5. Mechanical (Manufacturing) Engg 6. Electronics and Instrumentation Engg 7. Information Technology 8. Electronics and Communication Engg
3.	Civil and Structural Engineering		
4.	Computer Science and Engineering	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering	1. Civil Engineering 2. Electronics and Instrumentation Engg 3. Electronics and Communication Engg 4. Mechanical Engineering 5. Mechanical (Manufacturing) Engg 6. Civil and Structural Engg 7. Electrical Engineering 8. Chemical Engineering
5.	Electrical and Electronics Engineering	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engg 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engg 6. Computer Science and Engineering 7. Information Technology
6.	Electronics and Communication Engg.		
7.	Electronics and Instrumentation Engg.		
8.	Information Technology	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering	1. Civil Engineering 2. Electronics and Instrumentation Engg 3. Electronics and Communication Engg 4. Mechanical Engineering 5. Mechanical (Manufacturing) Engg 6. Civil and Structural Engg 7. Electrical Engineering 8. Chemical Engineering
9.	Mechanical Engineering	1. Mechanical Engineering 2. Mechanical (Manufacturing) Engg.	1. Civil Engineering 2. Civil and Structural Engg 3. Electrical Engineering 4. Chemical Engineering 5. Computer Science and Engineering 6. Electronics and Instrumentation Engg 7. Information Technology 8. Electronics and Communication Engg
10.	Mechanical (Manufacturing) Engg.		

DEPARTMENT OF ELECTRICAL ENGINEERING

VISION

To develop the Department into a "Centre of Excellence" with a perspective to provide quality education and skill-based training with state-of-the-art technologies to the students, thereby enabling them to become achievers and contributors to the industry, society and nation together with a sense of commitment to the profession.

MISSION

M1: To impart quality education in tune with emerging technological developments in the field of Electrical and Electronics Engineering.

M2: To provide practical hands-on-training with a view to understand the theoretical concepts and latest technological developments.

M3: To produce employable and self-employable graduates.

M4: To nurture the personality traits among the students in different dimensions emphasizing the ethical values and to address the diversified societal needs of the Nation

M5: To create futuristic ambience with the state-of-the-art facilities for pursuing research.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Envisage a solid foundation in Basic Sciences, Electrical and Electronics Engineering for a successful career and Life-long Learning in the fields of having Societal Implications.

PEO2: Design and implement effective solutions for complex Electrical and Electronics Engineering problems using modern tools and techniques.

PEO3: Establish Professionalism, Good Communication skills and ethical attitude in multi-disciplinary team work.

PEO4: Apply creative thinking and critical reasoning skills in collaborative research.

PEO5: Contribute to the economical growth of the country by creating job opportunities through entrepreneurship.

PROGRAM OUTCOMES (POs)

After the successful completion of B.E (Electrical and Electronics Engineering Engineering) Program the students will be able to:

PO 1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/Development of Solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct Investigations of Complex Problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern Tool Usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The Engineer and Society:

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and Sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and Team Work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project Management and Finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-Long Learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

At the time of graduation, the students will be able to:

PSO 1: Identify, formulate and investigate various problems of electrical and electronic circuits, power electronics and power systems by applying the fundamental knowledge of mathematics, science and engineering.

PSO 2: Design, develop and implement multidisciplinary projects in the field of electrical power and energy using state-of-the-art technologies and modern software tools.

PSO 3: Develop effective communication skills and leadership qualities with professional and ethical responsibilities to meet the global technological challenges of the society and electrical industry.

Mapping PO with PEO															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
PEO1	3											3	3		
PEO2	3	2	3		3	1	1						2		3
PEO3						3		3	2	3	1			3	3
PEO4	2	2		2		3					3		1	3	
PEO5	1		2			2	2	2			3	1			2

DETAILS OF COURSE CODE

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
YY	Code of the Program 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.

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. (Four Year) Degree Program (FULL–TIME)

Choice Based Credit System (CBCS)

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION 2018)

SEMESTER I

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
18ETBS101	**BS-I**	Physics	3	1	0	25	75	100	4
18ETBS102	**BS-II**	Mathematics – I	3	1	0	25	75	100	4
18ETES103	**ES-I**	Basic Electrical Engineering	3	1	0	25	75	100	4
18ETBP104	**BSP-I**	Physics Laboratory	0	0	3	40	60	100	1.5
18ETSP105	**ESP-I**	Electrical Engineering Laboratory	0	0	2	40	60	100	1
18ETSP106	**ESP-II**	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
			Total Credits						**17.5**

SEMESTER II

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
18ETHS201	**HS-I**	English	2	0	0	25	75	100	2
18ETBS202	**BS-III**	Chemistry	3	1	0	25	75	100	4
18ETES203	**ES-II**	Programming for Problem Solving	3	0	0	25	75	100	3
18ETBS204	**BS-IV**	Mathematics – II	3	1	0	25	75	100	4
18ETHP205	**HSP-I**	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
18ETBP206	**BSP-II**	Chemistry Laboratory	0	0	3	40	60	100	1.5
18ETSP207	**ESP-III**	Computer Programming Lab	0	0	4	40	60	100	2
18ETSP208	**ESP-IV**	Engineering Graphics and Drafting	1	0	4	40	60	100	3
							Total Credits		**20.5**

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.

HS	Humanities and Social Sciences including Management courses
BS	Basic Science courses
ES	Engineering Science Courses
CA	Continuous Assessment Marks
FE	Final Exam Marks

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETBS301	**BS-V**	Engineering Mathematics -III	3	1	-	25	75	100	4
ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
ETES303	**ES-IV**	Engineering Mechanics	3	-	-	25	75	100	3
EEES304	**ES-V**	Fluid Mechanics and Hydraulic Machinery	2			25	75	100	2
EEPC305	**PC-I**	Electrical Circuit Analysis	3	-	-	25	75	100	3
EEPC306	**PC-II**	Analog Electronics	3	1		25	75	100	4
EESP307	**ESP-V**	Hydraulic Lab	-	-	3	40	60	100	1.5
EECP308	**PCP-I**	Electrical Circuits Lab	-	-	3	40	60	100	1.5
EECP309	**PCP-II**	Analog Electronics Lab	-	-	3	40	60	100	1.5
ETIT310	**IT-I**	Internship Inter/ Intra Institutional Activities*	***Four*** *weeks during the summer vacation at the end of* ***II Semester***				100	100	**4.0**
For the ***Lateral entry students' total credit for III Semester is ***23.5*** as they are exempted from internship during summer vacation of II semester.*			**Total Credits**						**27.5**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
*EEBS401	**BS-VI**	Probability, Random Process and Numerical Methods	3	-	-	25	75	100	3
EEES402	**ES-VI**	Data Structures & C++ Programming	2	-	-	25	75	100	2
EEPC403	**PC-III**	Electrical Machines	3	-	-	25	75	100	3
EEPC404	**PC-IV**	Digital Electronics	3	-	-	25	75	100	3
EEPC405	**PC-V**	Electrical Measurements & Instruments	3	-	-	25	75	100	3
EEPC406	**PC-VI**	Electromagnetic Fields	3	-	-	25	75	100	3
EECP407	**PCP-III**	Electrical Machines Lab	-	-	3	40	60	100	1.5
EECP408	**PCP-IV**	Digital Electronics Lab	-	-	3	40	60	100	1.5
EECP409	**PCP-V**	Electrical Measurements Lab	-	-	3	40	60	100	1.5
								Total Credits	**21.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.									

SEMESTER V									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EEPC501	**PC-VII**	Microprocessor and Microcontroller	3	-	-	25	75	100	3
EEPC502	**PC-VIII**	Power Electronics	3	-	-	25	75	100	3
EEPC503	**PC-IX**	Control Systems	3	-	-	25	75	100	3
EEPC504	**PC-X**	Power Systems-I	3			25	75	100	3
EEPE505	**PE-I**	Professional Elective I	3	-	-	25	75	100	3
EEPE506	**PE-II**	Professional Elective II	3	-		25	75	100	3
EECP507	**PCP-VI**	Microprocessor and Microcontroller Lab	-	-	3	40	60	100	1.5
EECP508	**PCP-VII**	Power Electronics Lab	-	-	3	40	60	100	1.5
EECP509	**PCP-VIII**	Control Systems Lab	-	-	3	40	60	100	1.5
ETIT510	**IT-II**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four** weeks during the summer vacation at the end of **IV Semester***				100	100	**4.0**
								Total Credits	**26.5**

SEMESTER VI									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EEPC601	**PC-XI**	Power Systems-II	3	-	-	25	75	100	3
EEPC602	**PC-XII**	Embedded Systems	3	-	-	25	75	100	3
EEPE603	**PE-III**	Professional Elective - III	3	-	-	25	75	100	3
EEPE604	**PE-IV**	Professional Elective - IV	3	-	-	25	75	100	3
EEPE605	**PE-V**	Professional Elective -V	3	-	-	25	75	100	3
#YYOE606	**OE-I**	**Open Elective - I**	3	-	-	25	75	100	3
EECP607	**PCP-IX**	Power Systems Lab	-	-	3	40	60	100	1.5
EECP608	**PCP-X**	Embedded System Lab	-	-	3	40	60	100	1.5
								Total Credits	**21.0**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.									

SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS701	**HS-II**	Engineering Ethics	2	-	-	25	75	100	2
EEPC702	**PC-XIII**	Industrial Electrical Systems	3	-	-	25	75	100	3
EEPE703	**PE-VI**	Professional Elective-VI	3	-	-	25	75	100	3
EEPE704	**PE-VII**	Professional Elective-VII	3	-	-	25	75	100	3
YYOE705	**OE-II**	**Open Elective - II**	3	-	-	25	75	100	3
EECP706	**PCP-XI**	Electrical Estimation and Drawing Lab	-	-	3	40	60	100	1.5
ETIT707	**IT-III**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four*** *weeks during the summer vacation at the end of VI* ***Semester***				100	100	**4.0**
								Total Credits	**19.5**

SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EEOE801	**OE-III**	**Open Elective – III (from the same department)**	3	-	-	25	75	100	3
EEOE802	**OE-IV**	**Open Elective – IV (from the same department)**	3	-	-	25	75	100	3
EEPV803	**PV-I**	**Project Work and Viva-Voce**	-	**PR** 10	**S** 2	40	60	100	**6**
								Total Credits	**12**

L	No. of Lecture	**TR**	No. of for Discussion on Industrial Training
T	No. of Tutorial	**S**	No. of Seminar on Industrial Training / Project
P	No. of Practical	**PR**	No. of for Discussion on Project work
CA	Continuous Assessment Marks	**FE**	Final Examination Marks
Credits	Credit points allotted to that course	**Total**	Total Marks

PROFESSIONAL ELECTIVES

EEPESCN-Electrical Machine Design

EEPESCN-Electrical Energy Conservation and Auditing

EEPESCN-Electrical Drives

EEPESCN-Electrical and Hybrid Vehicles

EEPESCN-Wind and Solar Energy Systems

EEPESCN-Digital Signal Processing

EEPESCN-Control Systems Design

EEPESCN-Computer Architecture

EEPESCN-Power System Protection

EEPESCN-High Voltage Transmission Systems

EEPESCN- Computer Aided Power System Analysis

EEPESCN-Communication Engineering

EEPESCN- VLSI Design

EEPESCN-Micro Electro Mechanical Systems

OPEN ELECTIVES

EEOESCN- Electrical Safety Engineering

EEOESCN- Generation of Electrical Energy

EEOESCN- Electrical Materials

EEOESCN-Soft Computing Tools for Electrical Engineering

EEOESCN- Biomedical Engineering

EEOESCN- Utilization of Electrical Energy

HONOURS COURSES

EEHESCN - Power System Dynamics and Control

EEHESCN - Restructured Power Systems

EEHESCN - Flexible AC Transmission System

EEHESCN - Power Quality Studies

EEHESCN - High Voltage Engineering

EEHESCN - Digital Control Systems

MINOR ENGINEERING COURSES

EEMISCN –Analog Electronics

EEMISCN –Digital Electronics

EEMISCN –Electrical Measurements & Instruments

EEMISCN –Microprocessor and Microcontroller

EEMISCN –Control System

EEMISCN – Industrial Electrical systems

SYLLABUS
FIRST SEMESTER

ETBS101	PHYSICS	L	T	P	C
		3	1	0	4

Oscillations, waves and optics

Pre-requisites: (i) Mathematics course on Differential equations

(ii) Introduction to Electromagnetic theory

Unit-I: Simple Harmonic Motion, Damped and Forced Simple Harmonic Oscillator

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

Unit-II: Non-Dispersive Transverse and Longitudinal Waves in One Dimension and Introduction to Dispersion

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves.

Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Unit-III: The Propagation of Light and Geometric Optics

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

Unit-IV: Wave Optics

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer.

Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Unit-V: Lasers

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Suggested Reference Books:

1. Ian G. Main, Oscillations and waves in physics
2. H.J. Pain, The physics of vibrations and waves
3. E. Hecht, Optics
4. A. Ghatak, Optics
5. O. Svelto, Principles of Lasers

Course Outcomes:

At the end of this course, the students will be able to

1. Analyze the various types of damping force.

2. Develop the wave equation for longitudinal and transverse wave motion.

3. Compare the different properties of light

4. Realize the importance of list phenomena in interference and diffraction.

5. State the principle and working of various laser system.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	1	3	2	1	1	-	-	-	1
CO2	3	2	2	1	2	1	1	1	-	-	-	1
CO3	3	2	1	1	1	1	1	1	-	-	-	1
CO4	2	1	2	2	1	1	1	1	-	-	-	1
CO5	3	2	1	1	2	1	1	2	-	-	-	1

ETBS102	MATHEMATICS - I	L	T	P	C
		3	1	0	4

Unit-I: Calculus

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Calculus

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit-III: Sequences and Series

Convergence of sequence and series, tests for convergence; Power series, Taylor's series ,series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit-IV: Multivariable Calculus (Differentiation)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit-V: Matrices

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Suggested Text/Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint,2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley &Sons,2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th Reprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole,2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.

7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes:

At the end of this course, students will able to

1. Solve improper integrals using Beta and Gamma functions.
2. Evaluate the extreme values for functions of two variables.
3. Analyze the convergence of infinite series.
4. Understand vector differentiation and recognize saddle points.
5. Solve eigen values and eigen vectors of a real matrix and Orthogonal transformation of a matrix.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2									
CO2	3	3	2	2								
CO3	3	3	2									
CO4	3	3										
CO5	3	3	3	2	2							

ETES103	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	1	0	4

Unit -I: DC Circuits

Electrical circuit elements (R,L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems. Time domain analysis of first order RL and RC circuits.

Unit-II: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L,C,RL, RLC combinations (Series and Parallel), resonance, Three phase balanced circuits, voltage and current relations in star delta connections.

Unit-III: Transformers

Magnetic Materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit-IV: Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, significance of torque-slip characteristics. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristics and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit-V: Power Converters and Electrical Installations

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation. Components of LT switchgear: Switch Fuse Unit(SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics of Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Text/ Reference Books:

1. D.P.Kothari and I.J.Nagrath “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D.C.Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L.S.Borow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E.Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V.D.Toro, ” Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Course Outcomes:

1. Describe and analyze the behavior of various DC circuits.
2. Recall the different terminologies associated with AC circuits to analyze their response.
3. Illustrate the construction and working principle of single and three-phase transformers.
4. Classify the different types of Electrical Machines and explain their construction and working principle.
5. Familiarize with various protective devices and safety measures in electrical installations.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2								2
CO2	3	3	3	2								2
CO3	3	3										
CO4	3	3										
CO5	3		3	3		2		1				2

ETBP104	PHYSICS LABORATORY	L	T	P	C
		0	0	3	1.5

LIST OF EXPERIMENTS:

1. Air Wedge
2. Newtons's Rings
3. Simple Pendulum
4. Dispersive power of the Prism
5. Diffraction Grating
6. Acoustic diffraction Grating
7. Compound Pendulum
8. Kunt's tube experiment
9. Young's double slit experiment
10. Laser Grating
11. Torsional Pendulum
12. Young's Modulus – Non-uniform Bending
13. Young's Modulus – Uniform Bending.

Course Outcomes:

At the end of this course, the students will be able to

1. Acquired the knowledge of torsional properties of metals wire.
2. Generalized the dispersion of light through the prism.
3. Calculate the wavelength of monochromatic and polychromatic source of light.
4. Analyze diffraction patterns can be formed by light passing through a series of fine lines.
5. Estimate the size and shape of given unknown fine powder using laser gratings.

Mapping of Course Outcomes with Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	3	2	1	-	-	-	-	-
CO2	3	3	-	-	3	1	1	-	-	-	-	-
CO3	3	2	2	-	3	1	1	-	-	1	-	-
CO4	3	2	2	-	3	1	1	-	-	1	-	-
CO5	3	2	2	-	3	1	1	-	-	1	-	-

ETSP105	ELECTRICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS/ DEMONSTRATIONS:

- Basic safety precautions, Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady – state and transient time-response of R-L,R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L and R-C circuits – impedance calculation and verification. Observation of phase difference between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonies. Loading of a transformer: measurement of primary and secondary voltages and currents and power.
- Three-phase transformers: Star and Delta connections, Voltage and Current relationships (line-line voltage, phase –to – neutral voltage, line and phase currents). Phase-shifts between the primary and secondary sides. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: de machine (commutator -brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging – slip ring arrangement) and single–phase induction machine.
- Torque Speed Characteristic of separately excited de motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load.
- Control of voltage through field excitation.
- Demonstration of (a) dc-dc convertors (b) dc-ac convertors – PWM waveform (c) the use of dc-ac convertor for speed control of an induction motor and (d) Components of LT switchgear.

Laboratory Outcomes:

1. Identify common electrical components and their ratings.
2. Familiarize with the usage of common electrical measuring instruments.
3. Examine the responses of AC circuits
4. Analyze the basic characteristics of transformers and electrical machines
5. Demonstrate the working of power electronic converters.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3		2					1				
CO2	3		2					1				
CO3	3	3			1							2
CO4	3	3							1			
CO5	3	3	3	2	1				1			2

ETSP106	ENGINEERING WORKSHOP / MANUFACTURING PRACTICES	L	T	P	C
		1	0	4	3

Traditional Engineering Graphics:

Principles of EngineeringGraphics;OrthographicProjection;DescriptiveGeometry;Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

Unit-I: Introduction to Engineering Drawing covering,

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola(General methodology); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Unit-II: Orthographic Projections covering,

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Unit-III: Projections of Regular Solids covering,

Those inclined to both the Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Unit-IV:Sections and Sectional Views of Right Angular Solids covering,

Prism, Cylinder, Pyramid, Cone–Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Unit-V: Isometric Projections covering**,**

Principles of Isometric projection–Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Overview of Computer Graphicscovering,

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Customisation & CAD Drawing

consistingofsetupofthedrawingpageandtheprinter,includingscalesettings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Annotations, layering & other functions covering

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two- dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Demonstration of a simple team design project that illustrates

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/Reference Books:

1. BhattN.D.,PanchalV.M.&IngleP.R.,(2014),EngineeringDrawing,CharotarPublishing House

2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
5. (Corresponding set of) CAD Software Theory and User Manuals

Course Outcomes:

Upon completion of this course, the students will be able to:

1. Utilize drawing instruments effectively and present engineering drawings and sketches
2. Construct basic and intermediate geometries.
3. Understand the concept of orthographic, isometric projections of points, lines and regular solids, component drawing, building drawing.
4. Acquire visualization skills to develop new products.
5. Develop their technical communication skills and promote life-long learning.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	-	1	-	-	-	-	2	-	-
CO2	-	2	3	2	2	-	-	-	-	2	-	-
CO3	3	2	3	2	1	2	-	-	-	2	-	-
CO4	-	2	-	-	-	3	-	-	-	-	-	2
CO5	-	-	-	1	-	-	-	-	-	3	-	3

SECOND SEMESTER

ETHS201	ENGLISH	L	T	P	C
		2	0	0	2

Unit-I: Vocabulary Building

1.1 The concept of Word Formation

1.2 Root words from foreign languages and their use in English

1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

1.4 Synonyms, antonyms, and standard abbreviations.

Unit-II: Basic Writing Skills

2.1 Sentence Structures

2.2 Use of phrases and clauses in sentences

2.3 Importance of proper punctuation

2.4 Creating coherence

2.5 Organizing principles of paragraphs in documents

2.6 Techniques for writing precisely

Unit-III: Identifying Common Errors in Writing

3.1 Subject-verb agreement

3.2 Noun-pronoun agreement

3.3 Misplaced modifiers

3.4 Articles

3.5 Prepositions

3.6 Redundancies

3.7 Clichés

Unit-IV: Nature and Style of sensible Writing

4.1 Describing

4.2 Defining

4.3 Classifying

4.4 Providing examples or evidence

4.5 Writing introduction and conclusion

Unit-V: Writing Practices & Oral Communication

5.1 Comprehension

5.2 Precis Writing

5.3 Essay Writing

Suggested Readings:

1. *Practical English Usage.* Michael Swan. OUP. 1995.
2. *Remedial English Grammar.* F.T. Wood. Macmillan.2007.
3. *On Writing Well.* William Zinsser. Harper Resource Book. 2001
4. *Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. *Communication Skills*. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. *Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. Oxford University, Press

Course Outcomes:

1. Get an exposure of vocabulary and gain a good glossary.
2. Get knowledge regarding use of Grammar in speech and writing.
3. Acquire a knowledge of remembering, understanding, applying, analyzing, evaluating & Creating.
4. Determine how to articulate their ideas effectively to a variety of listeners.
5. Acquire ability to speak and write effectively in English.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	2	-	-

ETBS202	CHEMISTRY	L	T	P	C
		3	1	0	4

.

Unit – I : Water Chemistry and Surface Chemistry

Hardness of water – Softening of hard water by ion exchange method – Boiler feed water – boiler troubles – Internal treatment methods – Estimation of hardness by EDTA method – Desalination of brackish water – Reverse Osmosis. Disinfection of water – Break point chlorination – Adsorption – Types of Adsorption – Freundlich and Langmuir adsorption isotherms – Applications of adsorption.

Unit – II : Electrochemistry and Corrosion

Electrode potential – Electrochemical cell – Measurement of EMF – Nernst equation for cell EMF – Concentration cells – Electrochemical series – Conductometry – Conductance, Cell constant – Types of conductometric titrations. Potentiometry – Principle of acid base titration. Corrosion – Dry and wet corrosion – Galvanic, concentration cell and pitting corrosion – Control of corrosion by Cathodic protection method.

Unit – III : Fuels and Storage Devices

Fuels – Classification – Calorific values – HCV and LCV – Analysis of coal – Proximate and ultimate analysis – Refining of petroleum. Cracking – Fixed bed – Synthetic petrol – Fischer – Tropsch process – Flue gas analysis by Orsat apparatus. Batteries – Primary and secondary – Dry cell – Lead acid storage battery –Ni-Cd battery – Lithium battery – H_2-O_2 fuel cell.

Unit – IV : Polymers and Nano Materials

Polymers – Types of polymerization – Addition, condensation and copolymerisation – Mechanism of addition polymerization (Free radical). Plastics – Thermoplastics and thermosetting plastics – Preparation, properties and uses of polyethylene, polyvinyl chloride, polystyrene, Nylon and bakelite. Nanochemistry – introduction to nano materials. Synthesis – Precipitation, sol-gel process, electrodeposition and chemical vapour deposition methods. Carbon nano tubes, fullerenes, nano wires and nano rods.

Unit – V : Engineering Materials and Spectroscopic Techniques

Refractories – Classification, characteristics (Refractoriness, RUL, Thermal spalling, porocity) and uses, Lubricants – Classification, properties (cloud and pour point, flash and fire point, viscosity index) and applications. Principles of spectroscopy – Beer – Lambert's Law – UV – Visible and IR spectroscopy – Basic principles and instrumentation (block diagram) – Fluorescence and its applications in medicine.

Suggested Text 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., Venkappaya, D. and Nagarajan, S. (2008) "Engineering Chemistry" Tata Mc Graw Publications Ltd., New Delhi.
4. Puri, B.R., Sharma, L.R. and Pathania, M.S. (2013) "Principles of Physical Chemistry" Vishal Publication Company, New Delhi.
5. Sharma, Y.R. (2010) "Elementary Organic Spectroscopy, Principle and Chemical Applications" S. Chand Publishers, New Delhi.
6. Asim K Das and Mahua Das (2017) "An Introduction to Nanomaterials and Nanoscience" CBS Publishers & Distributors Pvt. Ltd., New Delhi.

Course Outcomes:

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

1. Develop innovative methods in soft water production for industrial uses and Adsorption analysis.
2. Describe the concept of electrochemistry and its applications; corrosion and its controlling Methods.
3. Demonstrate the properties of fuels and applications of energy storage devices.
4. Evaluate the synthetic method of various polymers and the applications of Nanochemistry.
5. Describe the principles of UV,IR techniques and properties of Refractories and Lubricants.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	-	3	1	-	-	-	-	-	-
CO2	3	2	1	-	-	1	1	-	-	-	-	-
CO3	3	-	-	2	2	-	1	-	-	-	-	-
CO4	2	-	1	-	1	1	1	-	-	-	-	-
CO5	3	1	-	-	2	1	-	-	-	-	-	-

ETES203	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
		3	0	0	3

Unit – I

Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memorylocations, Syntax and Logical Errors in compilation, object and executable code.

Unit – II

Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit – III

Arrays: Arrays (1-D, 2-D), Character arrays and Strings, Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

Unit – IV

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit – V

Structure: Structures, Defining structures and Array of Structures, Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion oflinked list (no implementation). File handling (only if time is available, otherwise should be done as part of the lab).

Suggested Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill

Suggested Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall ofIndia.

Course Outcomes:

At the end of this course, the students will be able to

1. Formulate algorithms, draw flowcharts and write pseudocode for solving arithmetic and logical problems.
2. Develop C programs using branching and looping statements.
3. Implement searching and sorting algorithms and analyze the order of complexities.
4. Define and call simple functions by value and by reference and also to write recursive functions.
5. Utilize structures, pointers and files in C programming.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-

ETBS204	MATHEMATICS - II	L	T	P	C
		3	1	0	4

Unit - I: Multivariable Calculus (Integration) *(10 lectures)*

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit – II: First order ordinary differential equations

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit – III:Ordinary differential equations of higher order

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit – IV:Complex Variable – Differentiation

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)and their properties; Conformal mappings, Mobius transformations and their properties.

Unit – V:Complex Variable – Integration

Contour integrals, Cauchy- Goursat theorem (without proof), Cauchy Integral formula (without proof),Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Suggested Text/Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint,2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley &Sons,2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.

4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India,1984.
5. E.A.Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. E. L. Ince, Ordinary Differential Equations, Dover Publications,1958.
7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36thEdition,2010.

Course Outcomes:

At the end of this course, students will able to

1. Solve double and triple integrals in finding area and volumes.
2. Solve first order ordinary differential equations
3. Solve Second order linear differential equations with constant coefficients.
4. Construct analytic function and analyze conformal mappings.
5. Evaluate the complex integrals and contour integration.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2								
CO2	3	3	2									
CO3	3	3	3	3	3							
CO4	3	3	2									
CO5	3	3	3	2								

ETHP205	COMMUNICATION SKILLS AND LANGUAGE LABORATORY	L	T	P	C
		0	0	2	1

List of Topics:

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

Suggested Software package: Globarena Package for communicative English

The Globarena Package consists of the following exercises

1. Reading comprehension
2. Listening comprehension
3. Vocabulary exercises
4. Phonetics
5. Role Play in dialogues
6. Auto Speak

Suggested Readings:

1. English Pronouncing Dictionary Daniel Jones Current Edition with CD.
2. Spoken English- R. K. Bansal and J. B. Harrison, Orient Longman 2006 Edn.
3. A Practical course in English Pronunciation, (with two Audio cassettes) by J. Sethi, Kamlesh Sadanand& D.V. Jindal, Prentice-Hall of India Pvt. Ltd., New Delhi.
4. A text book of English Phonetics for Indian Students by T.Balasubramanian (Macmillan).
5. English Skills for Technical Students, WBSCTE with British Council, OL.

Course Outcomes:

1. Student will heighten their awareness of correct usage of English Grammar in writing and speaking.
2. Acquire speaking ability in English both in terms of fluency and comprehensibility.
3. Enhance competence in the four modes of literacy; Writing, Speaking, Reading and Listening.
4. Ensure student to improve their accuracy and fluency in producing and understanding spoken and written English

5. Exposure of the grammatical forms of English and the use of these forms in specific communicative contexts.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	-	-	2	-	2	3	-	3
CO2	-	-	-	-	-	-	2	-	2	3	-	3
CO3	-	-	-	-	-	-	2	-	2	3	-	3
CO4	-	-	-	-	-	-	2	-	2	3	-	3
CO5	-	-	-	-	-	-	2	-	2	3	-	3

ETBP206	CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

List of Experiments:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductance of solutions
7. Potentiometry - determination of redox potentials and emfs
8. Saponification/acid value of an oil
9. Determination of the partition coefficient of a substance between two immiscible liquids
10. Adsorption of acetic acid by charcoal
11. Volumetric analysis

Course outcomes:

At the end of the course the students will be able to

1. Determine the physical properties like surface tension and viscosity.
2. Determine rate of reactions and soapnification of oil.
3. Calculate the quantity of adsorbate adsorbed by charcoal.
4. Determine the impurity from Pharmaceutical products and hardness of water.
5. Determine exact concentration of acid and bases present in the industrial wastes.

Mapping of Course Outcomes with Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	1	-	-	1	-	-	-	-	-
CO2	2	1	-	-	-	1	-	-	-	-	-	-
CO3	3	2	-	1	-	-	2	-	-	-	-	-
CO4	3	-	1	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-

ETSP207	COMPUTER PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given]

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

Laboratory Outcomes:

At the end of this course, the students will be able to

1. Analyze program requirements and develop programs using conditional and looping statements.
2. Write programs for handling arrays and strings.
3. Create C programs with user defined functions and recursive function calls.
4. Utilize pointers and structures for dynamic memory allocation in C programming.
5. Develop C programs for handling files.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	-	2	-	-	-	-	-	-	-
CO2	2	1	1	-	2	-	-	-	-	-	-	-
CO3	2	1	1	-	2	-	-	-	-	-	-	-
CO4	1	1	1	-	2	-	-	-	-	-	-	-
CO5	1	1	1	-	2	-	-	-	-	-	-	-

ETES208	ENGINEERING GRAPHICS AND DRAFTING	L	T	P	C
		1	0	4	3

(i) Lectures & Videos ***(10 hours)***

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures)
2. CNC machining, Additive manufacturing (1lecture)
3. Fitting operations & power tools (1lecture)
4. Electrical & Electronics (1 lecture)
5. Carpentry (1lecture)
6. Plastic moulding, glass cutting (1lecture)
7. Metal casting (1lecture)
8. Welding (arc welding & gas welding), brazing (1lecture)

(ii) Workshop Practice: (60 hours)

1. Machine shop (10 hours)
2. Fitting shop (8hours)
3. Carpentry (6hours)
4. Electrical & Electronics(8hours)
5. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4hrs)
6. Casting (8hours)
7. Smithy (6 hours)
8. Plastic moulding & Glass Cutting (6hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and NirjharRoy S.K., "Elements of WorkshopTechnology",Vol.I2008andVol.II2010, Mediapromoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering andTechnology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I"PearsonEducation, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India,1998.
5. RaoP.N.,"ManufacturingTechnology",Vol.IandVol.II,TataMcGrawHillHouse, 2017.

Course Outcomes:

Upon completion of this course, the students will be able to

1. Summarize the various conventional and latest manufacturing processes
2. Gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

3. Acquire the ability to fabricate models of their own.
4. Develop skill to make simple fitting joints.
5. Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

Mapping of Course Outcomes with Program Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	2	-	-	-	-	-	-	2
CO2	3	-	2	-	-	-	-	-	-	-	-	1
CO3	3	-	2	-	-	-	-	-	2	-	-	-
CO4	3	-	1	-	-	-	-	-	2	-	-	1
CO5	3	-	2	-	-	-	-	-	1	-	-	2

THIRD SEMESTER

ETBS301	ENGINEERING MATHEMATICS - III	L	T	P	C
		3	1	0	4

Course Objectives:

- To understand the basic concepts of partial differential equations which is helpful in solving Real world problems.
- Introduce Fourier series which is very useful in the study of electrostatics, acoustics and computing.
- Introduce Boundary value problems which is helpful in investigation of the important features of electromagnetic theory.
- The study of Fourier transform is useful in solving problems in frequency response of a filter and signal analysis.
- Provide a study of Z-transform which can played important role in the development of communication 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., 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.

References Books:

1. Ramana B V., Higher Engineering Mathematics.,2007, Tata McGraw Hill Pub.
2. Veerarajan, T., Engineering Mathematics, 3rd edition, 2005, Tata McGraw Hill Pub.
3. Singaravelu, A., Engineering Mathematics, Meenakshi Publications, Chennai,2004.

Course Outcomes:

At the end of this course, students will able to

1. Acquire basic understanding of the most common partial differential equations.
2. Understand the concepts of Fourier series.
3. Ability to solve boundary value problems.
4. Able to investigate signals problems using Fourier transform
5. Familiarize Z-transform that play important roles in many discrete engineering problems.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3			1			2						2	
CO2	3	3		1										1	
CO3	3	3		2				2					2		
CO4	3	3	3	2	1			2					2	2	
CO5	3	3	3										1		

ETES302	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

Course Objectives:

- To realize the importance of environment for engineering students.
- To understand the basics of ecosystems.
- To discuss various aspects of bio diversity and its conservation.
- To make aware the student about global environmental pollution 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 Program - 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)**

Text Books:

1. Agarwal, K.C., 2001. Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad.

References:

1. Brunner, R.C., 1989. Hazardous Waste Incineration, McGraw Hill Inc. .
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.
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.
7. Hawkins, R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay..
8. Heywood, V.H.&Waston, R.T., 1995. Global Biodiversity Assessment. Cambridge Univ. Press..
9. Jadhav, H.&Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi.
10. Mckinney, M.L. & School, R.M., 1996. Environmental Science systems & Solutions, Web enhanced edition. .
11. Mhaskar A.K., Matter Hazardous, Techno-Science Publication..
12. Miller, T.G. Jr., Environmental Science, Wadsworth Publishing Co.
13. Odum, E.P., 1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
14. Rao M N. &Datta, A.K., 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd.
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 .
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 .

Course Outcomes:

At the end of this course, students will demonstrate the ability to

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 Program Outcomes															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1					2				2		3		
CO2		2	2										1		
CO3					1		2		2						1
CO4						2			2				1		
CO5						2			2				2		

ETES303	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

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 discuss about geo material properties of different types of surfaces of solids.
- To analyze the dynamics of particles and Newton's law of motion.
- 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.

References:

1. Natesan,S.C., (2002). Engineering Mechanics (Statics and Dynamics), First Edition, Umesh Publications, New Delhi.
2. S.S.BhavikattiandK.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:

At the end of this course, students will demonstrate the ability to

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.
4. Study about Dynamics of particles.
5. Understand the elements of rigid body dynamics.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1			1							1		
CO2	3	3	2			2									2
CO3	3	3	1			1		2			1		2		
CO4	3	3				1			1		2		1		
CO5	3	3				1			1						1

ETES304	FLUID MECHANICS AND HYDRAULICS MACHINERY	L	T	P	C
		2	0	0	2

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 - venturi meter, orifice meter 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 - Chey'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 AL, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, 9th Edition, New Delhi; 2014.

References:

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

Course Outcomes:

At the end of this course, students will demonstrate the ability to

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

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3			1		1						1		
CO2	3	3									1				1
CO3	3	3	1		1		1						1		
CO4	3	3	1	2	1								1		1
CO5	3	3					1				1				1

EEPC305	ELECTRICAL CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the concepts of network theorems along with node and mesh methods
- To explain the time domain solution for first and second order networks
- To elucidate the steady state analysis of the ac circuits and the theory of mutually coupled circuits
- To introduce the Laplace transforms for electrical circuits and explain its transfer function representation
- To articulate the relationship among the variables in two port networks

Unit - I: Network Theorems

Super position theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Unit - II: Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit - III: Sinusoidal Steady State Analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit - IV: Electrical Circuit Analysis Using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Unit - V: Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

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.

References:

1. M. E. Van Valkenburg, Network Analysis, Prentice Hall,2006.
2. D. Roy Choudhury, Networks and Systems, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, Engineering Circuit Analysis, McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, Electric Circuits, McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, Basic Circuit Analysis, Jaico Publishers, 1999.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Apply network theorems for the analysis of electrical circuits
2. Analyze the transient and steady-state response of electrical circuits
3. Understand the sinusoidal steady-state analysis
4. Apply Laplace transforms for deriving the transfer function representation
5. Understand the relationship of the variables in two post networks

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	3							1	3	2	1
CO2	2	3	3	2	3							1	3	3	1
CO3	3	2	2	3	3							1	2	3	1
CO4	3	3	2	2	3							1	2	2	1
CO5	3	2	2	2	3							1	3	2	1

EEPC306	ANALOG ELECTRONICS	L	T	P	C
		3	1	0	4

Course Objectives:

- To introduce the basics of PN junction and develop applications from its operation
- To explain the structure, characteristics and operational aspects of BJT circuits
- To elucidate the theory of MOSFET and there from develop its small signal and high frequency equivalent circuits
- To articulate the operation of differential, multistage and operational amplifiers
- To develop applications for op-amp circuits

Unit - I: Diode Circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit - II: BJT Circuits

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit - III: MOSFET circuits

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit - IV: Differential, Multi-Stage and Operational Amplifiers

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain band width product)

Unit - V: Linear Applications of Op-Amp

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).

Analog to Digital Conversion. Zero Crossing Detector, Square-wave and triangular-wave generators.

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.

References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press,1998.
2. J. V. Wait, L. P. HuelsmanandG. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S.,1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education,1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press,1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons,2001.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the basics of PN junction from an application perspective
2. Analyze the operation of BJT circuits
3. Apply the operation of MOSFET to obtain its equivalent circuits
4. Analyze the operation of differential, multistage and operational amplifiers
5. Apply the theory of op-amps to derive practical applications

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	1	2	2								2	2	1
CO2	2	2	3	2	3								2	2	1
CO3	3	2	3	2	3								3	2	1
CO4	1	2	2	3	3								2	2	1
CO5	1	2	2	2	3								2	2	1

EESP307	HYDRAULICS LABORATORY	L	T	P	C
		0	0	3	1.5

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 Venturi meter
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:

At the end of this course, students will demonstrate the ability to

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.
5. Develop Characteristics of turbines.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1		2		2							2		
CO2	1	2				2							1		
CO3	1	2				2							1		
CO4	1	1				1									1
CO5	1	1				1							1		

EECP308	ELECTRICAL CIRCUITS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To solve circuits by applying theorems.
- To illustrate the concepts of RL and RC circuits.
- To gain knowledge about resonance circuits

List of Experiments:

1. Verification of Thevenin's theorem
2. Verification of Norton's theorem.
3. Verification of Super position theorem
4. Verification of Maximum power transfer theorem.
5. Verification of Reciprocity Theorem
6. Study of Series and parallel RL circuits
7. Study of Series and parallel RC circuits
8. Study of Series and parallel RLC circuits
9. Wave shaping circuits
10. Series resonance circuits
11. Parallel resonance circuits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Basic Knowledge about theorems.
2. Analyze RL, RC and RLC series circuits.
3. Analyze RL, RC and RLC parallel circuits.
4. Understand different wave shaping circuits.
5. Ability to design resonance circuit.

Mapping with program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	3	2												2	
CO3			2											2	
CO4		2											2		
CO5	2												2		

EECP309	ANALOG ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To understand basic electronic components and its applications
- To understand the basic functions of operational amplifier.
- To illustrate the application of operational amplifier.

List of Experiments:

1. Characteristics of Junction diode, Characteristics of Zener diode and Zener diode as a voltage regulator.
2. Half wave and full wave rectifiers with capacitor filter.
3. Characteristics of Transistors.
4. Characteristics of Field Effect Transistor.
5. Wave shaping circuits
6. Zero crossing detector and Schmitt trigger using OP-AMP
7. Precision Rectifiers
8. R.C Phase Shift Oscillator using OP-AMP
9. Voltage to Current Converter and Current to Voltage Converter
10. Instrumentation Amplifier
11. Design of Low Pass Filters/High Pass Filters.
12. Analog to Digital Converter.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Learn the application and characteristics of basic electronic devices.
2. Understand the characteristics of transistors.
3. Design and analyze various rectifier and amplifier circuits.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits
5. Understand the circuit connections and testing points.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2			2								2		
CO2		2			2								2		
CO3		2			2									2	
CO4	3												2		
CO5	2						2						2		

FOURTH SEMESTER

EEBS401	PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

Course Objectives:

- Introduce Probability theory which is helpful in investigating the important features of the random experiment.
- To understand the basic concepts of random processes which are widely used in Electrical fields.
- The aim of theory of sampling is to get as much information as possible of the population to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in finding numerical solution of Interpolation, differentiation and integration problems.
- Provide the study of numerical solution of algebraic and transcendental equations, 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 rules.

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

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

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

Solution of ordinary differential equations: Taylor series method, Runge–Katta 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:

At the end of this course, students will demonstrate the ability to

1. Acquire skills in handling situations involving random experiments.
2. Familiarize the concept of random processes.
3. Understand the basic concepts of theory of sampling to any collection of individuals of their attributes can be numerically specified.
4. Solve problems algebraic transcendental equations and numerical integration.
5. Obtain numerical solution of ordinary and partial differential equations.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3						2					2	2	
CO2	3	3			2								2	2	
CO3	3	3		2				2					2	2	
CO4	3	3	3	2				2					2		
CO5	3	3	3	2	2			2					2		

EEES402	DATA STRUCTURES AND C++ PROGRAMMING	L	T	P	C
		2	0	0	2

Course Objectives:

- To introduce the concepts of linear data structure.
- To understand the different methods of non linear data structure representations.
- To introduce object oriented programming concepts.
- To study objects and classes.
- To impart knowledge on inheritance and operator overloading.

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 in heritance. 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.

References:

1. R.F.Gilberg, B.A.Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2005.
2. Sahni, "Data Structures Using C++", Tata McGrawHill, 2006.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the linear data structures such as arrays, linked lists, stacks and queues.
2. Understand then on linear data structures like sorting, searching, insertion and deletion of data.
3. Understand the basic concepts of object-oriented programming language.
4. Obtain knowledge about objects and classes.
5. Gain knowledge about various types of inheritance and operator overloading.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2			2			1	2			2			
CO2	2	3			2			2	2			2			
CO3	2	3	2		2			2				2		2	
CO4	2	3	3	3	2			2	2			2		2	2
CO5	2	2	2	2	2			2	2			2		2	2

EEPC403	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn about construction, principle of operation, characteristics and testing of DC machine.
- To have a sound knowledge about transforms.
- To familiarize the students with the constructions, operating principle, speed control of three phase induction motors.
- To provide basic knowledge about the single phase induction motor and to illustrate the different testing techniques available and obtain their characteristics.
- To important knowledge on various aspects of synchronous 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 – Buckholts 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- Sumner’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

Constructionalfeatures,cageandslipringrotors,principleofoperation,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.

References:

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

Course Outcomes:

At the end of this course, students will demonstrate the ability to

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 Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		3			2	2					2	3		
CO2	3	2				2	2						3	3	
CO3	3	2											3	2	
CO4	3	2	3										3	3	
CO5	3		3										3	3	

EEPC404	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To review the fundamental concepts relating to Number systems, codes and Boolean algebra function of logic gates and to explain the working and the characteristics of Logic families and Logic packages.
- To bring out the 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 about operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.

Unit - I: Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit - II: Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit - III: Sequential circuits and systems

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D- types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit - IV: A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter,A/D-converter using voltage to frequency and voltage to time conversion,specifications of A/D converters, example of A/D converter ICs.

Unit - V: Semiconductor memories and Programmable logic devices.

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array(FPGA).

Text Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.

References:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.
2. R. Anandh Digital Electronics – Kendra publishing house
3. Donald P. Leach, Albert Paul Malvino, GoutanSaha, “Digital Principles and Applications” Seventh Edition, 2010.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Apply PLDs to implement the given logical problem.
5. Design digital circuits for consumer application

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2										3	2	
CO2		2			2								2		
CO3	3		3										2	2	
CO4		2			2									2	
CO5		2			2									2	

EEPC405	ELECTRICAL MEASUREMENTS & INSTRUMENTS	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the basic functional elements of instrumentation
- To discuss different methods of power and energy measurement.
- To explain various resistance and impedance measurement methods
- To study various storage and display devices
- To study 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 - 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.

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, Dhanapala and Co, New Delhi, 2010.
2. E.W. Golding &F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler& Co, 2001.

References:

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. BouwensA.J.,"Digital Instrumentation", Tata McGraw Hill Publishing Co. Ltd., New Delhi -1997.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand basic principle of measuring instruments.
2. Understand the concept of measurement of power and energy in single and three phase circuits.
3. Gain Knowledge on the measurement of resistance and impedance.
4. Acquire knowledge of display instruments, amplifier measurements and CRO
5. Distinguish recorders, transducers, data acquisition systems and display devices, frequency and period measurements.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2										2		
CO2	3		2										2		
CO3	3	3	2										2		
CO4					2								2	3	
CO5					2								2		

EEPC406	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

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, electrostatic field due to various charge distribution, electric potential, energy density.
- To study Electro static boundary conditions, capacitors of various geometries, Poisson's and Laplace's equations.
- 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, magnetic boundary conditions and Maxwell's equations.

Unit - I: Review of Vector Calculus

Vector algebra-addition, subtraction, scalar and vector multiplications, three orthogonal coordinate systems (rectangular, cylindrical and spherical), Conversion of a vector from one coordinate system to another. Vector calculus-vector operator-del, gradient, divergence and curl.

Unit - II: Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference. Electric dipole, Electrostatic Energy and Energy density.

Unit - III: Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit - IV: Static Magnetic Fields

Biot - Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Unit - V: Time Varying Fields and Maxwell's Equations

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations. Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances, Derivation of Wave Equation, Uniform Plane Waves, Poynting theorem.

Text Books:

1. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education,2012.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.

References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication,2014.
2. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India,2012.
3. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans,1954.
4. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication,1980.
5. W.J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill,1968.
6. E.G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press,1966.
7. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
8. Electromagnetic waves, Shevgaonkar, McGraw Hill.

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand the application of vector calculus for analyzing electromagnetism.
2. Analyze electrostatic fields due to different charge distributions, electric potential and energy density.
3. Familiarize about various capacitor geometries, solutions of Poisson's and Laplace's equations.
4. Understand basic concepts of static magnetic field, scalar and vector magnetic potentials.
5. Understand Maxwell's equations, wave propagation, magnetic circuits and magnetic boundary conditions.

	Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3			1			2					2		
CO2	3	2						2					2	2	
CO3	3	2	2					2					2		
CO4	3		2					2					2		
CO5	3		2					2					2		

EECP407	ELECTRICAL MACHINES LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To familiarize the students with the functioning of different types of DC, AC machines,
- To illustrate the different testing techniques available for DC, AC machines and transformer and obtain their characteristics practically.
- To make the students understand the concept of predetermination of voltage regulation of alternator by various method.
- To make the students understand the V and inverted V characteristics of three phase synchronous machine at different load condition
- To illustrate the synchronization and parallel operation of 3 phase alternators.

LIST OF EXPERIMENTS:

1. Open Circuit Characteristics of DC Shunt Generator
2. Internal & External Characteristics of DC Shunt &Compound Generators
3. Swinburne's Test
4. Open Circuit & Short Circuit Tests on Single Phase Transformer
5. Separation of Losses in Single Phase Transformer
6. Pseudo load test on Three Phase Transformer
7. Load test on 3 phase slip ring induction generators
8. Load test on 3 phase slip ring induction motor
9. Predetermination of equivalent circuit of 1 phase induction motor
10. Predetermination of voltage regulation of 3 phase alternator using
    a) EMF method b) MMF method c) ZPF method
    d) V and inverted V curves of synchronous motor
11. Synchronization and parallel operation of two 3 phase alternators

Course Outcomes:

At the end of the course, students will demonstrate the ability

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 Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3												3	1	
CO2		2											2		
CO3		1											1		
CO4				2									1		
CO5						3							3	2	

EECP408	DIGITAL ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To understand the basic code conversion and Karnaugh Map reduction
- To illustrate the design of Combinational and Sequential logic circuits.
- To design different counters.

List of Experiments:

1. Verification of basic gates and logic circuit using universal building blocks.
2. Karnaugh Map reduction
3. Parity generator and checker circuits
4. Multiplexer and De multiplexer
5. a. Design of Half adder and full adder circuitsb. Full adder circuit using Multiplexer
6. Decimal to BCD converter.
7. BCD to seven segment display.
8. Design of Modulo UP Counters
9. Design of Modulo DOWN Counters
10. Design of digital to analog circuits
11. Design of Non-Sequential Counter
12. Design of Sequence Generator

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand the basic code conversion and Karnaugh mapping technique
2. Acquire the operating theory of combinational and sequential circuits.
3. Explore the use of digital logic in integrated circuit applications.
4. Acquire the design capability of digital circuits
5. Design various counters.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2			2									2	
CO2	3	2			2								2		
CO3		2			2								2		
CO4			2											2	
CO5	2		2											2	

EECP409	ELECTRICAL MEASUREMENTS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To understand the the need for DC and AC bridges.
- To illustrate the calibration of various instruments.
- To measure generalized constants in transmission lines
- To learn about various measurement methods and fault detection.
- To study the reactive power variation with various loads.

List of Experiments:

1. Measurement of Inductance using a) Anderson's bridge b) Hay's bridge
2. Measurement of Resistance using a) Kelvin's double bridge b) Wheatstone bridge
3. Measurement of Capacitance using a) Schering bridge b) Desauty bridge
4. Two Wattmeter Method of Power Measurement.
5. Determination of B-H loop in a transformer core using CRO
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. Measurement of ABCD constants in a short transmission line
10. Cable fault detection
11. Measurement of Induction using three ammeter, three voltmeter method
12. Reactive power measurement.

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Measure various electrical parameters using bridges.
2. Understand the methods involved in magnetic measurements
3. Acquire knowledge in calibrating various Energy Meters for different load conditions.
4. Investigate ABCD constants in transmission lines, detection of cable fault and RLC transients.
5. Explore the impact of real and reactive powers for constant power factor loading.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2					2					3		
CO2	3	2						2					3		
CO3	3	2	2					2					2		
CO4	3	3	2					2					2		
CO5	3	3	3					2					2		

FIFTH SEMESTER

EEPC501	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the architecture, addressing modes and instructions setoff 8085 microprocessors.
- To study the architecture, addressing modes and instructions set of 8051 microcontrollers.
- To understand Instruction Set and Programming for the processors
- To gain knowledge about interrupt, I/O and communication interface
- To know about interfacing related to various applications.

Unit - I: Fundamentals of programmable device -8085

Fundamentals of Microprocessor Architecture - 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Architecture of 8085 microprocessor, memory organization, timing diagram and interrupts, interfacing of I/O devices.

Unit - II: 8051 Architecture

Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit - III: Instruction Set and Programming

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, indexed addressing, Bit inherent addressing, bit direct addressing.

8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs.

Unit - IV: Memory, I/O and communication Interfacing

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers,

counters, memory devices, Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Unit - V: Interfacing and Control

LED, LCD and Keyboard interfacing, stepper motor interfacing, D.C motor interfacing, sensor interfacing, Introduction to 16-bit microcontroller - 8097

Text / References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education,2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar CengageLearning,2004.
3. R. Kamal, "Embedded System", McGraw HillEducation,2009.
4. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing,1996
5. D.A.Patterson and J.H. Hennessy, "Computer Organization and design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.
6. D.V.Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.

Course Outcomes:

At the end of this course, students will acquire the ability to

1. Understand the fundamental of microprocessors.
2. Explore the architecture of various microcontrollers.
3. Develop assembly language programs for the processors.
4. Incorporate the memory and peripheral devices.
5. Extend the development of the microprocessor based automation system.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3											2	3		
CO2	3														
CO3	3														
CO4			3		2									3	
CO5					3				3		2		2	2	3

EEPC502	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the family of power semiconductor devices
- To explain the operation of different types of thyristor rectifiers
- To elucidate the theory of operation of chopper circuits
- To articulate the operation of the single phase voltage source inverters through different modulation techniques
- To bring out the switching state from the operation of a three phase voltage source inverter

Unit - I: Power switching devices

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Unit - II: Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit - III: DC-DC buck converter

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit - IV: Single-phase voltage source inverter

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Unit - V: Three-phase voltage source inverter

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Text/References:

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons,2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media,2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India,2009.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the details of switching devices
2. Analyze use of thyristors in different types of rectifier circuits
3. Analyze the operation of DC-DC buck and boost converters
4. Apply the different modulation techniques to the operation of single-phase voltage source inverters
5. Analyze the operation of three phase voltage source inverters

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	2	3								1	2	1
CO2	1	2	2	3	3								2	2	1
CO3	1	2	3	3	3								2	2	1
CO4	1	2	3	3	3								2	2	1
CO5	1	2	2	2	2								2	2	1

EEPC503	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To develop a mathematical model for physical systems – translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To study time response 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 and design of controllers
- To study the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

Unit - I: Introduction to control problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit - II: Time Response Analysis

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit - III: Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit - IV: Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit - V: State variable Analysis

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability

and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems. Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Text/References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education,1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall,1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall,1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International,2009
5. Ambikapathy,"Control systems ",khanna book publishing co.(p) ltd,Delhi.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and feedback control systems.
2. Gain knowledge about time response analysis and the use of Root – loci to determine stability of systems.
3. Understand the concept of frequency response analysis
4. Design simple feedback controllers.
5. Acquire knowledge about state variable analysis.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3											3		
CO2	3		3		2								3	2	
CO3	3	2	3	2	2								3	2	
CO4	3	3	3	2									3	2	
CO5	3	3	2	2	1								3	2	

EEPC504	POWER SYSTEMS-I	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the fundamentals of transmission lines
- Learn the mathematical modeling and performances of transmission lines.
- 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: Fundamentals of Transmission 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: Modeling and Control 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 Properties and Corona loss

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 and Cables

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” DhanpatRai 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:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of power systems
2. Determine the line parameters and analyze the performance of transmission lines
3. Acquire knowledge of mechanical characteristics of transmission lines
4. Analyze the concepts of distribution systems
5. Understand concept of insulation

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1									1	3		
CO2	3	3	1									1	3		
CO3	2	2	3			1	1					1	3	2	
CO4	1	1	2			1	1					2	3	2	
CO5	1	1	1	2		1	1		1			3	3	2	

EECP507	MICROPROCESSOR AND MICROCONTROLLER LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To understand practically the programmable devices.
- To have a sound knowledge about different categories of processors and controllers.
- To familiarize the students with the functioning of different peripheral interfacing.
- To illustrate the different processing capabilities of 8085, 8051 and 8097 practically.
- To expose the students to the programming facilities available in the lab.

LIST OF EXPERIMENTS:

1. Study of 8085 Microprocessor
   a. Finding out the largest and smallest number
   b. Sorting an array
2. Multi byte Addition and Subtraction using 8085 Microprocessor
3. Study of 8255 PPI – I/O Mode and BSR Mode
4. Serial Data Communication using USART 8251 and Timer 8253
5. Study of 8051 Microcontroller
   a. Arithmetic Operations
   b. Code Conversion
6. Stepper Motor Control using 8051 Microcontroller
7. Seven Segment LED Display using 8051 Microcontroller
8. Study of Keyboard Display Interface 8279 using 8051 Microcontroller
9. Serial Data Communication Between Two 8051 Kits
10. Timer and Counter Programming in 8051 Microcontroller
11. Study of 8097 Microcontroller
    a) Arithmetic Operations b) Logical Operations
12. Applications of 8097 Microcontrollers
    a) DAC b) ADC c) PWM Generation

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the architecture and operations of microprocessors and microcontrollers.
2. Write programs for performing real world a task.
3. Validate the theoretical concepts by performing experiments in practical sessions.
4. Distinguish the various categories of programmable devices.
5. Study the different interfacing techniques available for 8085 and 8051.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2								1	1		1	3		
CO2	3								1	1		1	3		
CO3	3	3	3	3					1	1		2	3	2	
CO4	1	2	2	2	2				1	1		2	3	2	
CO5	2	3	3	3	3				1	1		3	3	3	

EECP508	POWER ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To explain the characteristics of power electronic devices.
- To train the students about the operation and uses of power converter circuits.

List of Experiments:

1. Switching characteristics of IGBT and MOSFET.
2. Performance evaluation of single-phase semi and full converters with R load.
3. Extended firing angle control of single-phase semi converter.
4. Performance evaluation of three phase semi and full converters.
5. Time ratio control of IGBT based single quadrant DC chopper.
6. Time ratio control of IGBT based two quadrant DC chopper.
7. Performance evaluation of series resonant converter.
8. Modulation index control of single-phase bridge inverter.
9. PWM pulse generation for power switches.
10. Voltage regulation of three phase VSI using IPM module.
11. PSIM of AC-DC bridge converter.
12. PSIM of chopper

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Develop schemes for generation of firing pulses suitable for the power switches in converter circuits.
2. Formulate procedures for testing the operation of power converters.
3. Evaluate the performance of power converter circuits.
4. Experience the platform for simulation of power electronic circuits.
5. Acquire knowledge on characteristics of switching devices

Mapping with Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3							3	3	3	
CO2	3	3	3	3	3							3	3	3	
CO3	3	3	3	3	3							2	3	3	
CO4	3	3	3	3	3							2	3	3	
CO5	3	3	3	3	3							2	3	3	

EECP509	CONTROL SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To gain knowledge about the various methods involved in the position and speed control of DC machine
2. To design and investigate the performance of the PID Controllers for temperature control systems.
3. To design and develop various Compensation Schemes for a given plant.
4. To acquire knowledge about the impact of step and continuous commands applied to the Stepper Motor operating in various modes.
5. To investigate on the output performance of the linear and nonlinear analog and digital control system.

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
13. Phase plane Analysis of Nonlinear Control System
14. Computation of Steady State Error Caused by nonlinear systems elements

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the methods involved in the position and speed control of DC machine
2. Calibrate and investigate the importance of PID Controllers for analog and temperature control systems.
3. Design and develop various Compensation Schemes for a given plant.
4. Acquire knowledge about the impact of step and continuous command on the Stepper Motor for various modes.
5. Investigate on the output performance of the linear and nonlinear analog and digital control system.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO 3**
CO1	3			2				1							
CO2	3	2	2					2					2	2	
CO3	3	3	3	3		2		2					3	3	
CO4	3		2										2		
CO5	3	2	3	2									2		

SIXTH SEMESTER

EEPC601	POWER SYSTEMS – II	L	T	P	C
		3	0	0	3

Course Objectives:

- Learn the fundamentals of power system modelling
- Understand the formation of bus impedance and bus admittance matrices.
- Learn different sparsity techniques and power flow methods.
- Impart in-depth knowledge on fault analysis using impedance matrix.
- Gain knowledge on short circuit fault analysis using admittance matrix.

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 Tinny 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.

References:

1. Pai, M.A., “Computer Techniques in Power System Analysis”, TMH, 2007.
2. Stagg and El-Abad, “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. HaadiSaadat, “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:

At the end of this course, students will demonstrate the ability to

1. Understand and analyze power system.
2. Form power system matrices.
3. Model power system components.
4. Apply load flow analysis to an Electrical power network and interpret the results of the analysis.
5. Analyze a network under symmetrical and unsymmetrical fault conditions and interpret the results.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1										3		
CO2	3	1	1										3		
CO3	3	3	3	3								3	3	2	
CO4	3	3	3			1						1	3	2	
CO5	3	3	3			1						1	3	2	

EEPC602	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the fundamentals of embedded systems, design paradigms and architectures.
- To study the basics of PIC Microcontroller PIC and their programming.
- To study the interfacing capabilities of PIC controllers and their Memory Organization.
- To study the ARM Architecture and their programming.
- To understand the Real Time Operating System, and Task Management.

Unit–I: Overview of Embedded Systems

Embedded system concept – Embedded hardware devices – Memory devices – memory management methods – timing and counting devices – watch dog timer – real time clock- in circuit emulator – target hardware- debugging-embedded processors.

Unit–II: PIC Microcontroller

Introduction to PIC microcontrollers - PIC 16C74A Architecture –Comparison of PIC with other CISC and RISC based systems- memory organization – addressing modes – instruction set – PIC programming in Assembly language.

Unit –III: Interfacing capabilities of PIC

I/O ports, I/O bit manipulation programming, timers / counters, Programming to generate delay and waveform generation, Interrupts- Data Conversion- A/D converter, I2C bus-UART-RAM & ROM Allocation–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 – 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. GA Onkar, “Microprocessor Architecture Programming and Application”, Penram International (P) Ltd., Mumbai, 5th edition, 2008.

2. Muhammad Ali Mazidi, Janice GillispieMazidi, "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.

References:

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:

At the end of this course, students will demonstrate the ability to

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 concept of RTOS.
4. Acquire knowledge about architecture, registers, instruction set of arm processor.
5. Know about operating system function, resource and task management function.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3											2	3		
CO2	3														
CO3	3														
CO4			3		2									3	
CO5					3				3		2		3	2	2

EECP607	POWER SYSTEMS LAB	L	T	P	C
		3	0	0	1.5

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-Seidel 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:

At the end of this course, students will demonstrate the ability to

1. Familiarize with analyzing the load flow problems.
2. Analyze load frequency problem.
3. Perform short circuit studies.
4. Perform transient stability studies.
5. Perform economic load dispatch.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	3			2					2	2	
CO2	3	2	2	2	3			2					2	2	
CO3	3	2		2	3			2					2	2	
CO4	3	2		2	3	2		2					2		
CO5	3	2		2	3		2	2					2	2	

EECP608	EMBEDDED SYSTEMS LAB	L	T	P	C
		3	0	0	1.5

Course Objectives:

- Learn the functioning of programmable processors and controllers.
- Study the basic operations of programmable processors and controllers.
- Develop processor and controller based programs.
- Study the functioning of different peripheral interfacing devices.
- Study the role of programmable devices in real-world applications.

List of Experiments:

1) Study of 89C51 Microcontroller
2) Application of 89C51 Microcontroller
   a. Frequency Measurement
   b. Boolean Operation
3) Stepper Motor Control Using 89C51 Microcontroller
4) Seven Segment LED Display Using 89C51 Microcontroller
5) Study of PIC Microcontroller 16F877
6) Application of PIC Microcontroller 16F877
   a. Seven Segment LED Display
   b. Analog to Digital Conversion
   c. PWM Generation
7) Real Time Clock Using PIC Microcontroller 16F877
8) I^2C Logic Based Character Display Using PIC Microcontroller 16F877
9) Study of ARM Processor LPC2148
10) Seven Segment LED Display Using ARM Processor LPC2148
11) ADC Using ARM Processor LPC 2148
12) Study of DSP Processor TMS320C50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the architecture and operations of MICROCHIP microcontrollers.
2. Write programs in Embedded C for performing a task.
3. Validate the theoretical concepts by performing experiments in practical sessions.
4. Distinguish the various categories of programmable devices.
5. Acquire knowledge about different interfacing capabilities of 89C51, PIC and ARM7.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2								1	1		1	3		
CO2	3								1	1		1	3		
CO3	3	3	3	3					1	1		2	3	2	
CO4	1	2	2	2	2				1	1		2	3	2	
CO5	2	3	3	3	3				1	1		3	3	3	

SEVENTH SEMESTER

ETHS701	ENGINEERING ETHICS	L	T	P	C
		2	0	0	2

Course Objectives:

- To understand the moral and ethical dimensions in engineering
- To take balanced decisions.
- To understand the ethical problems and principles through theory, historical case studies and research and presentation.
- To allow students to explore the relationship between ethics and engineering
- To apply classical moral theory and decision making to engineering issues encountered in academic and professional careers.

UNIT - I

Senses of Engineering Ethics – Verity of Moral Issues – Types of Inquiry – Moral Dilemmas - Moral Autonomy – Kohlberg "Theory - Gilligan "Theory– Consensus and Controversy – Professions and Professionalism – Professional Ideas And Virtues - Uses of EthicalTheories.

UNIT - II

Engineering As Experimentation - Engineering As Responsible Experiments – Research Ethics – Code of Ethics – Industrial Standards - A Balanced Outlook Law- The Challenger Case Study.

UNIT - III

Safety And Risk - Assessment of Safety And Risk – Risk Benefit Analysis - - Reducing–The Government Regulator's Approach to Risk–Chernobyl Case Studies and Bhopal

UNIT - IV

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

UNIT V

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

Text Books:

1. Govindarajan, M, Natarajan.S. and Senthilkumar. V S. “Professional Ethics and Human Values.” PHI Learning, New Delhi,2013.
2. Mike Mertin and Roland Schinzinger, “Ethics Engineering “, McGraw Hill, New York, - 4thEdition,2005.

References:

1. Charles E Harries, Michael S Pritchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases,” Thompson Learning, 4thEdition,2004
2. Charles.D. Fleddermann, “Engineering Ethics", Prentice Hall, New Mexico, 1999
3. John R Boatright, “Ethics and the Conduct of Business,” Pearson Education, 2003
4. Edmund G Seebauer and Robert L Barry,” Fundamentals of Ethics for Scientists and Engineers.“ Oxford University Press ,2001
5. David Ermann and Michele S Shauf,” Computers, Ethics and Society,” Oxford University Press, ThirdEdition2003.

Course Outcomes:

At the end of the course the students will be able to

1. Understand and build the relationship between the Engineer and the Society.
2. Describe the importance of Developing ethical codes in engineering practice.
3. Develop the knowledge on the legal, moral and ethical aspects in Engineering.
4. Construct the moral and ethical dimensions in engineering.
5. Improve the Knowledge about Multinational Corporation.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3					3	3	3							3
CO2	3					3	2	3							3
CO3	3			2		3	2	3							3
CO4	3					3	1	3							3
CO5	3					3	1	3							3

EEPC702	INDUSTRIAL ELECTRICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart a wide knowledge about the components of LT system wiring components and their selection.
- To provide basic concepts regarding residential and commercial wiring systems and guide lines for their installation.
- To learn about various industrial electrical system and their production schemes.
- To familiarize the student with different automation schemes of Industrial Electrical systems.
- To understand different types of illumination systems and methods involved in design.

Unit - I: Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit - II: Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, Earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit - III: Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit - IV: Industrial Electrical System and Automation

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Unit - V: Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, floodlighting.

Textbooks:

1. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating &Costing", Khanna publishers,2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International,2007.

References:

1. S. Singh and R. D. Singh, "Electrical estimating and costing", DhanpatRai and Co.,1997.
2. Web site for IS Standards.
3. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education,2008.

Course Outcomes:

At the end of this course, students will able to

1. Familiarize with different electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
2. Understand various components of industrial electrical systems.
3. Analyze and select the proper size of various electrical system components.
4. Acquire knowledge about various industrial automation system.
5. Train and get exposed with the design of illumination system.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		3			2		3				1	1	1	
CO2	3		2			3		2				2	3	2	
CO3	2		2			3		2				2	3	2	
CO4	2		2			2						1	3	2	
CO5	2		2			2						2	2	2	

EEPC706	ELECTRICAL ESTIMATION AND DRAWING LAB	L	T	P	C
		0	0	0	1.5

Course Objectives:

1. To provide the students simple hands-on-experience in the basic aspects of electrical engineering diagrams using CADD.
2. Exercises in estimating the materials and cost of materials required for pump room, industry and house wiring.
3. To 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. 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
8. Symbols
9. Earthing
10. Insulators
11. Lamps
12. SF6 circuit breaker
13. Towers
14. Three phase four wire energy meter

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand basic tools of CADD.
2. Estimate of the materials required.
3. Draw various electrical components.
4. Acquire the designing of wiring system.
5. Understand the design of lighting schemes.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2		2		2	2		2	2				2	2	2
CO2	3	2	2		2	2						2	2	2	1
CO3	2	2	2	2	2							2	2	2	1
CO4	2	2										2	2	2	1
CO5	2	2	2		2				2	2			2	2	1

ETIT707	SEMINAR/ INDUSTRIAL TRAINING	L	TR	S	C
		0	1	2	2

Course Objectives:

- To work on a technical topic and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals
- To train the students in the field work related to Electrical and Electronics Engineering and to have a practical knowledge in carrying out field related works.
- To train and develop skills in solving problems during execution of certain works related to Electrical and Electronics Engineering.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation should also be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

The students individually undergo a training program in reputed concerns in the field of Electrical and Electronics Engineering during the vacation for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the semester. The students will be evaluated, by a team of staff members nominated by Head of the Department, through a viva-voce examination.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Face the audience and to interact with the audience with confidence.
2. Tackle any problem during group discussion in the corporate interviews.
3. Face the challenges in the field with confidence.
4. Manage the situation that arises during the execution of works related to Electrical and Electronics Engineering
5. Develop the ability of writing technical papers for Conferences and Journals

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1									2				2		
CO2								1	1					2	
CO3	2														2
CO4	3					2	2	2	2						2
CO5	3							3		3			3		3

EIGHTH SEMESTER

EEPV803	PROJECT WORK AND VIVA-VOCE	L	PR	S	C
		0	8	4	10

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:

At the end of this course, students will demonstrate the ability to

1. Take up any challenging practical problems and find solution by formulating proper methodology on completion of the project work.
2. Carry out any experimental works.
3. Understand the modeling, analysis and design.
4. prepare research papers for Conferences and journals
5. Acquire confidence to face any type of audience

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	1		1	3	2	3	2	3	1	3		3
CO2	3	2	3	2	3	2	3	3	3	3	2	1	3	2	3
CO3	3		2	1		1	3	3	3	2	2	2	3	1	3
CO4	3		2				2	3	3	2	2		2	3	3
CO5	3	3	2		3	1	1	2	3	2	3	1	2	3	3

PROFFESSIONAL ELECTIVES

EEPESCN	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn about the various materials used in electrical machines and factors affecting the electrical, mechanical and thermal loadings of electrical machines.
- To understand the construction, design and cooling of transformers.
- To develop sound knowledge on the design of induction motors and study the performance characteristics.
- To familiarize with the complete design of a synchronous machine as per the requirements and constraints.
- To get exposed to the optimal design of electrical machines using software tools and techniques.

Unit - I: Introduction

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit - II: Transformers

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Unit - III: Induction Motors

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Unit - IV: Synchronous Machines

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Unit - V: Computer aided Design (CAD):

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons, 2016.
2. M.G. Say, "The Performance & Design of A.C. Machines", CBS, 2002.
3. S. K. Sen, "Principles of Electrical Machine Design with C++", Oxford and IBH Publishing, 2014.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 2002.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 2015.
6. K. M. Vishnu Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the various factors which influence the design of electrical machines and select proper material for the design.
2. Design a transformer and estimate its performance characteristics.
3. Relate the output power of an induction motor with its main dimensions and design squirrel cage and slip ring induction motors.
4. Obtain the optimal design of a synchronous machine as per the requirements and constraints specified.
5. Apply software tools to do design calculations.

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2					2				3			
CO2	3		3		2					3				3	
CO3	3		3		2					3				3	
CO4	3		3		2					3				3	
CO5					3									2	

EEPESCN	ELECTRICAL ENERGY CONSERVATION AND AUDITING	L	T	P	C
		3	0	0	3

Course Objectives:

- To gain knowledge about the Electrical energy Scenario.
- To study the various forms of energy and its Basic.
- To impart knowledge about Energy Efficiency of Electrical Systems.
- To Familiarize Energy Efficient Technologies in Electrical systems.
- To inculcate the feasibility of Energy Management and Audit.

Unit - I: Energy Scenario

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit - II: Basics of Energy and its various forms

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Unit - III: Energy Efficiency in Electrical Systems

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. Compressed Air System: Types of air compressors, compressor efficiency, compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Unit - IV: Energy Efficient Technologies in Electrical Systems

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Unit - V: Energy Management & Audit

Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Text/References:

1. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill,1991.
2. Success stories of Energy Conservation by BEE, New Delhi(www.bee-india.org)
3. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
4. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Gain knowledge onthecurrent energy scenario and the importance of energy conservation.
2. Comprehend the various forms of energy.
3. Familiarize the concepts of energy efficiency of electrical systems and energy management.
4. Acquire awareness of the methods adopted for improving energy efficiency in various electrical systems.
5. Understand the basic concepts and implementation schemes of energy audit and energy management.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2	3			3	2			2		3	2	
CO2	3	2	3	2			2	2					2	2	
CO3	3	2	2	2				2					3	2	2
CO4	3		3	2				2					2	2	
CO5	3	2	2	2				2					3	2	2

EEPESCN	ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the basics of electric drives
- To explain the operation of phase controlled DC drives
- To elucidate the theory of chopper fed DC motor drives
- To explain the different speed control mechanisms for induction motor drives
- To articulate the theory for operating synchronous motor and special machine drives.

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 Schermie's 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 – cycle 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.

References:

1. Pillai, S.K., "A First course on Electric Drives", Wiley Eastern Ltd, Bombay, 1988.
2. VedamSubramanayan, "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:

At the end of this course, students will demonstrate the ability to

1. Understand the basics of electric drives
2. Analyze the operation of phase-controlled dc drives
3. Apply the theory of self commutated switches to the operation of chopper fed drives
4. Analyze the speed control mechanisms for induction motor drives
5. Understand the operation of synchronous motor and special machine drives

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	3	2	1	1				1	1	2	2	1
CO2	2	2	2	3	3	1	1				1	1	2	2	1
CO3	2	2	2	3	3	1	1				1	1	2	2	1
CO4	2	2	2	2	3	1	1				1	1	2	2	1
CO5	2	2	2	2	3	1	1				1	1	2	2	1

EEPESCN	ELECTRICAL AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To acquire knowledge on the social and environmental importance, basic concepts and configuration of hybrid EV and electric driven train.
- To study various types of electric machines and energy storage devices used in hybrid and electric drive and to study the configuration and control of various electrical machines.
- To learn in detail about the Energy Storage Requirements in Hybrid and Electric Vehicles apart from the communication and supporting subsystems used.
- To understand the design of different energy management strategies, implementation issues in hybrid electric vehicle and battery electric vehicle.

Unit - I: Introduction

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit-II: Hybrid Vehicles

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive- train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit - III: Electric Trains

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit - IV: Energy Storage

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit - V: Energy Management Strategies

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons,2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer,2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press,2004.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge,2016.
5. A.K.Babu, "Electric & Hybrid Vehicles", Khanna Publishers, New Delhi 2019
6. Anupam Singh, "Electric Vehicles: And the end of ICE Age", Adhyyan Books, New Delhi 2019.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the models to describe hybrid vehicles and their performance.
2. Identify the different possible strategies in hybridization of EV.
3. Know the various topologies of electric drive and its control.
4. Familiarize the different strategies related to energy storage systems.
5. Gain knowledge about different energy management strategies adopted for EV.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2					3	1				2	3		
CO2	3	2	2	2		2	2		2		2	2		2	
CO3	3	2	3		2	2		1	2		2		2		
CO4	3	2	2	2		2	2	2		2		2		2	3
CO5	3	3		2	3	2		2	2		3	2		2	3

EEPESCN	WIND AND SOLAR ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the wind speed statistics and probability distributions
- To understand various wind generator topologies
- To study the various solar resources and estimation of solar energy availability
- To study the power electronics convertors and MPPT
- To analyze the hybrid and isolated operation of solar PV and wind systems

Unit - I: Physics of Wind Power:

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit - II: Wind Generator Topologies:

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit - III: Solar Resources:

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit - IV: Solar Photovoltaic:

Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV Unit, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit - V: Network Integration Issues:

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. Solar thermal power generation: central receivers, solar pond

Text / References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd.,2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons,2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill,1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications,2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons,1991.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Comprehend the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Gain knowledge about the basic physics of wind and solar power generation.
3. Familiarize the power electronic interfaces for wind and solar generation.
4. Understand the concept of solar photovoltaic power generation.
5. Acquire awareness about the issues related to the grid-integration of solar and wind energy systems.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	1	2	2	1					3	2	2
CO2	3	2	1		1	2	2						2	2	1
CO3	3	3	2	2	1								3	3	1
CO4	3	2	2	1		2	2						3	3	2
CO5	3	2	3	1	1	1							3	2	1

EEPESCN	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives:

- To represent the discrete system using different equations
- To study Z and inverse Z transforms
- To understand DFT and FFT
- To design FIR filters & IIR filters
- To Study the application of Digital signal processing

Unit - I: Discrete-time signals and systems

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals aliasing; Sampling theorem and Nyquist rate.

Unit - II: Z-transform

Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using Z-transform, Properties of Z-transform for causal signals, Interpretation of stability in Z-domain, Inverse Z- transforms.

Unit - III: Discrete Fourier Transform

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit - IV: Design of Digital filters

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High- pass filters.Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

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/Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill,2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall,1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall,1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall,1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall,1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons,1988.
7. Venkatramani, B. and Bhaskar, M., "Digital Signal Processors", TMH, 2002.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyze discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital filters for various applications.
5. Apply digital signal processing for the analysis of real-life signals.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		2											2	2	1
CO2	3												2	2	1
CO3			2										2	2	1
CO4	3	2											2	2	1
CO5		2								2			2	2	1

EEPESCN	CONTROL SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the effect of gain on transient and steady state response
- To understand the concept of different compensators in time domain
- To analyze a steady state and transient response with compensator in frequency domain
- To study the different controllers for first, second & third order systems
- To understand controllability & observability

Unit - I: Design Specifications

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

Unit - II: Design of Classical Control System in the time domain

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

Unit - III: Design of Classical Control System in frequency domain

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Unit - IV: Design of PID controllers

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Unit - V: Control System Design in state space

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle. Various types of non-linearities Singular points.

Text / Reference Books:

1. N. Nisei, "Control system Engineering", John Wiley,2007.
2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley,2018.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern,2014.
4. Ogata, "Modern Control Engineering", Prentice Hall,2015.
5. B. C. Kuo, "Automatic Control system", Prentice Hall,2014.
6. J. J. D'AzzoandC. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
7. R.T. Stefani and G.H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 2006.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Study various design specifications.
2. Design classical control system in time domain
3. Design classical control system in frequency domain.
4. Analyze the controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
5. Understand controllers using state-space approach.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2		1	1	1				2	2	2	2
CO2	3	3	3	2		1	1	2	2		1	2	2	3	1
CO3	3	3	3	2		1	1	2	2		1	2	2	3	1
CO4	3	3	3	2	2		1	2	2	2	2	2	3	3	2
CO5	3	3	3	2	2			1		3	2	2	2	2	1

EEPESCN	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the building blocks of computer organization
- To study about Input – output organization
- To impart the knowledge about 16 and 32 bit microprocessors
- To illustrate the concept of pipelining
- To discuss the features of different architectures

Unit - I: Introduction to computer organization

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating-point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization. System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit - II: Input – output Organization

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Unit - III: 16 bit and 32-bit microprocessors

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, addressing modes of 80x86, Instruction set of 80x86, I/O addressing in80x86.

Unit - IV: Pipelining

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Unit - V: Different Architectures

VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming.

Text/ Reference Books:

1. V. Carl, G. Zonke and S. G. Zaky, "Computer organization", McGraw Hill,1978.
2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education,2000.
3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011.
4. W. Stallings, "Computer organization", PHI, 1987.
5. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann,2012.
6. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall,2004.
7. Y. C. Lieu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India,1986.
8. J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall, 1987.
9. B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill, 1991.
10. P. Able, "8086 Assembly Language Programming", Prentice Hall India.

Course Outcomes:

At the end of this course, students will be able to

1. Understand the architecture and functions of the computer system.
2. discuss the features of various I/O interfaces and select the required I/O for a particular objective.
3. Understand the concepts of microprocessors, their principles and practices.
4. Analyze the task and develop the assembly language program using 8086 instruction set.
5. Differentiate processor architectures like VLIW, DSP, SOC and their suitability for the desired application.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3				2										
CO2		3	3		2				1				2	2	
CO3	1				3										
CO4		3	3						2						
CO5	2	3		1									2		

EEPESCN	POWER SYSTEM PROTECTION	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart knowledge on different components of protection system.
- To discuss different types of faults, overcurrent protection and relay coordination
- To explain various equipment protection schemes.
- To study computer aided protection schemes.
- To understand various system protection and application of wide area measurement system.

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: Digital Protection

Computer aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues. Digital protection techniques - Introduction - advantages – algorithms - microprocessor based protection schemes.

Unit - V: System Protection

System Protection Schemes. Under-frequency, under- voltage and df/dt relays, Out-of-step protection, CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Text/References:

1. Sunil Serrao, “Protection and Switchgear”, Khanna Publishers, New Delhi, 2019.
2. Rabindaranath, B., Chander, M., “Protective System Protection and Switchgear”, New age International, New Delhi, 2009.
3. Wadhwa, C.L., “Electrical Power Systems”, New Age International, New Delhi,2016.
4. J. L. Blackburn, “Protective Relaying: Principles and Applications”, Marcel Dekker, New York, 2014.
5. Y. G.Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India,2010.
6. A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, John Wiley & Sons, 2012.
7. A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer,2017.
8. D. Reimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis,2006.
9. MadhavaRao. T.S., “Power System Protection - Static Relays with Microprocessor Applications”, Tata McGraw Hill Publishing Co., New Delhi, 2017.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Study the different components of a protection system.
2. Understand the operation of circuit breakers.
3. Analyze the protection schemes for different power system components.
4. Impart basic principles of digital protection.
5. Understand system protection schemes and the use of wide-area measurements.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		1	1		1	2	1			1	2	2	2	1
CO2	3	2	1	1	2	1	2	1				1	1	2	
CO3	2		1			1	2	1				1	1	3	2
CO4		2	2	2	3	1	2	1	2	2		2	1	3	1
CO5	1	2	1					1			1	1	1	2	1

EEPESCN	HIGH VOLTAGE TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To study HVAC and HVDC for overhead and underground transmission systems and factors governing the choice of them.
- To learn about the bundle conductors and reducing the corona loss.
- To introduce the problems of EHVAC transmission at power frequency and compensation.
- To introduce modern developments in HVDC transmission and FACTS.
- To learn about the overvoltage problem, cables and insulation 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 - Generalized 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. Rakesh 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:

1. 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 about bundled conductors and corona loss.
3. Analyze the problem of EHVAC transmission at power frequency and compensation.
4. Learn the DC transmission system in case of harmonics and as well as multi-terminal DC transmission system.
5. Impart the knowledge of over voltage problem cables and insulating materials.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3						1			2					
CO2	3	2					2						2		
CO3	3						2								2
CO4	3						2						3		3
CO5	3														

EEPESCN	COMPUTER AIDED POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

- To study economic dispatch techniques of power system.
- To understand optimal power flow methods.
- To familiarize different unit commitment methods.
- To design and implement load-frequency controller and its dynamics.
- To gain knowledge about 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 Nekota 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. HaadiSaadat, "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:

At the end of the course, the studentswill be able to

1. understand the economic operation of power system operation.
2. Enhance skills to develop the policies for optimal load flow using various methodologies.
3. Design Unit Commitment under various strategies.
4. Gain knowledge in load-frequency control and in designing various types of Controllers.
5. Learn the analysis of the transient stability for power system using various techniques

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2				2		2	2		2		3		
CO2	3	2	2			2		2					2	2	
CO3	3	2	2				1					2	3		
CO4	3	2						1	2			2	2	2	
CO5	3	2	2			2		2					2	2	

EEPESCN	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To give an exposure of different types of analog modulation techniques and their significances in communication systems.
- To familiarize the students about angle modulation techniques in communication systems.
- To introduce pulse modulation techniques
- 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-Blockdiagram – Pre-emphasis circuit - Frequency demodulation –DetectionofFM and PM signals –Automaticfrequencycontrol - 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, a synchronous 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&GautamSaha "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. HariBhat& 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:

At the end of this course, students will demonstrate the ability to

1. Provide idea about modulation and demodulation techniques employed in communication systems.
2. Understand angle modulation technique in communication system
3. Understand pulse modulation technique and its conversion
4. Explain the concepts of pulse modulation systems and multiple access techniques used in communication field applications.
5. Understand the various broadband communication systems and recent advancements in communication systems.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2												1		
CO2	2												2		
CO3	2												1		
CO4						1							1	2	
CO5	2	1						2						2	

EEPESCN	VLSI DESIGN	L	T	P	C
		3	0	0	3

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 Calibration 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 modelling a digital system using VHDL.

Unit–I: VLSI Design Concepts

Evolution of VLSI – VLSI design flow--Design domains Behavioural, 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 behaviour 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 modelling issues –VHDL code structure: Library declaration, Entities and Architectures –Data types- Operators-Concurrent and Sequential Statements-Signals and Variables-Packages and Libraries - Introduction to behavioural, dataflow and structural modelling-simple VHDL code examples.

Text Books:

1. Neil, H.E. Waste, 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. Katarina& Sons; 1st edition, 2013.
2. R. Sakthivel, "VLSI Design", S.Chand& Company Ltd, 4th edition, 2008.
3. SaritaChauhan, "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:

At the end of this course, students will demonstrate the ability to

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 of analog circuit
4. Design and analyze digital circuits like multipliers, adders and understand the architecture and programming technologies of FPGA.
5. Model a simple digital system using VHDL.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3												2	2	1
CO2		2			2								2	2	1
CO3		2											2	2	1
CO4	3				2								2	2	1
CO5		2										1	2	2	1

EEPESCN	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- This course intends to provide a conceptual understanding of micro fabrication techniques and the issues surrounding them.
- To know the major classes, components and applications of MEMS devices/systems and to demonstrate an understanding of the fundamental principles behind the operation of these devices/systems.
- To learn Bulk micromachining process and to understand the concept of different etching process and etching materials in fabrication process.
- To impart knowledge about surface micromachining process and to understand the types and concept of bonding process.
- To study and design of different types of MEMS actuators, Micro grippers, MEMS resonators and their applications.

Introduction to Micro Machined Devices

Microsystems vs. MEMS - Markets for Microsystems and MEMS, Scaling Principles-Materials for micromachining, Micromachining terms- mechanical properties of silicon-native oxides of silicon and other semiconductors-typical silicon wafer types.

Bulk Micro Machining

Wet etching of silicon-Isotropic etching-anisotropic etching, alkali hydroxide etchants-ammonium hydroxide- tetramethyl ammonium hydroxide (TMAH)-ethylene diaminepyrochatechol (EDP)-ultrasonic agitation in wet etching stop layers for dopant elective etchants. Porous-silicon formation – antistrophic wet etching of porous aluminum-antistrophic wet etching- quartz- vapor phase etches. RIE laser driven bulk processing.

Surface Micromachining

Thin film processes-nonmetallic thin film for micromachining –silicon dioxide – silicon nitride - silicon carbide – polycrystalline diamond - polysilicon and other semiconductors and thin film transition – wet etching of non-metallic thin film-metallic thin film for micromachining - Resistive evaporation – E-beam evaporation-sputter deposition-comparison of evaporation and sputtering – CVD of metals - adhesion layer for metals - electro deposition (E plating) – Electro deposition mechanism: - DC electroplating-pulsed electroplating-Agitation for electroplating-black metal film-electro less plating.

Bonding Processes

Anodic Bonding-Anodic bonding using deposited glass-silicon fusion bonding-other bonding and techniques - compound processes using bonding. Sacrificial Processes and other

Techniques: Sticking problem during wet releasing prevention of sticking-phase change release methods-geometry-examples of sacrificial processes.

Mems Actuators and Their Applications

Actuation mechanisms–Electrostatic actuation–Electrostatic cantilever actuators–Torsional electrostatic actuators–Electrostatic comb drives–Feedback stabilization of electrostatic actuators -Electrostatic rotary micro motors - Electrostatic linear micro motors – Electrostatic micro grippers–Electrostatic relays and switches - Thermal actuation – Thermal expansion of solids – Thermal array actuators –Piezoelectric actuation–Cantilever resonators.

References:

1. Chang Liu, Foundations of MEMS, Pearson Education,2nd edition, 2014.
2. Muhammad H. Rashid, Micro Electronic Circuits: Analysis and Design, Cenage Learning,2nd edition 2012.
3. Reza Ghodssi, Pinyen Lin, MEMS materials and processes Handbook, Springer science business media, 2011
4. Chang Liu, Foundations of MEMS, (ILLINOIS ECE Series), Pearson Education International, 2006.
5. Tai-Ran-Hsu, MEMS & Microsystems Design and Manufacture, Tata McGrawHill, New Delhi, 2002
6. Stephen D. Senturia, Microsystems Design, Springer International Edition, 2001.
7. Gregory T.A. Kovacs, Micro machined Transducers, WCB McGraw Hill, 1998.

Course Outcomes:

1. Understand the concept of scaling laws that are used extensively in the design of micro devices and systems.
2. Analyze the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
3. Impart knowledge about thin film process and etchants used for isotropic and anisotropic etching.
4. Analyze semiconductor materials for common micro components and devices.
5. Understand the types of bonding process and the techniques used for MEMS

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		2								2			2	2	1
CO2	3						2						2	2	1
CO3			2										2	2	1
CO4	3	2											2	2	1
CO5		2								2			2	2	1

OPEN ELECTIVES

EEOESCN	ELECTRICAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart knowledge about safety requirements
- To provide guidance on prevention of electrical shocks
- To study about various first aid methods
- To create awareness about various Hazardous areas
- To familiarize with 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.

References:

1. J. Cadick, D. Neitzel and A. Winfield, "Electrical Safety HandBook", 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:

At the end of this course, students will demonstrate the ability to

1. Get an insight on Electrical safety, IE act and IE rules
2. Acquire knowledge about prevention of electrical shocks
3. Familiarize with various first aid measures
4. Recommend electrical safety measures in hazardous areas
5. Understand the significance of safety management

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3					1						1	3		
CO2	3		2			2			2				3		
CO3	3		3			2							3		
CO4	3		3			2			2				3		
CO5	3					2		1	3	3	3	1	3		2

EEOESCN	GENERATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To emphasize on power generation technology using conventional and non-conventional energy sources
- To create an understanding of conversion of various forms of energy to electrical energy.
- To highlight the operation and major components of electric generating plants.
- To highlight the operation and major components of hydro power plant
- To introduce to the basics of Tariff structure for energy production.

Unit – I: Thermal, Gas and Diesel Power Plants

Thermal Power Plant: Plant layout, Components of thermal power plant, Advantages and disadvantages, choice of site.

Gas Turbine Power Plants: Plant layout, advantages and disadvantages, Applications, Open cycle and closed cycle gas turbine power plant, combined cycle power plant, Comparison with steam power plants.

Diesel power plant: Plant Layout, advantages and disadvantages, Applications, Choice and characteristic of diesel engines, auxiliaries.

Unit – II: Hydro Power Plant

Advantages and disadvantages, choice of site, Classification, Schematic arrangement, constituents of hydro power plant, Hydro turbines, Economics of small hydro schemes, Pumped storage plants, types, Advantages.

Unit – III: Nuclear Power Plant

Location and size selection, Layout and components of Nuclear Power Plants, Nuclear reactors-types and applications, Safety measures for Nuclear Power Plants-Radiation shielding, Radioactive and waste disposal

Unit- IV: Power from Renewable Energy

Principle, Construction, working and types of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas, Fuel Cell and Magneto-Hydro dynamic system.

Unit-V: Power Plant Economics and Tariffs

Factors affecting cost of generation, Selection of type of generation and generation equipment, Load curve, load duration curve, Effect of load on power plant design, tariffs, depreciation, causes and effects of low power factor and its improvement.

Text Books:

1. B.R. Gupta , "Generation of Electrical Energy", S. Chand and Co., 2010
2. 2. NagpalG.R. "Power Plant Engineering", *Khanna Publishers: 2007.*

References:

1. Uppal S.L. "Electrical Power", *Khanna Publishers: 2007.*
2. Arora S.C. and Domakundwar S. "A Course in power plant engineering"*DhanpatRai& Co (P)Ltd., Delhi: 2005.*
3. Nag. P.K., "Power Plant Engineering", Tata McGraw – Hill., 2008.
4. Singhai D.K. "Fundamentals of Nuclear Power Engineering" *KhannaPublishers: 2007.*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Know different types of power plants, their functions and issues related to them.
2. Understand the significance of Hydro Energy and its economical benefits.
3. Understand the principle of operation and performance of various nuclear reactors and their impact on environment.
4. Understand the importance of renewable energy sources as an alternative to energy crisis.
5. Learn the basics of Tariff structure for energy production.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3		1	2	2					2	3		
CO2	3	2	2			2	2						3		
CO3	3	2	2			1	1						3		
CO4	3	2	3	1		1							3		
CO5	3	1	3		1	2							3		

EEOESCN	ELECTRICAL MATERIALS	L	T	P	C
		3	0	0	3

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.*

References:

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 ofSemiconductordevices",3rd Edition, *WileyEastern, 2007.*
4. Van Vlack, L.H., "Material Science for Engineers", *Addison Wesley, 2000.*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

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

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3														
CO2	3	2													
CO3	3	2													
CO4	3		2			1								1	
CO5	3				1		1								

EEOESCN	SOFT COMPUTING TOOLS FOR ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To familiarize the students with the various architectures and learning algorithms of Artificial Neural Network.
- To make the students to understand the basis of classifying neural networks and suitability for different applications.
- To enable the students to acquire knowledge on Fuzzy logic and their operations
- To acquire the ability of designing 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 – Korhonen self-organizing Maps – Adaptive Resonance Theory- Basic architecture - Algorithm - Introduction to Neuro controllers - Application of ANN for Economic Load Dispatch problem.

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- Fuzzy logic controller for DC motor speed control.

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. LawreneFaussett, "Fundamental of neural networks", *Prentice Hall, 2004.*
2. Rajasekaran and VilyalakshmiPai 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.

References:

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. SN and Deepa. SN, “Neural networks with Matlab”, *TMH* 2007.

Course Outcomes:

At the end of this course, students will be able to

1. Analyze and select a suitable technique for the particular problem domain.
2. Recognize the merits and demerits of applying a particular ANN model for a particular problem.
3. Design and apply fuzzy Logic based reasoning to handle uncertainty in engineering problems.
4. Apply Neuro-controller, Fuzzy Logic Controller for non-linear controlling applications.
5. Solve combinatorial optimization problems using genetic algorithm.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3											3	2	
CO2	3	2	3		2								3	3	
CO3		2	3		3				1				2	2	
CO4			3	2	3									2	
CO5		3	2		3								3	2	

EEOESCN	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To give an exposure to the physiology and anatomy of human system.
- To familiarize the students about the bio-potential electrodes and amplifiers used in biomedical engineering
- To learn the various types of biological transducers used in medical engineering field for signal acquisition.
- 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 cardiograph – Blood Pressure -Blood flow - Cardiac output - Plethysmography -Impedance cardiology - Cardiac arrhythmias - Pacemakers - Defibrillators – Electroencephalograph - Evoked potential response – Electromyograph - Fatal 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 cardiograph - CT scan -Magnetic Resonance Imaging (MRI) –X-Ray imaging using special techniques- Holter monitoring.

Text Books:

1. Leslie Cromwell, Fred Weibull 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.

References:

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:

At the end of this course, students will demonstrate the ability to

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

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						1						1		
CO2	1	1				2							2	1	
CO3		2											1	2	
CO4			2										1	2	
CO5						2							2	2	

EEOESCN	UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To study about the different systems of electric traction
- To introduce the energy saving concept by different ways of illumination.
- To explore the utilisation of electrical energy for heating and welding
- To provide basic knowledge about Refrigeration and Air-conditioning
- To expose the students to the economics of Electrical Energy Utilization

Unit – I: Electric Drives and Traction

Fundamentals of electric drive – choice of an electric Motor – application of motors for particular services-Traction Motors – Characteristic features of traction motor – Systems of railway electrification – Electric braking – Train movement and energy consumption – Traction motor control – Track equipment and collection gear.

Unit – II: Illumination

Introduction – Definition and meaning of terms used in illumination Engineering – Classification of light sources- Incandescent lamps, sodium vapor lamps, mercury vapor lamps, fluorescent lamps – Design of illumination systems – Indoor lighting schemes – factory lighting halls – Outdoor lighting schemes – flood lighting – street lighting – Energy saving lamps.

Unit – III: Heating and Welding

Introduction – advantages of electric heating – Modes of heat transfer – Methods of electric heating – Resistance heating – Arc furnaces – Induction heating – Dielectric heating-Electric welding – Types – Resistance welding – Arc welding – Radiation welding – Requirements of good weld – Power supply for arc welding.

Unit – IV: Refrigeration and Air Conditioning

Introduction – Refrigeration cycle – Refrigeration system – Types of refrigerants – Domestic refrigerator – Water coolers – Air conditioning systems – Air conditioning cycle – Classification of air conditioning systems – Central system – Unitary systems

Unit – V: Economics of Electrical Energy Utilization

Economics of Electric power supply – General rule for charging the energy – Economical cross section of a conductor – Ratings of a motor – temperature rise in a motor – power factor improvement– Economic choice of equipment – energy management – energy auditing

Text Books:

1. Dr.N.V. Suryanarayana, "Utilisation of Electric power", Wiley Eastern Limited, New Age International Limited, 1993.
2. J.B. Gupta, "Utilisation Electric power and Electric Traction", S.K. Kataria and Sons, 2012.

References:

1. R.K.Rajput, "Utilisation of Electrical Power", Laxmi publications (P) Ltd., 2016.
2. H. Partab, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai and Co, New Delhi – 2017.
3. Ocklawaha, "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt. Ltd., 2003.

Course Outcomes:

At the end of this course the students will be able to

1. Know about different type of electric drives and systems employed in electric traction.
2. Understand the various lamps and design illumination schemes.
3. Acquire the knowledge of existing methods used for heating and welding.
4. Familiarize the concepts and theory of refrigeration and air conditioning.
5. Analyze the various energy saving methods.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		3		2		2	2		3	1	3	3	1		2
CO2	3	2	2		2		3	2				3	2	1	2
CO3	2			1		2		1		1	2	3	2	1	
CO4		2	3		2		2	3	2	2	2	3	1		1
CO5	2	2	3	2	2			2			2	3		1	1

HONOUR ELECTIVES

EEHESCN	POWER SYSTEM DYNAMICS AND CONTROL	L	T	P	C
		3	1	0	4

Course Objectives:

- To introduce various aspects of power system operation, stability and control
- To discuss about the analysis of linear dynamical system and various numerical integration techniques.
- To analyze the modeling of synchronous machines and associated controllers in detail
- To explain the modeling of various power system components
- To understand various types of stability analysis of power system.

Unit - I: Introduction to Power System Operations

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Unit - II: Analysis of Linear Dynamical System and Numerical Methods

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

Unit - III: Modeling of Synchronous Machines and Associated Controllers

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short-circuit Transient Analysis of a Synchronous Machine. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Unit - IV: Modeling of other Power System Components

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads.

Unit - V: Stability Analysis

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Stabilizing Controllers (Power System Stabilizers) Introduction to Torsional

Oscillations and the SSR phenomenon. Operational Measures- Preventive Control. Emergency Control.

Text/References:

1. K.R. Wadiyar, "Power System Dynamics, Stability and Control", B. S. Publications,2002.
2. P. Kundur, "Power System Stability and Control", McGraw Hill,1995.
3. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall,1997.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand basic power system operation
2. Understand the problem of power system stability and its impact on the system.
3. Analyze linear dynamical systems and use of numerical integration methods.
4. Model different power system components for the study of stability.
5. Understand the methods to improve stability.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1		1		2	1				2	1	2
CO2	3	3	2	2	2			2				2	2		
CO3	3	2	3					2	2				2	2	1
CO4	3	2	2	2				2					2		2
CO5	3	2		2				2	2				2	2	

EEHESCN	RESTRUCTURED POWER SYSTEMS	L	T	P	C
		3	1	0	4

Course Objectives:

1. To understand the fundamentals of restructured power systems
2. To learn the significance of Independent System Operator
3. To impart knowledge on transmission open access and pricing
4. To know about the ancillary services and their management
5. 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. Bullen, 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.

References:

1. Mohammad Saidpur 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:

At the end of this course, students will demonstrate the ability to

1. Understand the difference between traditional and restructured power systems
2. Understand about various entities involved in power markets.
3. Familiarize with transmission open access and electricity pricing
4. Understand various ancillary services management
5. Understand the power system analysis under market environment

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1			2	3	1	3	3		3		3	3	1		2
CO2		2	1	3	1	2	3	3	2	3	2	1	1		1
CO3	3	2		3	2			1	3		2	2		2	2
CO4	1	2		2				1	1	1	1	2	1		2
CO5	3	1	1	2	2		1	1	3	1	3	2		1	2

EEHESCN	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide knowledge on FACTS controllers, emphasize the need for controllers and introduce the basic varieties of compensators.
- To convey the significance of FACTS which involves power electronics interface.
- To describe how FACTS controllers can provide controllability of Voltage, Impedance, Reactive power, active power and enhance stability.
- To study the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
- To familiarize the reader about the modeling aspects of emerging FACTS controllers and analyze their performance in unbalanced A.C systems. Also to know about various 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.

References:

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:

At the end of this course, students will able to

1. Conceptualize the different methods adopted in power system control and Learn the classification of compensators along with its application
2. Learn the characteristics, modeling and operating schemes of different types of shunt and series switched reactive power generating devices.
3. Familiarize with all types of compensators and know their significance.
4. Equip with basic procedure of FACTS controller design and get exposed with emerging facts controllers
5. Build an enhanced knowledge of how to realize control strategies to ensure a smooth transfer of power with improved performance indices.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2					2			2	2	3	1	
CO2	3	3	2		2	3		2			3	2	3	2	
CO3	3	3				2		1			3		3	2	
CO4	2		2			1						1	2	2	
CO5	2				2							1	2	1	

EEHESCN	POWER QUALITY STUDIES	L	T	P	C
		3	0	0	3

Course Objectives:

- To study the basic functional issues in power quality issues
- To analyze the impact of various types of loads in different types of power system.
- To learn the effects of load compensation methods to mitigate the power quality problems.
- To comprehend the importance of shunt compensator and the need for DSTATCOM
- To investigate the advantages of using Unified power quality conditioner for power quality improvement.

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 phases 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, Cranachan, M.F., Santoso, S. and Wayne Beaty, H, "Electrical Power System Quality", McGraw Hill publishers, New York, Second Edition, 2008.

References:

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, New York, 2014.
3. Heydt, G.T., "Electric Power Quality", Stars in a Circle Publications, 2nd Edition, West LaFayette, 1994.
4. Derek A. Paice, "Power Electronic Converter Harmonics", John Wiley & Sons, London,1999.
5. Arrillga, A.J. and Neville R. Watson, "Power System Harmonics", John Wiley publishers, London, Second Edition, 2003.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Familiarize with the basic concepts of power quality standards and issues
2. Understand and analyze single phase and three phase system with various types of loads
3. Gain knowledge with the use of various load compensating methods compute the concept of improving the power quality to sensitive load by various mitigating methods.
4. Identify the schemes for load compensation using DSTATCON
5. Acquire awareness about DVR and the impact of Unified power quality conditioner for power quality issues.

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2			2	2	2				3	2	
CO2	3	3	2					2					3	2	
CO3	3	2	2	2				2					3	3	
CO4	3		2					2						2	2
CO5	2	2	2	3				2					3	2	2

EEHESCN	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- To gain knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
- To introduce the concept of H.V tests on H. V. equipment and on insulating materials, as per the standards.
- To explain how over-voltages arise in a power system, and protection against these overvoltage's.

Unit-I: Breakdown in Gases

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Unit-II: Breakdown in liquid and solid Insulating materials

Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Unit-III: Generation and measurements of High Voltages

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators. Measurements: Peak voltage, impulse voltage and high direct current measurement method, measurement of dielectric constant and loss factor, partial discharge measurements.

Unit-IV: Lightning and Switching Over-voltages

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Unit-V: High Voltage Testing of Electrical Apparatus

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text Books:

1. M. S. Naidu and V. Kamaraj, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.

References:

1. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
2. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. To understand the breakdown mechanism gaseous insulating materials.
2. To analyze the processes lead to breakdown of solid and liquid insulating materials.
3. To gain knowledge about high voltage and current generation equipment.
4. To explain how Lightning and Switching Over-voltages arises in the system
5. To analyze the suitable H.V tests required for particular equipment as per the standards.

Mapping with Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		3		2						2	3	2	
CO2	3	2		3								2	2	3	
CO3	2	3			2								2		
CO4	3			2									3	2	
CO5	2	3			2								3	3	

EEHESCN	DIGITAL CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To develop a mathematical model of sample and hold circuit
- To study Z, inverse Z transforms and solution methodology of discrete time systems.
- To analyze the stability of discrete time system
- To study the state space analysis of discrete time systems
- To analyze the design of discrete PID controller, discrete observer and discrete compensator

Unit - I: Discrete Representation of Continuous Systems

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. OH equivalent.

Unit - II: Discrete System Analysis

Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Unit - III: Stability of Discrete Time System

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Unit - IV: State Space Approach for discrete time systems

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Constructability and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit - V: Design of Digital Control System

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. Design of discrete output feedback control.

Text Books :

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs,1995.
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern,1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley,1998.

4. B.C. Kuok, “Digital Control System”, Holt, Rinehart and Winston,1980.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Obtain knowledge on discrete representation of continuous systems.
2. Understand the usage of Z and inverse Z transform in discrete-time systems.
3. Gain knowledge about stability of discrete time systems.
4. Acquire knowledge about state space approach for discrete time systems.
5. Design discrete controllers and discrete compensators.

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	1	
CO2	3	3	3	2	1								3	2	
CO3	3	2	2	1									3	2	
CO4	3	3	2	1									3	1	
CO5	3	2	2	2									3	3	

MINOR ELECTIVES

EEMISCN	ANALOG ELECTRONICS	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide sound knowledge at the fundamental of electronic circuits
- To analyze the BJT circuits and its characteristics
- Introduction to MOSFET and small signal models
- To study multi-stage and operational amplifier
- To study the application Linear and non linear applications of op-amp circuits.

Unit - I: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit - II: BJT circuits

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit - III: MOSFET circuits

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit - IV: Differential, multi-stage and operational amplifiers

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit - V: Linear applications of op-amp

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift) Analog to Digital Conversion. Zero Crossing Detector, Square-wave and triangular-wave generators.

Text/References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press,1998.
2. J. V. Wait, L. P. HuelsmanandG. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S.,1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education,1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press,1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons,2001.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of transistors.
2. Design and analyses various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Understand the structure and I.V characteristics of MOSFET & BJT.

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2								2	2	1
CO2	2	2	3	2	3								2	2	1
CO3	3	2	3	2	3								3	2	1
CO4	1	2	2	3	3								2	2	1
CO5	1	2	2	2	3								2	2	1

EEMISCN	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To review the fundamental concepts relating to Number systems, codes and Boolean algebra and to explain the working and the characteristics of Logic families and Logic packages.
- 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 about operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.

Unit - I: Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic ,one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit - II: Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit - III: Sequential circuits and systems

A 1-bit memory, the circuit properties of astable latch, the clocked SR flip flop, J- K-T and D- types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit - IV: A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter ,dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Unit - V: Semiconductor memories and Programmable logic devices.

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array(FPGA).

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.
4. R.Anandh Digital Electronics – Kendra publishing house.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the working of logic families and logic gates.
2. Design and implement Combinational logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Apply PLDs to implement the given logical problem.
5. Design and implement sequential logic circuits.

Mapping with Program Outcomes															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2		2										3	2	
CO2		2			2								2		
CO3	2		3										2	2	
CO4		2			2									2	
CO5		2			2									2	

EEMISCN	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To develop a mathematical model for physical systems – translational and rotational system block diagram reduction techniques for obtaining transfer function.
- To study time response 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 and application of controllers
- To study the concept of controllability and observability and state space analysis. (Obtaining state equation for physical, phase and canonical variable)

Unit - I: Introduction to control problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit - II: Time Response Analysis

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit - III: Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit - IV: Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit - V: State variable Analysis

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems. Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Text/References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education,1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall,1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall,1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International,2009
5. Ambikapathy," control systems ", khanna book publishing co.(p) ltd, Delhi.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and state- space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.
4. Design simple feedback controllers.
5. Acquire knowledge about state variable analysis.

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3		3		2								3	2	
CO3	3	2	3	2	2								3	2	
CO4	3	3	3	2									3	2	
CO5	3	3	2	2	1								3	2	

EEMISCN	INDUSTRIAL ELECTRICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart a wide knowledge about the components of LT system wiring components and their selection.
- To provide basic concepts regarding residential and commercial wiring systems and guide lines for their installation.
- To learn about various industrial electrical system and their production schemes.
- To familiarize the student with different automation schemes of Industrial Electrical systems.
- To understand different types of illumination systems and methods involved in design.

Unit - I: Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit - II: Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, Earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit - III: Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit - IV: Industrial Electrical System and Automation

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Unit - V: Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, floodlighting.

Text Books:

1. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating &Costing", Khanna publishers,2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International,2007.

References:

1. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co.,1997.
2. Web site for IS Standards.
3. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education,2008.

Course Outcomes:

At the end of this course, students will able to

1. Familiarize with different electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
2. Understand various components of industrial electrical systems.
3. Analyze and select the proper size of various electrical system components.
4. Acquire knowledge about various industrial automation system.
5. Train and get exposed with the design of illumination system.

Mapping with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3			2		3				1	1	1	
CO2	3		2			3		2				2	3	2	
CO3	2		2			3		2				2	3	2	
CO4	2		2			2						1	3	2	
CO5	2		2			2						2	2	2	