ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. Electrical and Electronics Engineering

HAND BOOK
2021

DEPARTMENT OF ELECTRICAL ENGINEERING

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

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

Choice Based Credit System (CBCS)

REGULATIONS 2021-2022

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as 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 programme 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 programme 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)
BRANCH XI	-	Computer Science and Engineering (Artificial Intelligence and Machine Learning)
BRANCH XII	-	Computer Science and Engineering (Data Science)

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 Programme is **166 (127** 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 (127 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(147credits 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 Programme

A student is normally expected to complete the B.E. programme 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 (127 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:

8.1Slow 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 programme, is included in the curriculum. **The student has to undergo the internship during the semester vacation in the II year and III year of the programme in accordance with 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 V and VII semesters respectively**.

During the vacation in the II and III year of the programme,

The student may choose any of the following **Internship / Innovation / Entrepreneurship** related activities for a total of **4 weeks** duration in each year

(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.

12.1Professional 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.

12.2Open Elective courses

Apart from the various Professional elective courses, a student must study **four** open elective courses **three/two** of which offered by the Department concerned and **one/two** 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.

12.3MOOC (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

A student can study one or more value added courses being offered by the Departments of Study in other Faculties of our University preferably in the sixth or seventh semester of the B.E degree programme.

12.5 One Credit Courses

One credit courses 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 (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 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-I)	:	15 marks
Second assessment (Test-II)	:	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 semester vacation of III / IVyear, the student has to present a report at the start of the subsequent odd semester (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 programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

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 of I & 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 programme 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 programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' 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-evaluation of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

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

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.
CGPA is similarly calculated considering all the courses taken from the time of admission.

21. Awarding Degree

After successful completion of the programme, 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 (147credits 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.

21.2First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 166 Credits within four years (127 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.

21.3First Class

To obtain B.E Degree First Class, a student must earn a minimum of 166 credits within ***five*** years (127 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).

21.4Second Class

For Second Class, the student must earn a minimum of 166 credits within **seven** years (127 credits within **six** years for lateral entry students) from the time of admission.

21.5B.E Degree with Minor Engineering

For Minor Engineering, the student must earn a minimum of 186 credits within four years (147 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 Programmes Eligible for the B.E (Lateral Entry) Programmes offered in FEAT

(from 2021-2022)

Sl.No.	Branches of Study	Eligible Diploma Programme (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 (Full Time) 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**
Sl.No.	**Branches of Study**	**Eligible Diploma Programme (FT / PT / SW)**
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.
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
10.	**Mechanical Engineering (Manufacturing Engineering)**	i. Mechatronics Engineering ii. Machine Tool Maintenance and Repairs iii. Tool and Die making iv. Tool Engineering v. Tool Design vi. Foundry Technology vii. Refrigeration and Air Conditioning viii. Agricultural Engineering ix. Agricultural Technology x. Marine Engineering xi. Mechanical Engineering(Production) xii. Mechanical Engineering(Tool &Die) xiii. Mechanical Engineering (Foundry) xiv. Mechanical Engineering(R & A.C.) xv. Electronics(Robotics) xvi. Mining Engineering xvii. Agricultural Engineering and Farm Machinery xviii. Equipment Technology
11	**Computer Science and Engineering (Artificial Intelligence and Machine Learning)**	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
12	**Computer Science and Engineering (Data Science)**	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

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	a. Chemical Engineering b. Pharmacy c. 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 10. Computer Science and Engineering. (Artificial Intelligence and Machine Learning) 11. Computer Science and Engineering (Data Science)
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. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 6. Computer Science and Engineering (Data Science) 7. Mechanical (Manufacturing) Engg 8. Electronics and Instrumentation Engg 9. Information Technology 10. Electronics and Communication Engg.
3.	Civil and Structural Engineering		
4.	Computer Science and Engineering	1. Computer Science and Engg.	1. Civil Engineering 2. Electronics and

5.	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering(Artificial Intelligence and Machine Learning) 5. Computer Science and Engineering(Data Science)	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
6.	Computer Science and Engineering (Data Science)		
7.	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. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 8. Computer Science and Engineering (Data Science) 9. Information Technology
8.	Electronics and Communication Engg.		
9.	Electronics and Instrumentation Engg.		
10.	Information Technology	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering.(Artificial Intelligence and Machine Learning) 5. Computer Science and Engineering(Data Science)	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 6. Chemical Engineering

11.	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. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 7. Computer Science and Engineering (Data Science) 8. Electronics and Instrumentation Engg. 9. Information Technology 10. Electronics and Communication Engg.
12.	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)

Curriculum for First Year B.E(2021-22 onwards)

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION 2021-22)

SEMESTER I

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
ETBS101	BS-I	Mathematics-I	3	1	-	25	75	100	4
ETBS102	BS-II	Physics	3	1	-	25	75	100	4
ETBS103	BS-III	Chemistry	3	1	-	25	75	100	4
ETES104	ES-I	Programming for Problem Solving	2	1	-	25	75	100	3
ETSP105	ESP-I	Computer Programming Laboratory	-	-	4	40	60	100	2
ETSP106	ESP-I	Engineering Workshop/Manufacturing Practices	1	-	3	40	60	100	2.5
ETSP107	ESP-II	Electrical Wiring and Earthing Practice Laboratory	-	-	2	40	60	100	1
								Total Credits	20.5

SEMESTER II

Course Code	Category	Course	L	T	P/D	CA	FE	Total	Credits
ETHS201	HS-I	English	3	1	-	25	75	100	4
ETBS202	BS-IV	Mathematics-II	3	1	-	25	75	100	4
ETES203	ES-II	Basic Electrical and Electronics Engineering	3	-	-	25	75	100	3
ETHP204	HSP-I	Communication Skills and Language Laboratory	-	-	2	40	60	100	1
ETBP205	BSP-I	Physics Laboratory	-	-	3	40	60	100	1.5
ETBP206	BSP-II	Chemistry Laboratory	-	-	3	40	60	100	1.5
ETSP207	ESP-IV	Engineering Graphics	2	-	3	40	60	100	3.5
								Total Credits	18.5

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**	Electric Circuits	3	-	-	25	75	100	3
EEPC306	**PC-II**	Analog Electronic Circuits	3	1		25	75	100	4
EESP307	**ESP-V**	Hydraulics Lab	-	-	3	40	60	100	1.5
EECP308	**PCP-I**	Electric Circuits Lab	-	-	3	40	60	100	1.5
EECP309	**PCP-II**	Analog Electronic Circuits Lab	-	-	3	40	60	100	1.5
			Total Credits						**23.5**

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 Circuits	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
ETHS407	**HS-II**	Universal Human Values	2	1	-	25	75	100	3
EECP408	**PCP-III**	Electrical Machines Lab	-	-	3	40	60	100	1.5
EECP409	**PCP-IV**	Analog and Digital Integrated Circuits Lab	-	-	3	40	60	100	1.5
EECP410	**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**	Embedded Systems	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**	Embedded Systems 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**	Electrical Energy Conservation and Auditing	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**	Energy Conversion 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

FIRST YEAR

SYLLABUS

FIRST SEMESTER

Course code	**ETBS101**				
Category	Basic Science Course				
Course title	**Mathematics - I**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**1**	**0**	**4**	

Course Objectives:

- To familiarize definite integrals and its application in finding area and volume.
- To Introduce the fundamentals of functions of several variables.
- To make the student to learn infinite series and its nature.
- To impart knowledge about Vector calculus.
- To provide the concept of eigen values and eigen vectors of a real matrix and its properties of great utility in many branches of engineering.

Unit - I Integral Calculus

Evaluation of definite integrals and their properties-Applications of definite integrals to evaluate surface areas and volumes of revolutions.Improper integral-Beta and Gamma functions and their properties.

Unit – II Functions of several Variables

Rolle's theorem-Mean value theorem. Indeterminate forms-L'Hospital's rule, Functions of two variables: Taylor's and Maclaurin's series expansions-Maxima and minima for functions of two variables.

Unit - III Sequences and Series

Convergence of sequence and series-tests for convergence: Comparison test(only for series with positive terms)-D'Alembert's ratio test-Cauchy's root test-Integral test-Leibnitz's test(Alternating series).

Unit – IV Vector Calculus (Differentiation)

Gradient, divergence and curl- Directional derivative-unit normal vector-Irrotational and solenoidal vectors- Expansion formulae for operators involving ∇.

Unit - VMatrices

Rank of a matrix- Symmetric, skew- Symmetric and orthogonal matrices-Characteristic equation-Eigen values and Eigen vectors –Cayley-Hamilton Theorem-Diagonalization of symmetric matrices by Orthogonal transformation.

Text Books:

1. Veerarajan T., "Engineering Mathematics for First Year", Tata McGraw-Hill, New Delhi, 2008.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010.

Reference Books :

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson publishers, Reprint,2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley &Sons,2006.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi,11th Reprint, 2010.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2008.

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 solenoidal and irrotational fields.
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	-	-	-	-	-	-	-

Course code	ETBS102				
Category	Basic Science Course				
Course title	PHYSICS				
Scheme and Credits	L	T	P	Credits	
	3	1	0	4	

Course Objectives :

- To understand the ray of light to undergo the phenomenon of interference diffraction and polarization.
- To understand the principle and various application of laser.
- To develop knowledge in crystal structure and its properties.
- To understand the energy quantization of subatomic particles like electron.
- Rationalize the law of conservation of energy in solar water heater and solar cells.

Unit - I 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 and Mach-Zehnder interferometer. Fraunhofer 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 - II Lasers

Introduction – Principles of Laser – Stimulated emission, Properties of laser beams: mono-chromaticity, coherence, directionality and brightness Einstein's theory of, stimulated emission 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, laser speckles, applications of lasers in science, engineering and medicine.

Unit - III Crystal Physics

Introduction to solid Materials – Crystal structure – Geometry of lattice unit cell – Bravais' lattice – crystal systems, Crystal structures of Materials –(Cordination number, Atomic radius, packing factor and packing density) – Types of crystal Lattice (Simple Cubic, Body Centered Cubic, Face Centered Cubic and Hexagonal Closed Packed) Miller Indices and their calculations - Finding Miller indices of crystal planes.

Unit - IV Quantum Mechanics

Heisenberg uncertainity Principle –CDual nature of Matter and radiation – De Broglie's Wave length – Wave Velocity and group velocity. The wave Equation, Schrödinger's time dependent and independent wave equations - The Wave function and its physical significance - The particle

in a box Problem (one dimensional box) - Energy quantization – Eigen values and Eigen functions.

Unit - V Energy Physics

Introduction to energy sources - Energy sources and their availability (Conventional and Non-conventional energy sources) solar energy – Methods of Harvesting solar energy – Solar heat collector, solar water heater and solar cells. Wind energy – Basic principle and components of wind energy Conversion system (WECS) – Application of wind energy. Biomass - Biogas Generation - Classification of Biogas plants –Properties and application of Biogas.

Text Books :

1. Arumugam.M. "Engineering Physics", Anuradha agencies, 2nd Edition, 1997.
2. John Twidell& Tony Weir, " Renewable Energy Resources" , Taylor & Francis, 2005.
3. Avadhanulu. M.N. and Kshirsagar P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005.
4. Gaur R.K. and Gupta S.L., "Engineering Physics", DhanpatRai Publishers, New Delhi, 2003.
5. Rai.G.D. , *"Solar Energy* Utilization" Volume-1 & 2 by - Khanna Publishers, New Delhi.
6. Pajput. R. K. Non – Conventional energy sources and Utilization - S . Chand Publication – 2013.

Reference Books :

1. Rajendran.V , "Engineering Physics", Tata McGraw Hill publishers, 2009.
2. Rai G.D., "Non-conventional Energy sources", Khauna Publications, 1993.
3. Mani. P. "Engineering Physics", Dhanam Publication, Chennai, 2011.
4. Agarwal.M.P, "Solar Energy", S.Chand& Co., I Edn, New Delhi, 1983.

Course Outcomes :

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

1. Gain knowledge on the construction of different types of interferometer.
2. Description on different types of laser and its application.
3. Analyze the importance of packing factor in different crystal system.
4. Evaluate the quantum mechanical concept of wave velocity and group velocity.
5. Compared the different energy resource and their availability.

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

Course Code	ETBS103				
Category	Basic Science Course				
Course title	Chemistry				
Scheme and Credits	L	T	P	Credits	
	3	1	0	4	

Course Objectives:

- To understand water treatment techniques and basic knowledge on surface chemistry.
- To provide knowledge on electrochemical cells and chemistry involved in corrosion.
- To learn various processes involved in fuel refining and mechanism involved in energy storage devices.
- To develop knowledge about synthesis of various types of polymers and nano materials.
- To get basic knowledge on refractories, lubricants and spectroscopical techniques.

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, porosity) 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.

Text Books :

1. Jain, P.C. and Monica Jain (2010) "Engineering Chemistry" DhanpatRai& Sons, New Delhi.
2. Dara, S.S. and Umare, S.S. (2014) "Text Book of Engineering Chemistry" S. Chand & Co. Ltd., New Delhi.
3. Gopalan, R., Venkappaya, D. and Nagarajan, S. (2008) "Engineering Chemistry" Tata McGraw 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 about adsorption analysis.
2. Describe the concept of electrochemistry and its applications; corrosion and its controlling methods.
3. Understand the properties of fuels and applications of energy storage devices.
4. Synthesis various polymers and understand about nanomaterials.
5. Gain knowledge on refractories, lubricants and understand the concepts of certain spectroscopical techniques

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

Course code	ETES104				
Category	Engineering Science Course				
Course title	**Programming for Problem Solving**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	2	1	0	**3**	

Course Objectives:

- To understand the fundamentals of C programming
- To provide students with understanding of code organization and functional hierarchical decomposition using complex data types.
- To understand how to break a large problem into smaller parts, writing each part as a module or function
- To effectively utilize structures and pointers in problem solving
- To enable students to take up Systems programming or Advanced C programming course.

Unit –I Fundamentals of Programming

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 Expressions and Control Structures

Arithmetic Expressions and Precedence, Conditional Branching and Loops, Writing and evaluation of Conditionals and consequent Branching, Iteration and Loops.

Unit – III Arrays

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 Functions

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 Files and Structures

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

Text Books :

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

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 Programme 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	-	-	-	-	-	-	-	-	-

Course code	ETSP105				
Category	Engineering Science Course				
Course title	Computer Programming Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	4	2	

Course Objectives:

- To enable students to code, compile and test C programs.
- To enable students to design algorithms using appropriate programming constructs for problem solving.
- Identify tasks in which the numerical techniques learned are applicable and apply them to write programs.
- To enable students to segregate large problems into functions using modular programming concepts.
- To enable students to apply pointer and structures in programs effectively.

[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

Course 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 Programme 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	-	-	-	-	-	-	-

Course code	ETSP106				
Category	Engineering Science Courses				
Course title	Engineering Workshop / Manufacturing Practices				
Scheme and Credits	L	T	P	Credits	
	1	0	3	2.5	

Course Objectives:

Objectives of this course are that, the students gain knowledge of the different manufacturing processes which are commonly employed in the industry, so as to select the suitable manufacturing process for the fabrication of various components using different materials.

(i) Lectures & Videos:

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

Text/Reference Books:

1. HajraChoudhury S.K., HajraChoudhury A.K. and NirjharRoy S.K., "Elements of WorkshopTechnology",Vol.I2008andVol.II2010,Mediapromotersandpublishers private limited,Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",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", 4thedition, Prentice Hall India, 1998.
5. RaoP.N.,"Manufacturing Technology",Vol.I and Vol.II, Tata McGraw Hill House, 2017.

(ii) Workshop Practice:

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

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

Course Outcomes:

At the end of the 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 manufacturingprocesses.

Mapping of Course Outcomes with Programme 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

Course code	ETSP107				
Category	Engineering Science Courses				
Course title	Electrical Wiring and Earthing Practice Laboratory				
Scheme and Credits	L	T	P	Credits	
	-	-	2	1	

Course Objectives:

- To create an awareness on the electrical safety in industrial and commercial environment.
- To enable the understanding on the principles of different types of electrical wiring.
- To offer exposure on the need for earthing and earthing practices.
- To provide practical knowledge on the various types of lighting circuits.
- To introduce methods for measuring the variables in electric circuits.

List of experiments:

1. a) Study of Basics of Safety Precautions
   b) Study of Wiring Materials

2. a) Study of types of Wiring
   b) Fan and Fluorescent Lamp Connections

3. Residential Wiring
4. Stair case Wiring
5. Industrial Wiring
6. Series and Parallel Lamp Circuits
7. Measurement of Earth Resistance
8. Measurement of Frequency and Phase of AC Circuits

Course Outcomes:

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

1. Familiarize with the electrical safety measures.
2. Identify the different types of electrical wiring.
3. Know the necessity of Earthing.
4. Gain knowledge on the different types of lighting circuits.
5. Understand the methods for measuring electrical variables.

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

SECOND SEMESTER

Course code	ETHS201				
Category	Humanities and Social Sciences including Management courses				
Course title	English				
Scheme and Credits	L	T	P	Credits	
	3	1	0	4	

Course Objectives:

- **To ensure the students with good vocabulary**
- **To make the students participate actively in writing activities**
- **To practice the unique qualities of professional writing style**
- **To develop the students the proficiency in communicative skills**
- **To ensure the students to face the demand of their profession**

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, Count and uncount nouns.

1.4 Synonyms, antonyms, and standard abbreviations.

1.5 Language development - Wh questions asking and answering yes or no questions

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 and Techniques for writing precisely

2.5 Organizing principles of paragraphs in writing

Unit – III Nature and Style of sensible Writing

3.1 Describing and Defining

3.2 Classifying and Providing examples or evidence

3.3 Writing introduction and conclusion

3.4 Comprehension

3.5 Precis Writing

Unit – IV Writing Practices & Oral Communication

4.1 Listening to lectures and making notes

4.2 Mechanics of presentation, asking and giving instruction

4.3 Essay Writing – Writing analytical essays and issue based essays.

4.4 Dialogue writing and conversation

4.5 Letter writing – Formal and informal

Unit – V Group Discussion and Job Application

5.1 Characteristics and practices of group discussion

5.2 Job application

5.3 Resume preparation

5.4 Writing reports – minutes of a meeting, accident, survey

5.5 E-mail – etiquette

Text /Reference Books:

1. Michael Swan,"Practical English Usage", OUP, 1995.
2. F.T. Wood,,"Remedial English Grammar",Macmillan,2007.
3. William Zinsser,"On Writing Well", Harper Resource Book, 2001,
4. Liz Hamp-Lyons and Ben Heasly,"Study Writing", Cambridge University Press, 2006.
5. Sanjay Kumar and PushpLata, "Communication Skills" Oxford University Press, 2011.
6. "Exercises in Spoken English. Parts. I-III", CIEFL, Hyderabad,. Oxford University Press.
7. Raman, Meenakshi and Shama, Sangeetha – "Technical Communication Principles and Practice", Oxford University Press, New Delhi,2014.

Course Outcomes :

At the end of this course, students will able to

1. Comprehension, writing and speaking skills.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 Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	2	-	2	-	-	-	-	-	3	-	3
CO2	-	2	-	2	-	-	-	-	-	3	-	3
CO3	-	-	3	-	-	-	-	-	-	3	-	3
CO4	-	-	2	3	-	-	-	-	-	3	-	3
CO5	-	-	3	2	-	-	-	-	-	3	-	3

Course code	ETBS202			
Category	Basic Science Course			
Course title	Mathematics - II			
Scheme and Credits	L	T	P	Credits
	3	1	0	4

Course Objectives:

- To familiarize multiple integrals and its application in finding area and volume.
- To make the student to learn line, surface and volume integrals.
- To solve Second order linear differential equations with constant coefficients.
- To acquaint the student with the techniques in the theory of analytic functions.
- To Introduce the fundamentals of complex integrations.

Unit-I Multivariable Calculus (Integration)

Double integrals (Cartesian) - change of order of integration in double integrals - Change ofvariables(Cartesiantopolar) - Applications: Area as a double integral.Triple integrals (Cartesian) - Applications: Volume as a triple integral.

Unit – II Vector Calculus (Integration)

Line, Surface and Volume integrals - Gauss divergence theorem (without proof) - Green's theorem in the plane (without proof) – Stokes theorem (without proof).Verification of the above theorems and evaluation of integrals using them.

Unit – III Ordinary differential equations

First order ordinary differential equations (Linear and Bernoulli's differential equations, exact differential equations). Solution of Second order ordinary linear differential equations with constant co-efficient (method of variation of parameters only).Solution of Second order ordinary linear differential equations with variable co-efficient (Euler and Legendre's linear equations).

Unit – IV Complex Variable (Differentiation)

Analytic functions and their properties-Cauchy-Riemann equations- Harmonic functions – harmonicconjugate ofelementaryanalyticfunctions– Construction of an analytic function.Mobius transformations.

Unit – V Complex Variable (Integration)

Cauchy theorem(withoutproof) –CauchyIntegralformula(without proof) – CauchyIntegralformula for higher derivatives (without proof) – zeros and poles of an analytic functions – singularities.Residues - Cauchy Residuetheorem (without proof) –Evaluationofdefiniteintegral using them.Taylor'sseries and Laurent's series.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition,2010.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley &Sons, 2006.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint,2002.
2. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn., Wiley India, 2009.
3. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India,1984.
4. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., Mc-Graw Hill, 2004.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

Course Outcomes:

At the end of this course, students will able to

1. Solve double and triple integrals in finding area and volumes.
2. Apply line, surface and volume integrals in Gauss, Greens and Stoke'stheorems.
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 Programme 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	-	-	-	-	-	-	-	-

Course Code	**ETES203**				
Category	Engineering Science Course				
Course Title	**Basic Electrical and Electronics Engineering**				
Scheme and Credits	L	T	P	Credits	
	3	**0**	**0**	**3**	

Course Objectives :

- To understand the basic laws and AC systems.
- To learn the need for earthing and protection.
- To understand the working of transformers and DC Machines.
- To know the operation and principles of AC machines.
- To learn the basic electronic and power electronic devices and their applications.

Unit-I Basic Circuits

Definition of current and voltage - Electrical circuit elements (R, L and C)- Ohm's Law- Kirchhoff's laws – solution for currents and voltages. AC circuits – RMS-Average values- sinusoidal steady state response of simple RLC circuits. Introduction to 3 phase systems - Advantages.

Unit-II DC Machines and Transformers

Laws of Electromagnetism–Construction of DC Machines– DC Generator- EMF Equation – Characteristics - DC Motor- Principle of operation–Types– Characteristics - Speed control of D.C shunt motors.

Single-phase Transformer: Construction and Working principle- EMF equation- regulation and efficiency- Three-phase transformer: Construction and Connections.

Unit-III Induction Motors and Alternators

Construction, Working principle of Three-phase induction motor - Single-phase induction motor - Types and Applications. Alternators - Types - Construction- Working principle - EMF equation

Unit-IV Basic Electronics

P-N junction - VI Characteristics of PN junction diode, Zener diode - Rectifier circuits- Voltage Regulator using Zener diode - Working principle and characteristics - BJT, SCR, JFET and IGBT

Unit-V Fundamentals of Communication Engineering

Introduction – Elements of Communication Systems– Principles of Amplitude and Frequency Modulations. Digital Communication - Communication Systems: Radio, Antenna, TV, Fax, ISDN, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TextBooks :

1. V.K. Mehta, Rohit Mehta, “Basic Electrical Engineering”, S.Chand Publications, 2012.
2. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, 2014.
3. C. L. Wadhwa, "Basic Electrical Engineering", New Age International Publications, Fourth Edition, 2007
4. Bimbhra, P.S., “Power Electronics”, Khanna Publishers, 2014.

Reference Books :

1. Thomas L. Floyd, “Electronic Devices”, 10th Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, “Electronic Principles”, McGraw Hill Education; 7th edition, 2017
3. Muhammad H.Rashid, “Spice for Circuits and electronics”, 4th ed., Cengage India,2019.
4. Del Toro, “Electrical Engineering Fundamentals”, Second edition, Pearson Education, New Delhi, 1989.
5. John Bird, “Electrical Circuit theory and technology”, Routledge, 5th edition, 2013.

Course Outcomes:

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

- Understand the concepts related with electrical circuits and AC fundamentals.
- Acquire knowledge on the concepts of DC machines and Transformers.
- Familiarize with the operating principle of AC machines.
- Enhance the knowledge about the basic electronic devices and their applications.
- Gain insight on the various elements of Communication systems.

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

Course code	ETHP204				
Category	Humanities and Social Sciences including Management courses				
Course title	Communication Skills and Language Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	

Course Objectives:

- To facilitate computer assisted multimedia instruction enabling individualized and independent language learning.
- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
- To bring about a consistent accent and intelligibility in students pronunciation of English by providing an opportunity for practice in speaking.
- To improve the fluency of students in spoken English .
- To train students to use Language appropriately for public speaking, group discussion and interviews.

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 communicativeEnglish

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. AutoSpeak

Text Books :

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

Course Outcomes:

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

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 Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	3	-	-	-	-	-	-	-	3	-	3
CO2	-	3	-	-	-	-	-	-	-	3	-	3
CO3	-	-	2	-	-	-	-	-	-	3	-	3
CO4	-	2	-	-	-	-	-	-	-	3	-	3
CO5	-	-	3	-	-	-	-	-	-	3	-	3

Course code	ETBP205				
Category	Basic Science Course				
Course title	Physics Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	3	1.5	

Course Objectives:

- To access the Rigidity modulus of wire.
- To assess the various properties of light.
- To asses the characterization of Metals.
- To analyses the thickness of microsized objects.

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 the 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	-	-

Course code	ETBP206				
Category	Basic Science Course				
Course title	Chemistry Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	3	1.5	

Course Objectives:

- To list the water quality standards.
- To assess the composition of an alloy.
- To appreciate the practical significance of acidimetry, alkalimetry, permananganometry, conductometry and potentiometry.
- To analyse quantitatively the amount of a substance present in a given sample.

List of Experiments:

1. Determination of surface tension andviscosity
2. Thin layerchromatography
3. Ion exchange column for removal of hardness ofwater
4. Determination of chloride content ofwater
5. Determination of the rate constant of areaction
6. Determination of cell constant and conductance ofsolutions
7. Potentiometry - determination of redox potentials andemfs
8. Saponification/acid value of anoil
9. Determination of the partition coefficient of a substance between two immiscible liquids
10. Adsorption of acetic acid bycharcoal
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 Pharmacheutical 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	-	-	-	-	-	-	-	-	-	-

Course code	ETSP207				
Category	Engineering Science Courses				
Course title	Engineering Graphics and Drafting				
Scheme and Credits	L	T	P	Credits	
	2	0	3	3.5	

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Reading a Drawing; Sectional Views; Dimensioning, True Length, Angle.

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 Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM)

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

CourseObjectives :

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

Unit- I Introduction to Engineering Drawing,

Introduction to Engineering Drawing: Lettering, Dimensioning and use of drawing instruments. Conic sections: Eccentricity method of/for drawing ellipse, parabola and hyperbola- Tangent and Normal from a point on the curve.

Unit- II Orthographic Projections,

Orthographic projections: Introduction – Projections of points Projections of Straight lines: Determination of true length and true angle of inclinations using half cone and trapezoidal methods – drawing the projections of straight lines using half cone method from true length and true angle of inclinations.

Unit -III Projections of Regular Solids,

Projections of solids in simple position: Projections of cube, Tetrahedron, prisms, Pyramids, cone and cylinder.

Projections of solids: Auxiliary projections – projections of prisms, pyramids, cylinder and cone when the axis is inclined to only one plane.

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

Sections of solids: Sections of prisms, pyramids, cylinder and cones – true shape of section.

Developments of solids: Developments of lateral surfaces of solids using parallel and radial line methods.

Unit -V Isometric Projections

Isometric projections: Projections of simple solids. Conversion of pictorial view of simple objects into orthographic projections (only elevation and plan)

Overview of Computer Graphics Covering

Introduction to CAD software: 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 Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

Customization& CAD Drawing

Consisting of setup of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines and other basic geometric entities.

Annotations, layering & other functions

applying dimensions to objects and annotations to drawings; Setting up and use of Layers, 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;

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 UserManuals.

Course Outcomes :

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

1. Utilize drawing instruments effectively and able to present engineering drawings and sketches.
2. Describe the concept of orthographic, isometric projections of points, lines and regular solids.
3. Visualize the images and drawings in engineering perspective.
4. Practice sectioning of bodies like machines and equipment's.
5. Develop their technical communication skills and promote life-long learning.

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

SECOND YEAR

THIRD SEMESTER

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

Course Objective

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

Unit I: Partial Differential Equations

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

Unit II: Fourier Series

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

Unit III: Boundary Value Problems

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

Unit IV: Fourier Transform

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

Unit V: Z – Transform and Difference Equations

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

Text Books

1. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., Engineering Mathematics,6th ed., (Vol-I & II) S. Chand& Co Ltd. 2006, New Delhi.

2. Ventakataraman, M.K., 2003. Engineering Mathematics-The National Publishing Co., Chennai.

References

1. Veerarajan, T., Engineering Mathematics, 3rd edition, 2005, Tata McGraw Hill Pub.

2. Singaravelu, A., Engineering Mathematics, Meenakshi Publications, Chennai, 2004.

Course Outcomes

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

1. Acquire basic understanding of the most common partial differential equations.
2. Understand Fourier series,
3. Ability to solve some boundary value problems.
4. Fourier transform and Z-transform analysis.
5. To know about the transform and Differential equation.

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 Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health - Case Studies.

Field Work

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

Text Books

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

References

1. Brunner, R.C., 1989. Hazardous Waste Incineration, McGraw Hill Inc. 480p.
2. Clark, R.S., Marine Pollution, Clanderson Press Oxford (TB).
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., 2001. Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p.
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Down to Earth, Centre for Science and Environment (R).
6. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p.

7. Hawkins, R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
8. Heywood, V.H. & Waston, R.T., 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
9. Jadhav, H. & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
10. Mckinney, M.L. & School, R.M., 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
11. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB).
12. Miller, T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB).
13. Odum, E.P., 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
14. Rao M N. &Datta, A.K., 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
15. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut.
16. Survey of the Environment, The Hindu (M).
17. Townsend, C., Harper J., and Michael Begon, Essentials of Ecology, Blackwell Science (TB).
18. Trivedi, R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R).
19. Trivedi, R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB).
20. Wanger, K.D., 1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

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.
3.

References

1. Natesan, S.C., (2002). Engineering Mechanics (Statics and Dynamics), First Edition, Umesh Publications, New Delhi.
2. S.S.Bhavikattiand K.G. Rajasekarappa,(1999).Engineering Mechanics, New Agent International (P) Ltd.
3. Sadhu Sing, (2000).*Engineering Mechanics,* Oxford & IBH Publishing Co., New Delhi.
4. Irving H. Shames, (2006).*Engineering Mechanics,* prentice Hall of India Ltd., New Delhi.
5. Hibbeller, R.C. and Ashok Gupta, (2010).*Engineering Mechanics: Statics and Dynamics,* Edition, Pearson Education.
6.

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. To 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 - Cavitation's'.

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	ELECTRIC CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives

- To study of different types of network and network elements, super mesh and super node analysis, graph of a network
- To understand the concepts of different network theorems and duality
- To introduce the analysis of single and three phase AC circuits.
- To analyze the magnetic circuits and the transient response of circuits.
- To impart knowledge on Two Port Network for the calculation of impedance parameters

Unit I: DC Circuits

Review of ideal and practical sources - linear relation between voltage and current of network elements - types of networks - active, passive, linear, nonlinear, unilateral, bilateral, lumped and distributed – Super mesh and node analysis of electrical circuits. Introduction to the graph of a network - oriented graph - tree - link - tie set and cut set schedule.

Unit Ii: Network Theorems

Network theorems and transformations - Star-delta transformation -Superposition theorem - Thevenin's theorem - Norton's theorem - Millman's theorem - Tellegen's theorem - Reciprocity theorem - Substitution theorem - Maximum power transfer theorem- Concept of duality and dual networks.

Unit Iii: Sinusoidal Steady State Analysis

AC circuit analysis- average power and complex power- Application of basic theorems in the analysis of ac circuits - Resonance in series and parallel circuits - Q factor- bandwidth of resonant circuits - Three phase circuits: three phase sources - Analysis of three phase 3 wire and 4 wire circuits with balanced and unbalanced loads - power relations.

Unit Iv: Magnetic Circuits and Time Domain Analysis

Magnetic circuit concepts and laws - Series and Parallel circuits - Statically and dynamically induced emf - coupled circuits - self and mutual inductances - coefficient of coupling - Dot Convention in coupled circuits- analysis of magnetically coupled circuits - single and double tuned coupled circuits.

Time domain analysis: step, ramp, sinusoidal and impulse functions - review of Laplace transform - solution of circuit problems using Laplace transform - transient response of R,L,C circuits with different types of forcing functions - complex frequency concept - poles and zeros.

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 Book:

1. 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
6. S. Salivahanan and S. Pravin Kumar, Circuit Theory, Vikas Publishing, 2014.

Course Outcomes:

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

1. Understand the basics requirements of electric circuits.
2. Apply network theorems for the analysis of electrical circuits
3. Obtain the transient and steady-state response of electrical circuits.
4. Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
5. Acquire an insight of two port networks and network parameters.

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 ELECTRONIC CIRCUITS	L	T	P	C
		3	1	0	4

Course Objectives

- To provide sound knowledge of the fundamentals of electronic circuits
- To analyse the BJT circuits and its characteristics
- Introduction to MOSFET and small signal models
- To understand the concepts of feedback amplifier and
- To study the op-amp circuits and its applications

Unit I: PN Junction Devices And Its Applications

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

Unit II: BJT Circuits

Structure, operation 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 circuit- Difference Amplifier-Class A,B,C and Push-Pull Amplifier- Transformer coupled amplifier-Tuned amplifiers-Single tuned, double tuned and stagger tuned amplifiers - high-frequency equivalent circuit.

Unit III: MOSFET Circuits

MOSFET structure, operationand 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, transconductance, high frequency equivalent circuit.

Unit IV: Feedback Amplifiers and Oscillators

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

Unit V: Operational Amplifiers

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

Text Books:

1. Jacob Milman, Christos. C. Halkias and Satyabratajit, "Electronic Devices and Circuits" TataMcGraw Hill Education Pvt. Ltd., Third Edition (Special Indian Edition), 2010.

2. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.

3. J. V. Wait, L. P. HuelsmanandG. A. Korn, "Introduction to Operational Amplifier theory and Applications", McGraw Hill U. S., 1992.

References:

1. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education,1988.

2. S. Salivahanan and N. Suresh Kumar, "Electronic Devices and Circuits" Tata McGraw Hill Education, Third Edition, 2012.

Course Outcomes:

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

1. Provide exposure to basic electronic devices.
2. Understand the characteristics of transistors.
3. Acquire knowledge about MOSFET.
4. Design and analyze feedback amplifier and oscillator circuits.
5. Able to design OP-AMP based circuits.

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 LAB	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	2	1
CO2	1	2				2							1	1	2
CO3	1	2				2							1	1	2
CO4	1	1				1								1	1
CO5	1	1				1							1	1	1

EECP308	Electric 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. Study of Series and Parallel RL circuits.
6. Study of Series and Parallel RC circuits.
7. Study of Series and Parallel RLC circuits.
8. Wave shaping circuits
9. Series resonance circuits
10. 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	Electronic Circuits Simulation 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 Transistors.
5. Zero crossing detector and Scmitt trigger using OP-AMP
6. R.C Phase shift oscillator using OP-AMP
7. Voltage to Current Convertor and Current to voltage convertor
8. Instrumentation amplifier
9. MATLAB/MULTSM Simulation of High pass Filter
10. MATLAB/MULTSM Simulation of Wave shaping circuits

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	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		

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	2			2								2		
CO2		2			2								2		
CO3		2			2									2	
CO4	3												2		
CO5	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 basic data structures such as arrays, linked lists, stacks and queues.
2. Apply algorithm for solving problems like sorting, searching, insertion and deletion of data.
3. Able to use object-oriented programming language like C++ and associated libraries to develop object-oriented programs.
4. Describe the procedural and object-oriented paradigm with concepts of streams, classes, functions, data and objects.
5. Able to get knowledge about C++ programming.

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

Review of laws of electromagnetism–construction of DC Machines – DC Generator - EMF Equation – Methods of excitation – Types – Armature reaction – Commutation – Characteristics - DC Motor – 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 and principle of operation– EMF equation – phasor diagram - Equivalent circuit –Open circuit and Short circuit tests –Regulation, Losses and Efficiency – All day Efficiency-Parallel operation - Sumpner's test – separation of core losses – Three phase transformer connections- Scott connection- Tap changing Transformers - auto transformer

Unit–III: Three Phase Induction Motors

Constructional features - cage and slip ring rotors - principle of operation –concept of slip- phasor diagram- torque equation – starting and running torques- condition for maximum torque- torque - slip characteristic- equivalent circuit - No-load and blocked-rotor tests - circle diagram - starting methods – Cogging and crawling- Speed control- Double cage induction motor

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-pre-determination of equivalent circuit parameters -Applications

Unit–V: Synchronous Machines

Constructional features of round rotor type and salient pole type machines-EMF equation- phasor diagram- voltage regulation - synchronous impedance, ampere turn and Potier methods-Parallel operation- Principle of operation of synchronous motor - phasor diagram- power developed- V curves and inverted V curves-hunting and its suppression-starting methods.

Text Books:

1. Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill Publishing Company Ltd, Fourth Edition, Fifth Reprint 2012.
2. Rajput, R.K., Electrical Machines, Lakshmi Publications, New Delhi, First Edition 1992.

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.
4. A K Theraja &B L Theraja, A Textbook of Electrical Technology, Vol.2, S. ChandPublishing, 2014.

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.

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 CIRCUITS	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.
- 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 design the different types of counters
- To explain the working and the characteristics of Logic families.
- To study about operation of A/D and D/A converters.
- To study the classification of semiconductor memories and programmable logic devices.

Unit - I: Boolean Algebra

Signed binary numbers - Binary arithmetic in computers - BCD arithmetic - one's and two's complements arithmetic data representation - Fixed and floating point representation - Exponent representation of floating point binary numbers - Weighted and Non weighted binary codes - Alphanumeric codes - Error detection and correction codes - Laws of Boolean algebra - Boolean expressions and logic diagrams - Negative logic - Introduction to mixed logic.

Unit - II: Combinational Logic Circuits

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

Unit - III: Sequential LogicCircuits

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

Unit - IV: Digital Integrated Circuits

Characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic - Multiplexer - Demultiplexer- Decoder - Code converter - Arithmetic functions -Digital to analog converters- weighted resistor/converter, R-2R Ladder D/A converter- Analog to digital converters-Successive approximation A/D converter, dual slope A/D converter.

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), Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Basics of VLSI-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 Applic ations" Seventh Edition, 2010
4. ZviKohavi and Niraj K. Jha, "Switching and Finite Automata Theory" Third Edition, 2011.
5. B. Holdsworth and Woods, "Digital Logic Design", Fourth Edition, 2002.
6. William Gothmann, "Digital Electronics: An Introduction to Theory and Practice" Prentice-Hall, 1982.

Course Outcomes:

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

1. Acquire knowledge in the basic concepts of digital systems and solve the problems related to number systems and Boolean algebra.
2. Develop the ability to identify, analyze and design combinational circuits.
3. Gain knowledge in design of sequential circuits.
4. Understand the significance of various logic families and logic packages.
5. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
6. Be able to use PLDs to implement the given logical problem.

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, Dhanapat Rai 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 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.
- To get knowledge of electromagnetic waves and Poynting vector

Unit - I: Introduction

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

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

Unit - III: Static Magnetic Field

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

Unit - IV: Electro Dynamic Fields

Faraday's laws 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, Relationship between Field Theory and Circuit Theory- Derivation of Wave Equation, Uniform Plane Waves.

Unit - V: Electro Magnetic Fields

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

Text Books:

1. 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. D. Sathaiah and M. Anitha, "Electromagnetic Fields", Scitech Publications, 2nd Edition 2007.
4. U.A. Bakshi and A.V. Bakshi, "Electromagnetic Fields", Technical Publications, Pune 2010.
5. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication,1980.
6. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
7. Electromagnetic waves, Shevgaonkar, McGraw Hill.

Course Outcomes:

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

1. To understand the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyze time varying electric and magnetic fields.
4. To understand Maxwell's equations in different forms and different media.
5. To understand the propagation of EM waves.

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		

ETHS407	UNIVERSAL HUMAN VALUES	L	T	P	C
		2	1	0	3

Course Objectives:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature / existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature / existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT-I Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1.1 Purpose and motivation for the course, recapitulation from Universal Human Values-I

1.2 Self-Exploration–what is it? - Its content and process;
Natural Acceptance and Experiential Validation- as the process for self-exploration.

1.3 Continuous Happiness and Prosperity- A look at basic Human Aspirations.

1.4 Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority.

1.5 Understanding happiness and Prosperity correctly-A critical appraisal of the current scenario.

1.6 Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence)rather than as arbitrariness in choice based on liking-disliking

UNIT-II Understanding Harmony in the Human Being - Harmony in Myself!

2.1 Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’.

2.2 Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility.

2.3 Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).

2.4 Understanding the characteristics and activities of ‘I’ and harmony in ‘ I’.

2.5 Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

2.6 Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease

UNIT-III Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

3.1 Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.

3.2 Understanding the meaning of Trust; Difference between intention and competence.

3.3 Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

3.4 Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.

3.5 Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life example,teacher-studentrelationship,goalofeducationetc.Gratitudeasauniversalvaluein relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT-IV Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

4.1 Understanding the harmony in the Nature.

4.2 Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self- regulation in nature.

4.3 Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4.4 Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-V Implications of the above Holistic Understanding of Harmony on Professional Ethics

5.1 Natural acceptance of human values.

5.2 Definitiveness of Ethical Human Conduct.

5.3 Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

5.4 Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

5.5 Case studies of typical holistic technologies, management models and production systems.

5.6 Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.

5.7 Sum up. include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

Text / References:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks, New Delhi,2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi,2004.
4. The Story of Stuff(Book).
5. TheStoryofMyExperiments withTruth- byMohandas KaramchandGandhi
6. Small is Beautiful - E. FSchumacher.
7. Slow is Beautiful - CecileAndrews
8. Economy of Permanence - JCKumarappa
9. Bharat Mein Angreji Raj -PanditSunderlal
10. Rediscovering India - byDharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K.Gandhi
12. India Wins Freedom - Maulana Abdul KalamAzad
13. Vivekananda - Romain Rolland(English)
14. Gandhi - Romain Rolland(English)

Course outcomes:

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

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature);
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. They would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

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

EECP408	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 regulator of alternator by various methods.

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 motor and generator
8. Circle Diagram of 3 phase cage 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
11. V and inverted V curves of synchronous motor
12. Synchronization and parallel operation of two 3 phase alternators

Course Outcomes:

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

1. Understand the construction, working principles and operations of DC machines, 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	

EECP409	ANALOG AND DIGITAL INTEGRATED CIRCUITS 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.
- To realize the applications of op-amp

List of Experiments:

1. Karnaugh Map reduction
2. Parity generator and checker circuits
3. Multiplexer and De-multiplexer
4. a. Design of Half adder and full adder circuits

   b. Full adder circuit using Multiplexer
5. Decimal to BCD converter.
6. BCD to seven segment display.
7. Design of Modulo UP and DOWN Counters
8. Design of Analog to Digital Converter
9. Design of Digital to Analog Converter
10. Design of Non-Sequential Counter
11. Op-amp based RC Phase Shift and Wein Bridge Oscillator
12. Design of Active Filter using Op-amp

Course Outcomes:

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

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. Obtain the design capability of digital circuits
5. Able to design various counters
6. Gain knowledge in the applications of op-amp.

Mapping with Program Outcomes															
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	2			2									2	
CO 2	3	2			2								2		
CO 3		2			2								2		
CO 4			2											2	
CO 5	2		2											2	

EECP410	ELECTRICAL MEASUREMENTS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To Design understand the principle of DC and AC bridges.
- To illustrate the calibration of various instruments.
- To learn about various measurement methods and fault detection.

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 of a short transmission line
10. Measurement of Inductance using three ammeter, three voltmeter method
11. Reactive power measurement.
12. Measurement of Earth resistance and study of cable faults.

Course Outcomes:

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

1. Develop skills to find error in any meters.
2. Acquire knowledge in the detection of faults.
3. Concept of the bridge balancing method to determine R,L and C.
4. Understanding the principle of calibration.
5. Able to identify the location of cable faults

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		

THIRD YEAR

FIFTH SEMESTER

EEPC501	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 8051 Microcontroller and programming
- 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 – Microcontroller – Embedded hardware devices – Memory devices – memory management methods – clock oscillator – watch dog timer — Brownout and Reset – Real Time Clock– in circuit emulator – target hardware- debugging- embedded processors.

Unit - II: 8051 Architecture

Internal Block Diagram , CPU, ALU, addressing modes, data and control bus, working registers, synchronous and asynchronous communication, SFRs, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles, instruction set , Assembly language programming.

Unit–III: PIC Microcontroller and Interfacing

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

I/O ports, I/O bit manipulation programming, timers / counters, Programming to generate delay and waveform generation, Interrupts- Data Conversion- A/D converter, SPI - I2C bus-UART Memories,LED, LCD, stepper motor interfacing, D.C motor interfacing, sensor interfacing,

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 / 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. Explorethe 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, 2010.

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

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	

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**	**PSO3**
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	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. Hossam A Gabbar, Energy Conservation in Infrastructure Systems, Wiley-IEEE Press, New Jersey, 2018
3. Success stories of Energy Conservation by BEE, New Delhi(www.bee-india.org)
4. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
5. 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 onthe current 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

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	ENERGY CONVERSION LAB	L	T	P	C
		3	0	0	1.5

Course Objectives:

- To have hands on experience on various system studies and different techniques adapted for Energy conversion
- Expertise in solar and wind energy conversion

LIST OF EXPERIMENTS:

1. a. Design a equivalent circuit parameter of a solar cell.
   b. VI – characteristics of a solar cell.
2. Determination of MPPT of a solar energy conversion system
3. Characteristics of the solar array using simulator.
4. Performance evaluation of a DC Transmission line fed from a solar energy source.
5. Determination MPPT of wind energy conversion system.
6. Cost estimation of a solar PV energy conversion system.
7. Cost estimation of wind turbine.
8. Characteristics of wind energy conversion systems using MATLAB simulation.

Course Outcome

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

1. Familiarize with the concepts behind energy conversion.
2. Understanding of solar cells
3. Perform MPPT for solar and wind energy conversion systems
4. Good knowledge in determining of cost estimation for solar and wind energy conversion systems.

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	

FOURTH YEAR

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 ApproachtoRisk–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, 4th Edition,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. Steven J. Marrano, C.E.M Craig Dilouie, "Electrical System Design & Specification Handbook for Industrial Facilities", The Fairmont Press, Prentice-Hall International (UK) Limited, London, 1998.
2. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna Publishers, 2008.
3. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
4. M. V. Deshpande, Electrical Power System Design, TMH Publication, New York, 2001

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:

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	3
CO3	3		3		2					3				3	3
CO4	3		3		2					3				3	3
CO5					3									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 2020
6. Anupam Singh, "Electric Vehicles: And the end of ICE Age", Adhyyan Books, New Delhi 2020.

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 beable 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, 2020.
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 differen t 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 RK methods

Text Books:

1. Murty. PSR., "Power System Operation and Control", CRC Press, Boca Raton, 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 International Publishing, New Delhi, 2010.
2. Elgerd, O.I., "Electric Energy Systems Theory - An Introduction", TMH, New York, 2006.
3. Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, "Power Generation, Operation, and Control, 3rd Edition, Wiley Publications, New Jersey, 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

EEPESCN	POWER GENERATION RESOURCES	L	T	P	C
		3	0	0	3

Course objectives:

- To provide a conceptual understanding of power plants and power generation.
- To know about all available source of energy for power generation.
- To learn about the variables in loads and power factor improvement
- To know how to conserve energy and factors behind conservation.
- To study about electricity tariff and pricing

Conventional Energy Generation: Thermal Power plants - Basic schemes and working principle - Gas Power Plants- open cycle and closed cycle gas turbine plants - combined gas & steam plants-basic schemes - Diesel power plant - Hydro Power Plants - Classification of hydroelectric plants - Basic schemes of hydroelectric and pumped storage plants - Nuclear Power Plants - Nuclear fission and nuclear fusion - Fissile and fertile materials - Basic plant schemes with boiling water reactor - heavy water reactor and fast breeder reactor - Efficiencies of various power plants.

New Energy Sources: Need - Impact of thermal, gas, hydro and nuclear power stations on environment - Green House Effect (Global Warming) -Renewable and non-renewable energy sources - Conservation of natural resources and sustainable energy systems - Indian energy scenario - Introduction to electric energy generation by wind, solar and tidal.

Comparative study on the selection of Power Plants of thermal, hydro, nuclear and gas power plants, Base load and peak load plants. Size and types of generating units, types of reserve and size of plant, Selection and location of power plants

Loads and Power Factor Improvement: Types of load - chronological load curve - load duration curve - energy load curve and mass curve - Maximum demand - demand factor-load factor - diversity factor - capacity factor and utilization.

Power Factor Improvement Causes and effects of low power factor and advantages of power factor improvement - Power factor improvement using shunt capacitors and synchronous condensers

Power Plant Economics: Capital cost of plants - annual fixed and operating costs of plants - generation cost and depreciation - Effect of load factor on unit energy cost - Role of load diversity in power system economics - Most economic power factor during constant demand in kW and kVA - Energy cost reduction - off peak energy utilization, co-generation, and energy conservation.

Electricity Tariff: Objectives of tariffs - Factors affecting the tariff - General tariff form- Types of Tariff -Flat demand rate - straight meter rate - block meter rate - Two part tariff, power factor dependent tariffs - three part tariff - Spot (time differentiated) pricing - Time of Day (ToD) Tariff - Availability Based Tariff.

Text / Reference Books:

[1] Philip Kiameh, Power Generation Handbook: Selection, Applications, Operation and Maintenance, Ist Edition, Mc-Graw Hill, New York, 2002.

[2] F.Carl Knopf, Modeling, Analysis and Optimization of Process and Energy Systems, 1st edition, Wiley, New Jersey, 2012.

[3] Roy L. Nersesian, Energy for the 21st Century: A Comprehensive Guide to Conventional and Alternative Sources, M.E. Sharpe, New York, 2006.

[4] Fang Lin Luo, Hong Ye, Renewable Energy Systems: Advanced Conversion Technologies and Applications, CRC Press, Boca Raton, 2013.

[5] Pratik Biswas, Sukanya Mandal, Indian Electricity Sector under Regulatory Regime, 1st edition, White Falcon Publishing, Chandigarh, 2019.

[6] S.C.Bhatia, Advanced Renewable Energy Systems (2 Volumes), Woodhead Publishing India Pvt Ltd, New Delhi, 2018.

Course Outcomes:

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

1. Apply knowledge of India's power scenario, power system structure
2. Explain about various types of power plants i.e., hydro, thermal, gas and nuclear.
3. Harness power from conventional and renewable sources.
4. Explore the methods and size of plant generating power for overall economy.
5. Decide the tariff structure for different type of users.

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		
CO2	3	2	2	1									1		2
CO3	3			3	2				2				1		1
CO4	3				2						2		1		
CO5	3							2			2				1

EEPESCN	SMART ELECTRICAL DISTRIBUTION SYSTEMS	L	T	P	C
		3	0	0	3

Course objectives:

- To know about the planning, design, analysis and operational concepts of the distribution system
- To learn the fundamentals of distributed energy sources.
- To understand the various network components and modeling technique
- To have a impart knowledge of planning operating modes and protection methods of micro grid
- To discuss various aspects of smart distribution system

Electrical Distribution System

Introduction - characteristics of distribution system - losses - distribution system planning - factors affecting - load modeling - uniform and non-uniformly distributed loads - classification of load forecasting - recent load forecasting methods - Radial distribution - Distribution feeders - Loop network types of distribution feeders - LV and HV distribution systems- factors affecting feeder voltage level - factors affecting primary feeder loading - design of secondary distribution system -secondary network types - methods for distribution feeder cost - Distribution Substation - location of substation - rating of the distributed substation - optimum location of substation - line drop compensation - voltage fluctuations.

Fundamentals of Distributed Energy Sources (DES)

Combined heat and power (CHP) technologies - steam - Gas turbine - combined cycle GT - Micro turbines - fuel cells - fuel cell based CHP - PV energy systems - grid connected PV arrays - Wind Energy Systems - types - Electrical Energy Storage Systems - Battery Energy Storages - Mechanical Energy Storages - Electrical Energy Storages - Management of DES - demand-side management (DSM)- demand response (DR), demand-side response (DSR), demand-side bidding (DSB) and demand bidding (DB) - Concept of a DSI regional controller - Characterization of DERs as a Virtual Power Plants (VPP) - two potential roles for a VPP: Commercial VPP (CVPP) and Technical VPP (TVPP) - Grid interface for DERs - dynamic voltage restorer (DVR)- Fault Current Limiter for network support.

Distributed Network Components and Modelling

Distributed line - distributed transformer - distributed load - distributed generators - dynamic voltage regulator (DVR)- Soft Open Point (SOP) for power management in distributed networks - Controllers for network components - control logic for voltage regulator and Capacitor controller- energy storage controller - sequential power flow in a smart distribution networks - fault analysis considering distributed generators - Electrical System Element Modelling - sequential power flow in a smart distribution systems - compositional modelling - modelling of dynamic components.

Control and Energy Management of Microgrids

Introduction - master-slave control strategy - control schemes for inverter based DGs - Control of Microgrid (MG) in islanded mode and Grid connected mode - requirements of MF protection - reverse power protection- Over current protection- Over/Under voltage Protection- Over/Under-Frequency Protection - feeder protection within microgrid - Impact on Downstream and upstream protection.

Microgrid Energy Management System (MEMS) - module - scheduling strategy - types - MG device models - Energy flow in a microgrid - Bus-based energy balance structure of a microgrid- optimal scheduling of a microgrid - Optimal planning of MG - annual microgrid operational cost .

Smart Distribution System

New Characteristics of a Smart Distribution Network - Distributed Energy Systems - Multi-Layer Autonomous Operation Areas -Operational Optimization of a Smart Distribution Network - Planning and Design of a Smart Distribution Network.

Planning-Load Forecasting - Influences of DG - typical solution process for the optimal planning of substations in a traditional distribution system and for the optimized substation planning of smart distribution systems - network planning - selection of network configuration - methods for network planning - effects of new components in smart distribution systems.

DC distribution network - Medium Voltage DC scheme - Conventional controller for AC-DC converter - Conventional *d–q* controller for inner control - PV connection through an MVDC line - multi-terminal DC Grid - DC microgrid - Radial-bus DC microgrid - Ring-bus DC microgrid.

Text Books

[1] Chengshan Wang, Jianzhong Wu, Janaka Ekanayake and Nick Jenkins, Smart Electricity Distribution Networks, Press, Boca Raton, 2017.
[2] Abdelhay A Sallam, O.P.Malik, Electric Distribution Systems, John Wiley & Sons, New Jersey, 2011.

Reference Books

[1] S.Sivanagaraju and V Sankar, Electrical Power Distribution and Automation, Dhanapat Rai and Co., Delhi, 2014.
[2] Alexis Kwasinski, Wayne Weaver, Robert S. Balog, Microgrids and other Local Area Power and Energy Systems, Cambridge University Printing House, Cambridge CB2 8BS, United Kingdom, 2016.

[3] Nicolae Badea, Design for Micro-Combined Cooling, Heating and Power Systems: Stirling Engines and Renewable Power Systems, Springer-Verlag London, 2015
[4] Nilanjan Ray, Chaudhuri Balarko, Chaudhuri Rajat, Majumder Amirnaser Yazdani, Multi-Terminal Direct-Current Grids: Modeling, Analysis, and Control, John Wiley & Sons, Inc., New Jersey, 2014.
[5] Manuela Sechila, Urban DC Microgrid Intelligent Control and Power Flow Optimization, Butterworth-Heinemann, Cambridge, 2016.
[6] Anthony J. Pansini, Guide to Electrical Power Distribution Systems, Sixth Edition, The Fairmont Press, Inc. Marcel Dekker/CRC Press, Boca Raton, 2005.
[7] David Wenzhong Gao, Energy Storage for Sustainable Microgrid, Academic Press (Elsevier), San Diego, 2015.
[8] Shin'ya Obara, Optimum Design of Renewable Energy Systems: Microgrid and Nature Grid Methods, IGI Global book series, Hershey, USA, 2014.

Course Outcomes:

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

1. Analyze the problems in distribution systems
2. Utlize the available methods and techniques in distributed systems
3. Familiarize with Energy Management And Control.
4. Gain knowedge in distributed network and modelling DVR
5. Understand the Concept of Smart Grid Implementation

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

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

Course objectives:

- To know about the planning concepts and tools
- To familarize with the concept of generation planning studies
- To study about the factors affecting transmission & distribution planning
- To learn about importance of demand side palnning
- To know how to maitain system reliability and quatlity

Introduction: Planning in Concept: Planning, Three cyclic components of Planning, Types of Planning. Planning Tools. DPR, Least Cost Utility Planning - National and Regional Planning, structure of Power System, planning tools. Electricity Regulation, Electrical Forecasting, forecasting techniques modelling

GenerationPlanning: Objectives & Factors affecting Generation Planning, Generation Sources, Integrated Resource Planning, Generation System Model, Loss of Load (Calculation and Approaches), Outage Rate, Capacity Expansion, Scheduled Outage, Loss of Energy, Evaluation Methods. Interconnected System, Factors affecting interconnection under Emergency Assistance

Transmission & Distribution Planning: Introduction, Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability. Radial Networks – Introduction, Network Reconfiguration, Evaluation Techniques, Interruption Indices, Effects of Lateral Distribution Protection, Effects of Disconnects, Effects of Protection Failure, Effects of Transferring Loads, Distribution Reliability Indices.

Demand Side Planning:Demand Response, Demand – Response Programmes, Demand–Response Technologies, Energy Efficiency, Energy - Economical Products, Efficient – Energy Users, Supply – Side Efficiency, Computer aided planning, wheeling. Environmental effects, the greenhouse effect. Technological impacts. Insulation coordination. Reactive compensation-Energy Audit

Reliability and Quality: Reliability Models, System Reliability, Reliability and Quality Planning, Functional Zones, Generation Reliability Planning Criteria, Transmission Reliability Criteria, Distribution Reliability, Reliability Evaluation, Grid Reliability, Reliability Target, Security Requirement, Disaster Management, Quality of Supply, Reliability and Quality Roadmap.

Textbooks:

[1] S. Pabla, Electric Power Planning McGraw Hill, 2nd Edition, 2016
[2] M. V. Deshpande, Electrical Power System Design, TMH Publication, New York, 2001
[3] B. R. Gupta, Electrical Power System Design, S.Chand, New Delhi, 2005

Reference Books:

[1] Wang, J. R. Mc Donald, Modern Power System Planning, McGraw Hill, New York, 1993.
[2] Turan Gonen, Electric Power Distribution Engg., Mc-Graw Hill, New York, 1986.
[3] R.L. Sullivan, Power System Planning, McGraw Hill International, New York, 1977.
[4] Colin Bayliss, Transmission and Distribution Electrical Engineering, Newnes (an imprint of Butterworth-Heinemann Ltd), Elsevier Science & Technology, Oxford, 2014.

Course Outcomes:

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

1. Gain Knowledge In Planning and Electrical Regulations
2. Under Stand process in power generation transmission and distrbution
3. Know how to handle distrbution demands
4. Learm the varrious problems in distribution demands and solving the issues
5. Maintain the relability between generation, transmission and distribution

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		
CO2	3		3				2								2
CO3	3		2		2				2			1	1		1
CO4	3	1			2	2									1
CO5	3	2						2			2				1

EEPESCN	FUNDAMENTALS OF DIGITAL AND NONLINEAR CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To know about mathematical modelling and various transfer function.
- To analyze the stability and performance properties of nonlinear systems.
- To learn aboutobservability and stability of discrete state space models
- To know about analysis tools of non linear systems
- To analyze about various system in liapunov's stability

Unit–I:Introduction to digital control: Introduction Discrete time system representation, Mathematical modeling of sampling process, Data reconstruction Revisiting Z-transform, Mapping of s-plane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system, Sampled signal flow graph.

Unit–II: **Stability analysis of discrete time systems:** Jury stability test, Stability analysis using bilinear transformation, Transient and steady state responses, Time response parameters of a prototype second order system, Design of sampled data control systems: Root locus method, Controller design using root locus, Bode plot, Lead, leg, lead-leg compensator design using Bode plot

Unit□III: **Discrete state space model:** Introduction to state variable model, Various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation Controllability, Observability and stability of discrete state space models

Unit–IV: **Non linear system analysis:** Introduction, nonlinearities in control system, function of common non linearity, the describing function method, concept of phase plane analysis, construction of phase portions, system analysis on the phase plane - Nonlinear Observers -Local and global observers - extended Kalman filter observer - high gain observer.

Unit–V:Liapunav's Stability analysis: Introduction to Liapunov's stability criterion-autonomous systems - Invariance principle -linear system and linearization - Nonautonomous systems - linear time varying systems and linearization - method of constructing liapunov function for non linear systems

Text Books:

[1] Nagrath, I.J., Gopal, M., Control Systems Engineering, New Age International, New Delhi, 2019.

[2] Hassan K Khalil, Nonlinear Systems, 3rd Edition, Pearson Education, Noida, 2015.

Reference Books:

[1] B. C. Kuo, Digital Control Systems, Oxford University Press, Indian Edition, 2007.

[2] K. Ogata, Discrete - Time Control Systems, Second Edition, Pearson, New Jersey, 2013.

[3] Hassan K Khalil, Nonlinear Control, Pearson Education, Noida, 2015.

Course Outcomes:

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

1. Gain knowledge about techniques for relaxing the constraints or redesigning the controller for achieving closed-loop specifications either in the time-domain or in the frequency domain.
2. Obtain dynamic responses of linear systems and determine their stability,construct root-locus and bode plots, and apply nyquist criterion in the context of controller design.
3. Under stand the mathematical tools that are needed to solve optimization problem.
4. Observe the non linear system analaysis.
5. Learn about linear and non linear 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	
CO2	2	2		1							1				1
CO3	2	3	2										1		1
CO4	2	2											1	1	
CO5	2	2				3					1				1

EEPESCN	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely ac to dc, dc to dc and ac to ac converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

Unit I Introduction

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-ghg emission) - qualitative study of different renewable energy resources: solar, wind, ocean, biomass, fuel cell, hydrogen energy systems and hybrid renewable energy systems.

Unit II Electrical Machines For Renewable Energy Conversion

Reference theory fundamentals-principle of operation and analysis: ig, pmsg, scig and dfig.

Unit III Power Converters

Solar: block diagram of solar photo voltaic system -principle of operation: line commutated converters (inversion-mode) - boost and buck-boost converters- selection of inverter, battery sizing, array sizing wind: three phase ac voltage controllers- ac-dc-ac converters: uncontrolled rectifiers, pwm inverters, grid interactive inverters-matrix converters.

Unit IV Analysis Of Wind And Pv Systems

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system- grid connection issues -grid integrated pmsg, scig based wecs, grid integrated solar system

Unit V Hybrid Renewable Energy Systems

Need for hybrid systems- range and type of hybrid systems- case studies of wind-pv maximum power point tracking (mppt).

Text book:

1. S. N. Bhadra, d.kastha, s.banerjee, "wind electrical systems", oxford university press, 2005.
2. B.h.khan non-conventional energy sources tata mcgraw-hill publishing company, new delhi,2009.

References:

1. Rashid .m. H "power electronics hand book", academic press, 2001.
2. Ion boldea, "variable speed generators", taylor & francis group, 2006.
3. Rai. G.d, "non conventional energy sources", khanna publishes, 1993.
4. Gray, l. Johnson, "wind energy system", prentice hall linc, 1995.
5. Andrzej m. Trzynnadlowski, 'introduction to modern power electronics', second edition, wiley india pvt. Ltd, 2012.

PROGRAM OUTCOMES:

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

1. understand and analyze power system operation, stability, control and protection.
2. handle the engineering aspects of electrical energy generation and utilization.
3. Gain Knowledge on converter and its types
4. analyse wind and solar energy systems.
5. Know about mppt analysis of hybrid power systems

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

EEPESCN	POWER PLANT INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course objective

- To acquaint with theory and working principles of different types of instruments and control used in power plantAutomation.
- To have familiarity with various components/equipment in power plants.
- To understand about process in different stages of power generation and transmission systems.
- To Familiarize with monitoring and control of boiler and turbine systems.
- To get exposure to automation of power plants.

Unit I-Introduction to unit operation and unit process:

Material and energy balance. Significance of instrumentation and layout of thermal, hydroelectric, nuclear, gas turbine, solar, wind power plants.Concept of regional and national power grid. Concept of distance protections and islanding types of power plant.

Unit IIInstrumentation and equipments of various unit operations

Evaporation, distillation, leaching, gas absorption,Heat exchangers, humidification and dehumidification, drying, size reduction, crystallization, mixing.

Unit III-Boiler instrumentation and optimization:

Combustion control, 3 element drum level control, steam pressure,Oxygen/co/co2 – flue gases control, furnace draft, boiler interlocks, start-up and shut-down procedures boiler loadcalculation, boiler efficiency calculation.Scada controls- boiler inspection and safety procedures

Unit IV-Turbine instrumentation and control

Valve actuation, auto-start up, start up and shut down, thermal stress control,Condition monitoring and power distribution instrumentation. Auxiliary control of water treatment plant,Electrostatic precipitator and oil automation system.

Unit V-Automation

thermal power plant, boiler automation – diagnostic functions and protection – digital electro –Hydraulic governor, man-machine interface- graphic display of automated power plant.Simulation experiments on scada, power plant monitoring and so on.

Text book(s)

1. Amrita vishwa vidyapeetham. Btc-eee b.tech curriculum june 2019 123
2. Mccabe w.l, smith j, peter harriot, “unit operation of chemical engineering”, seventh rev edition, tata mcgrawHill publishing company, , 2005.
3. Popovic and bhatkar, “distributed computer control in industrial automation”, second edition, crc press, 1990.

Reference(s)

B.g.liptak, “instrument engineers handbook: process measurement and analysis”, third edition, butterworth

Heinemann, 1995.

Program Outcomes:

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

1. Familarize with all types of power plant and its operation.
2. Understand about the process involved in generation .
3. know how maintain the stabilty of boiler
4. Learn the parmaetersthat control the trubine
5. know about the automation process involved in the power plants

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

EEPESCN	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Course objective:

1. To Analyze permanent magnet material property and circuits
2. To Enumerate the stepper motor from other motor
3. To Distinguish switched reluctance motor from synchronous reluctance motor
4. To Analyze square wave and sine wave permanent magnet brushless motor drives.
5. To get a Comprehensive idea about the linear motor

Unit:1 stepper motors:

Constructional features-principle of operation types and torque equations-modes of excitation,Characteristics, driver circuits, and microprocessor control of stepper motors, concept of lead angle,Applications.

Unit:2 Reluctance motors:

Switched reluctance motors: Constructional feature – principle of operation – torque production –power convertersand their controllers – methods of rotor position sensing sensor less operationcharacteristics-Closed loop control applications.

Synchronous reluctance motors: Constructional feature -axial and radial flux motor-operating principles-voltage andTorque equation – phasor diagram --performance characteristics -applications.

Unit:3 permanent magnet brushless dc motors:

Permanent magnet materials-magnet characteristics-permeance coefficient-permanent magnet vs.Electromagnet. Magnetic circuit analysis – emf and torque equations – commutation – powerConverter and their controllers – characteristics – applications.

Unit:4 synchronous motors

Permanent magnet synchronous motors- principle of operation-ideal pmsm -emf and torque equations-armature mmf—synchronousReactance-sine wave motor with practical windings-phasor diagram-characteristics- power converterAnd their controllers-converter volt ampere

requirements-applications.Advanced synchronous machines - flux switching motors-flux reversal motors-claw pole alternators-construction and
Working-characteristics-applications.

Unit:5 linear motors:

Linear dc motors-linear induction motor -linear synchronous motors -linear switched Reluctance motors-constructions and working-applications.Line start synchronous motors: line start permanent magnet synchronous motor - line startSynchronous reluctance motor - line start permanent magnet synchronous reluctance motor -Applications.

Text book(s)

1. T.j.e miller, “brushless permanent magnet and reluctance motor drives”, clarendon Press, oxford 1989.
2. T. Kenjo, a. Sugawara, ‘stepping motors and their microprocessor controls’, clarendon Press london, 1994.
3. R. Krishnan, “permanent magnet and brushless dc motors drives”, crc press, new york, 2010. Ion boldea, 'linear electric machines, drives, and maglevs handbook', crc press, London, 2013.

Reference books

. P. P. Acarnley, ‘stepping motors – a guide to motor theory and practice’, fourth Edition, peter peregrinus, london, 2007.
T. Kenjo and s. Nagamori, 'permanent magnet and brushless dc motors', clarendon press, London, 1988.
. R. Krishnan, ‘permanent magnet and brushless dc motors drives’, crc press, new york, 2010

Program outcomes

At the end of this course, students will demonstrate the ability to
1. apply mathematics and science in engineering applications
2. Have a clear understanding of the subject related concepts and of contemporary issues
3. Acquire problem solving ability- solving social issues and engineering problems
4. analyze the advanced synchronous motor
5. Select the appropriate drive for the specific purpose.

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

EEPESCN	IoT FOR ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide knowledge on the basic concepts of IoT.
- To convey the significance of computing techniques for IoT.
- To describe how IoT be applied for power system.
- To study in depth about the IoT application toElectric Vehicles.
- To familiarize withthe design considerations and application of IIoT

UNIT I - Introduction to Internet of Things (IoT)

Internet of Things Concepts - Core Concepts - Machine-to-Machine communications- Industrial Internet of Things- Internet of Things framework- characteristics of IoT - application of IoT - Information and Communication Technology Infrastructure - Architecture and Reference Models -

UNIT II - Computing Techniques for IoT

Cloud and Fog Computing in IoT- IoT system requirements - Cloud Computing in IoT - characteristics of cloud computing - Cloud computing service models - Common cloud-based IoT architecture - Advantages of using Cloud for IoT - Industrial domain - Smart Cities - Key Challenges of Cloud-Based IoT - Fog Computing in IoT - need for and requirements - - architecture of Fog computing - Revised fog-enabled architecture combining fog and cloud-based IoT - advantages of using Fog for IoT - Potential Future Fog usages in IoT for Smart grid - Connected Vehicles - Smart buildings.

UNIT III - IoT for Power systems

Evolution of the electric power grid - Extended energy value chain and IoT use cases - Generation - Transmission - Distribution and Metering - Storage - Marketing, Sales, and Service - Customers - Smart grid IoT connections - Energy Case Studies - Smart Monitoring and Diagnostics Systems at Major Power Plants - Smart generation architecture - Smart logging and analytics architecture - Smart Monitoring and Diagnostics Systems in Major Power Plants - Asset Integration Architecture of Smart M&D - Microgrids and Virtual Power Plants - Overview of virtual power plant / microgrid management system (VPP/MMS).

UNIT IV - IoT for Electric Vehicles

Electric Vehicles (EV) - classifications - charging - eMobility - EV charging services - eRoaming - EV remote management - AIA for Reva Remote Management - EVs and cross-energy management - Intermodal Services - automated driving: technologies - system architecture - Digital Horizon - Automated parking smart parking - Smart City - projects - Relevance for IoT - Ignite | IoT Strategy Execution - IoT opportunity categories - Innovation Project Canvas with AIA - IoT Opportunity Management Indian EV - 4 wheelers - 3 wheelers - 2 wheelers - electric bus - E Trucks - V2V - V2I - V2C - Vehicle-to-Everything (V2X) paradigm - Intelligent connected Vehicles - benefits and challenges of V2X communication.

UNIT V - Industrial IoT (IIoT)

Introduction -requirements - design considerations- application of IIoT - benefits and challenges of IIoT - real-time monitoring and control of processes - deploying smart machines, smart sensors, and smart controllers with proprietary communication and internet technologies - maximize safety, security and reliability through high precision automation and control

Reference Books

[1] Qusay F. Hassan, Internet of Things A to Z Technologies and Applications, John Wiley & Sons, Inc., NewJersey, 2018.

[2] Jeeva Jose, Internet of Things, Khanna Publishers, New Delhi, 2018.

[3] Dirk Slama, Frank Puhlmann, Jim Morrish & Rishi M. Bhatnagar, Enterprise IoT Strategies & Best Practices for Connected Products & Services, O'Reilly Media, Inc., Sebastopol, USA, 2016.

[4] Stuart Borlase, Smart Grids Advanced Technologies and Solutions, Second Edition, CRC Press, Boca Raton, 2018.

[5] Ravi Ramakrishnan, Loveleen Gaur, Internet of Things Approach and Applicability in Manufacturing, CRC Press, Boca Raton, 2019, ISBN 978-1-138-59815-7.

[6] Gilchrist, Alasdair, Industry 4.0: the Industrial Internet of Things, Apress (Springer Group), New York2016

Course Outcomes:

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

1. Understand the basic concepts of IoT.
2. Understand about the significance of computing techniques for IoT.
3. Familiarize with how IoT be applied for power system.
4. Understand various in- depth concepts about the IoT application toElectric Vehicles.
5. familiarize withthe design considerations and application of IIoT

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

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", DhanpatRai 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

EEOESCN	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	1	0	4

Course Objectives:

- To enable the students to study the evolution of Management,
- To study the functions and principles of management.
- To learn the application of the principles in an organization.
- To enable the effective and barriers communication in the organization
- To study the system and process of effective controlling in the organization.

Unit- 1 **Basic concepts of Management:** Definition – Essence, Functions, Roles, Level. Functions of Management: Planning – Concept, Nature, Types, Analysis, Management by objectives; Organization Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organizational Effectiveness.

Unit- 2 **Management and Society**: Concept, External Environment, CSR, Corporate Governance, Ethical Standards. People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship

Unit 3 **Leadership:** Concept, Nature, Styles. Decision making: Concept, Nature, Process, Tools & techniques. Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control

Unit 4 **Customer Management**: Market Planning & Research, Marketing Mix, Advertising & Brand Management. Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS. Management Control Systems - Security Analysis and Portfolio Management - Organizational Change and Development - Online Social Media - Project Management

Unit- V **Controlling**

Process of controlling-Types of control-Budgetary and non-budgetary control techniques-MIS-Managing productivity-Constant control-purchase control- Maintenance control-quality control-planning operations-performance standards-Measurement of performance-Remedial actions

Text/References:

[1] Anil Bhat, Arya Kumar, Principles of Management: Competencies, Processes, Practices, Oxford University Press, Oxford, London, 2019.
[2] Harold Koontz, Essentials for Management, Tata McGraw Hill, New Delhi, 2010.
[3] Stephen P. Robbins, Mary Coulter, Nancy Langton, Management, Pearson Education Canada, 2006.
[4] Ghuman, Management, Tata McGraw Hill, Noida, 2010.
[5] Kenneth A. Merchant, Modern Management Control Systems: Text and Cases, Prentice Hall, New Delhi, 1998.

Course Outcomes:

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

1. understand managerial functions like planning, and have somebasic knowledge on international aspect of management
2. understand the planning process in the organization
3. understand the concept of organization
4. demonstrate the ability to directing ,leadership and communicate effectively
5. Analyse and isolate issues and formulate best control methods.

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

EEOESCN	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Course objectives:

- To define and formulate linear programming problems and appreciate their limitations
- To solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
- To conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship.
- To develop mathematical skills to analyse and solve integer programming and network
- To Effectively communicate ideas, explain procedures and interpret results and solutions in written and electronic forms to different audiences

Introduction: Development of scientific management - Application of operations research – Classification of operation Research(OR)models – Procedures to obtain optimum solution – Scope of OR - Management information systems (MIS)- Classification of MIS - Cost volume and profit(CVP)analysis - Relationships - Various approaches – Limitation of CVP analysis.

Linear Programming: Introduction – Graphical solution; Graphical sensitivity analysis – The standard form of linear programming problems – Basic feasible solutions – unrestricted variables – simplex algorithm – artificial variables – Big M and two phase method – Degeneracy – alternative optima – unbounded solutions – infeasible solutions.
Dual problems-Relation between primal and dual problems - Dual simplex method Transportation model – starting solutions. North West corner Rule - lowest cost method –Vogels approximation method - Transportation algorithms –Assignment problem – Hungarian Method.

Inventory models– Economic order quantity models – Quantity discount models - Stochastic inventory models-Multi product models – Inventory control models in practice.
Inventory decisions - Selective approach to management inventory - Application of EOQ to production process. Reordering - Determination of optimum level - Optimal level of safety stock - Joint ordering - Reordering with planned stock outs - discounts.

Network Models : Definitions – Transportation Assignment Models -Travelling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models -Project network - CPM and PERT – Their Algorithms- Integer Programming : Branch and Bound Algorithms cutting plan algorithm. Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic modes, prediction of date of completion, crashing of a simple networks, resource levelling by network techniques.

Decision models – Game theory – Concept of dominance, Graphical method of solving. Sequencing problems - Heuristic problem solving -Two person zero sum games – Graphical solution- Algebraic solution- Replacement models – Replacement theory, Introduction, Economic life of equipments, Replacement considering both the cases with and without tie value of money, group replacement policy. Single / Multi variability search technique – Dynamic Programming – Simple Problem.

Text Books:

1. Hillier and Libeberman, Operations Research, Holden Day, San Francisco 2005
2. Taha H.A., Operations Research, Sixth Edition, Prentice Hall of India, New Delhi, 2003.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Jeffrey D. Camm, James J. Cochran, An Introduction to Management Science: Quantitative Approaches to Decision Making, Cengage Learning, Boston, 2015.

Reference Books:

1. Budnick F.S., Principles of Operations Research for Management, Irwin (Richard D.) Inc, Homewood, 1990.
2. Philip D.T. and Ravindran A., Operations Research, John Wiley, New Jersey, 2006.
3. Chidambaram I.A., Sridhar. N.D. and Paramasivam. B., "Quantitative Management Techniques", Sci Tech Publications, Chennai, 2009.
4. Tulsianand Pasdey V., Quantitative Techniques, Pearson Asia, New Delhi, 2002.
5. Jhamb L C, "Production Operations Management", 18th edition, Everest Publishing House, New Delhi, 2013.

Course Outcomes:

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

1. understand the mathematical tools that are needed to solve optimization problem.
2. impart knowledge in concepts and tools of operations research
3. apply these techniques constructively to make effective business decisions.
4. Learn about network model , algorithm and integratingProgramming
5. Understand about different techniques in problem solving

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

EEOESCN	ENGINEERING OPTIMIZATION	L	T	P	C
		3	0	0	3

Course Objectives:

- To Understand the basic concepts of engineering optimization
- To Analyze the 1- d search methods in optimization
- To Design gradient based optimization method for various algorithms
- To Formulate and analyze system using conjugate direction methods
- To Program and analyze for dynamic optimization

Unit–IOptimization Basics And Search Methods

Taylor's Series, single-variable optimization, multivariable optimization without and with equality andinequality constraints, definitness of matrices, sylvester's criterion, convex programming problem.golden section search, fibonacci search, inexact line search.

Unit–IIGradient Based Optimization

Gradient descent method, method of steepest descent, newton's method, levenberg marquardtalgorithm.

Unit–IIIConjugate Direction Methods

Conjugate directions and conjugate gradient method, fletcher-reeves formula. convergence analysisof all algorithms.dynamic programming- dynamic optimization- sample applications of gradient based and gradient free methods in engineering.

Unit–IVApplication Of Optimization Methods To Neural Networks

nn basics, capabilities and limitations of single perceptron, multilayer perceptron. training by gradientbased and gradient free methods.

Unit–VGradient-Free Optimization

Direct and indirect methods, limitations of gradient based methods, metaheuristic algorithms,introduction to the genetic algorithm, particle swarm optimization. simulated annealing.

Text Book/ Reference Books

1. Introduction to optimization by chong and zak, john wiley & sons, inc., iv ed., 2013.
2.Engineering optimization, theory and practice by s s rao, john wiley & sons, inc., iv ed., 2009.
3.Practical methods of optimization, by fletcher, john wiley & sons, inc.,

Course Outcomes:

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

1. apply mathematics and science in engineering applications
2. Have a clear understanding of the subject related concepts and of contemporary issues
3. Have computational thinking (ability to translate vast data in to abstract concepts and to understand database reasoning)
4. Apply mathematics and science in engineering applications
5. understand the genetic algorithm and pso algorithm design of a component or a product applying all the relevant standards with realistic constraints

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

EEOESCN	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Course objectives:

- To impart basic knowledge about the principles of cloud computing.
- To partake a detailed study of the various cloud service models
- To make the students recognize the basics of virtualization
- To familiarize the programming models available in cloud
- To get an insight on some applications and prospects of cloud computing

Unit–I: Fundamentals

Motivation-Definition-Principles of Cloud Computing-Cloud Ecosystem-Requirements for Cloud Services-Cloud Application-Benefits and Drawbacks. Cloud Architecture-Anatomy of the Cloud-Network Connectivity in Cloud Computing-Applications on the Cloud-Managing the Cloud-Migrating Application to Cloud.

Unit–II: Cloud Deployment Models and Service Models

Private Cloud-Public Cloud-Community Cloud-Hybrid Cloud-Cloud Service Models - Infrastructure as a Service- Platform as a Service- Software as a Service- Other Cloud Service Models. Technological Drivers for Cloud Computing-SOA and Cloud- SOA and SOC - Benefits of SOA - Technologies Used by SOA - Similarities and Differences between SOA and Cloud Computing.

Unit–III: Virtualization

Introduction- Virtualization Opportunities- Processor Virtualization- Memory Virtualization Storage Virtualization - Network Virtualization - Data Virtualization Application Virtualization -Approaches to Virtualization- Full Virtualization – Para virtualization - Hardware-Assisted Virtualization -Types of Hypervisors- From Virtualization to Cloud Computing- IaaS- PaaS- SaaS.

Unit–IV: Programming Models for Cloud Computing

Existing and Extended Programming Models for Cloud- BSP Model- MapReduce Model- MapReduce --Model- Cloud Haskell- Multimillion- Erlang- SORCER: Object-Oriented Programming- Programming Models in Aneka- New Programming Models Proposed for Cloud- Orleans- BOOM and Bloom- Grid Batch- Simple API for grid applications.

Unit–V: Networking for Cloud Computing

Overview of Data Center Environment- Networking Issues in Data Centers- Transport Layer Issues in DCNs- TCP Enhancements for DCNs- Cloud Service Providers- EMC- Google- Amazon Web Services- Microsoft- IBM- SAP Labs- Salesforce- Rackspace- VMware- Manjra soft- An Overview of Open Source in Cloud Computing-Advanced Concepts in Cloud Computing-Inter cloud- Cloud Management- Mobile Cloud- Media Cloud- Cloud Governance- Green Cloud- Cloud Analytics.

Text Books

1) K. Chandrasekaran, "Essentials of Cloud Computing", CRC Press, 2015.

2) Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

Reference Books

1) Dan C. Marinescu, "Cloud Computing: Theory and Practice, Morgan Kaufmann, 2013.

2) San Murugesan, Irena Bojanova, "Encyclopedia of Cloud Computing", Wiley-IEEE Press, 2016.

3) Derrick Rountree, Ileana Castrillo, "The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice", Syngress, 2013.

Course outcomes:

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

1. Conceptualize the basic ideas and motivation for cloud computing
2. Familiarize with the cloud models and services offered by the companies
3. Understand the concept and significance of Virtualization
4. Identify the areas of application and explore future prospects
5. Discuss the suitability of each programming model to different kinds of application

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

EEOESCN	TOTALQUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart the importance of quality in manufacturing and service
- To understand the various quality principles
- To know the importance of six sigma concepts
- To study about the tools and techniques involved in quality standards
- To learn about types of quality system available in manufacturing and service sectors

UNIT I Introduction

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM Principles

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM Tools And Techniques I

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM Tools And Techniques II

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V Quality Systems

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.

TEXTBOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

Course Outcomes:

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

1. Understand the importance of quality in manufacturing and service sectors
2. Gain knowledge about the quality process and principles to be followed
3. know how to use the quality tools and techniques
4. Have a understanding of various control and improvements concepts
5. know about different ISO standards requirements and implementation

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
CO2	3													1	1
CO3				1			2							1	
CO4			2			1				2					1
CO5								2			2		1		

EEOESCN	ENTERPRISE RESOURCE PLANNING	L	T	P	C
		3	0	0	3

Course Objectives:

- To know the basics of ERP
- To understand the key implementation issues of ERP
- To know the business modules of ERP
- To be aware of some popular products in the area of ERP
- To appreciate the current and future trends in ERP

UNIT 1 Introduction

ERP: An Overview, Enterprise – An Overview, Benefits of ERP, ERP and Related Technologies, Business Process Reengineering (BPR), Data Warehousing, Data Mining, OLAP, SCM

UNIT II ERP Implementation

ERP Implementation Lifecycle, Implementation Methodology, Hidden Costs, Organizing the Implementation, Vendors, Consultants and Users, Contracts with Vendors, Consultants and Employees, Project Management and Monitoring

UNIT III The Business Modules

Business modules in an ERP Package, Finance, Manufacturing, Human Resources, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution

UNIT IV The ERP Market

ERP Market Place, SAP AG, PeopleSoft, Baan, JD Edwards, Oracle, QAD, SSA

UNIT V ERP – Present and Future

Turbo Charge the ERP System, EIA, ERP and e-Commerce, ERP and Internet, Future Directions

TEXT BOOK

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill, New Delhi, 2000

REFERENCES

1. Joseph A Brady, Ellen F Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Thompson Course Technology, USA, 2001.

2. Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning – Concepts and Practice", PHI, New Delhi, 2003

Course outcomes:

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

1. Understand the technical aspects of ERP systems;
2. Learn concepts of reengineering and how they relate to ERP system;
3. Understand the steps and activities in ERP implementation;
4. Have an idea about typical functional modules in ERP system;
5. Know the technology areas of ERP and enterprise applications

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

6. Understand the difference between traditional and restructured power systems
7. Understand about various entities involved in power markets.
8. Familiarize with transmission open access and electricity pricing
9. Understand various ancillary services management
10. 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 PowerEngineering 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", TheMcGrawHill 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 LAB 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. Uunderstand the breakdown mechanism gaseous insulating materials.
2. Analyze the processes lead to breakdown of solid and liquid insulating materials.
3. Gain knowledge about high voltage and current generation equipment.
4. Understand how Lightning and Switching Over-voltages arises in the system
5. 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-typesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialtoparallel 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", 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	