GOVERNMENT COLLEGE OF ENGINEERING
SALEM - 636 011

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2018

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING (FULL TIME)

GOVERNMENT COLLEGE OF ENGINEERING: SALEM 636011

(An Autonomous Institution Affiliated to Anna University, Chennai)

(NAAC ACCREDITED)

REGULATIONS 2018

CHOICE BASED CREDIT SYSTEM
Common to all B.E. (FULL TIME) DEGREE PROGRAMME
(For the students admitted to B.E Programme during the Academic year 2018-2019 and onwards)

1. DEFINITIONS AND NOMENCLATURE

In this regulation, unless the contest otherwise specifies

(i) **"Programme"** means Degree Programme (i.e) B.E. Degree Programme.

(ii) **"Course"** means a Theory or Practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, etc.,

2. ELIGIBILITY FOR ADMISSION

For admission to the Bachelor Degree Programme candidates will be required to satisfy the conditions of admission thereto prescribed by the Government of Tamilnadu and Anna University, Chennai. Provision is made for lateral entry candidates with Diploma in Engineering / Technology in the third semester of the programme of one of the branches of study and they will be required to satisfy the conditions of admissions thereto prescribed by the Government of Tamilnadu and Anna University, Chennai.

3. BRANCHES OF STUDY

Branches will be offered at the time of admission to the programme. The following are the branches offered in this college.

B.E. Civil Engineering

B.E. Computer Science and Engineering

B.E. Electronics and Communication Engineering

B.E. Electrical and Electronics Engineering

B.E. Mechanical Engineering

B.E. Metallurgical Engineering

4. DURATION AND STRUCTURE OF THE PROGARMME

4.1 The Minimum and Maximum period of the U.G. Full time programme are given below:

The total duration for completion of the programme shall not exceed the maximum duration irrespective of the period of break of study (vide clause 25) or prevention (vide clause 11.6) in order that the student may be eligible for the award of the degree (vide clause 23)

Programme	Minimum	Maximum
B.E. (Regular Stream)	4 Years (8 Semesters)	7 Years (14 Semesters)
B.E. (Lateral Entry)	3Years (6 Semesters)	6 Years (12 Semesters)

4.2 The duration of B.E. programme shall be 4 Years for Regular Stream and 3 Years for Lateral Entry. Each academic year will be divided into two semesters. The number of working days shall be 80 days or 540 periods (which includes the days for conducting periodical tests) each of 50 minutes duration. The number of working days shall exclude study holidays, Government holidays and end semester examination days.

4.3 Categorization of Courses

Every B.E. programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

i. **Humanities and Social Sciences (HS)** courses include Technical English, Ethics and Human Values, Communication skills.

ii. **Basic Sciences (BS)** courses include Mathematics, Physics, Chemistry, Biology, Physics laboratory, Chemistry laboratory, etc.

iii. **Engineering Sciences (ES)** courses include Engineering practices, Computer Practice, Engineering Graphics, Engineering Mechanics, Basics of Electrical / Electronics / Mechanical / Civil/ Computer Engineering etc.

iv. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/ branch.

v. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.

vi. **Open Elective (OE)** courses include the courses relevant to the chosen specialization / branch which a student can choose from the curriculum of other B.E. programmes and courses offered by the Departments under the Faculty of Science and Humanities.

vii. **Project** includes Project Work, Mini Project, Seminar, Internship and Industrial/Practical Training.

viii. **Mandatory** Course includes Environmental Science, Constitution of India, Induction Programme/**NCC / NSS / SPORTS / YRC/Yoga** activities.

4.4 The courses of study shall be both theory and practical and shall be in accordance with the prescribed syllabi.

4.5 Each semester curriculum shall normally have a blend of lecture and practical courses not exceeding 9 courses. However Employability and Enhancement course(s) may be included as additional course.

4.6 A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enroll to improve his/her marks in a course or the aggregate marks.

4.7 The medium of instruction, examination and project report shall be English, except for courses on language other than English.

4.8 Internship

The Industrial / Practical Training / Internship / Summer Project shall carry 100 marks and shall be evaluated through continuous assessment only. At the end of Industrial / Practical training / Internship / Summer Project, the student shall submit a detailed report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and Viva-voce Examination, conducted internally by a three member Departmental Committee constituted by the HOD. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to COE by the HOD with due recommendations. The training will appear in the list of Value Added Courses in the Grade Sheet with the credits (additional/extra credits) obtained.

4.9 Credit Assignment

Each course is assigned certain number of credits based on the following

Contact period per week	**CREDITS**
1 Lecture Period	1
1 Tutorial Periods	1
2 Practical Periods (Laboratory / Seminar / Project Work / Mini Project/ Internship etc.)	1

4.10 One Credit Courses

One credit courses shall be offered by a Department with the prior approval from the Board of Studies. The details of the syllabus must be approved by the Board of Studies. 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. They shall be allowed to take one credit courses offered in other Departments also with the permission of Head of the Department offering the course.

4.11 Online Courses / Self Study Courses

4.11.1 Students may be permitted to enroll for one Online Course or Self Study Course with the approval of respective Board of Studies.

4.11.2 The students can opt for Self Study Course from the list of Professional Electives provided, the students does not have any standing arrears and the CGPA should be 7.5 and above. The purpose of the course is to permit the student to study a course

of the student's choice. The students shall study on their own under the guidance of a faculty member. No formal lectures need to be delivered. One Faculty member assigned by the HOD shall be responsible for the periodic monitoring and assessment of the student in that course.

4.11.3 The Self Study Course or online Course of 3 credits can be considered instead of one Professional Elective Course.

5 COURSE ENROLLMENT AND REGISTRATION

5.1 Each student, on admission shall be assigned to a Faculty Advisor (vide clause 6) who shall advise and counsel the student about the details of the academic programme and the choice of courses considering the student's academic background and career objectives.

5.2 Every student shall enroll for the course of the succeeding semester in the current semester. However, the students shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the concerned semester.

5.3 No course shall be offered by a Department unless a minimum of 10 students register for that course.

5.4 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

5.5 Each student on admission shall register for **all the courses prescribed in the curriculum in** the student's **first Semester of study.**

5.6 The enrollment for the courses of the Semesters II to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If the student wishes, the student may drop or add courses (vide clause 5.7) within **five** working days after the commencement of the concerned semester and complete the registration process duly authorized by the Faculty Advisor.

5.7 Flexibility to Add or Drop courses

5.7.1 A student has to earn the total number of credits specified in the curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if the student wishes, then the student is permitted to earn more than the total number of credits prescribed in the curriculum of the student's programme.

5.7.2 From the III to VIII semesters, the student has the option of registering for additional courses or dropping existing courses. Total number of credits of such courses cannot exceed 6.

5.7.3 The student shall register for the project work in the respective semester only.

5.8 Fast Track System

5.8.1 Fast Track System is for meritorious B.E Full time students.

5.8.2 With the eligibility criteria he/she will be permitted to take up and complete an eight semester professional core/professional elective in the fifth semester, a professional elective in the sixth semester and a professional elective in the seventh semester under Fast track system.

5.8.3 Eligibility Criteria for opting Fast Track System: Students should have earned minimum CGPA of 7.5 up to previous semesters. There should not be any standing arrears up to IV semester for enrollment of a Professional Core/Professional elective in the V semester of study, up to V semester for enrollment of a Professional Elective in the VI semester of study and up to VI semester for enrollment of a Professional Elective in the VII semester of study.

5.8.4 If the eligibility is not satisfied at any point of time the candidate will not be permitted to continue in FAST TRACK SYSTEM and further he/she has to complete the course as per the regular system.

5.8.5 FAST TRACK SYSTEM is optional.

6 FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a teacher of the Department who shall function as Faculty Advisor for those students throughout their period of study. The Faculty Advisor shall advise the students in registering of courses, authorize the process, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

The responsibilities for the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

7 SYSTEM OF EXAMINATION

Performance in each courses of study shall be evaluated based on (i) continuous internal assessment throughout the semester and (ii) an end – semester examination.

7.1 THEORY

End-semester Examination will be conducted in all theory courses at the end of each semester for all the programmes. The maximum marks of each course shall be 100, out of which the

continuous internal assessment will carry 40 marks, while the end semester Examination will carry 60 marks.

7.2 PRACTICAL / MINI PROJECT

The practical classes for all the Practical/Laboratory component courses will be assessed continuously. The maximum marks for the Practical/Laboratory component courses shall be 100, out of which continuous internal assessment will carry 40 marks and the end semester practical examination will carry 60 marks. If any practical course contains Part A and B components, the maximum for each Part of the laboratory will be 50, out of which the continuous internal assessment will carry 20 marks, and the end semester practical examination will carry 30 marks. The end semester practical examination for award of marks shall be conducted by both Internal and External examiners.

7.3 PROJECT WORK AND VIVA – VOCE

For the project work and viva – voce examination, the maximum marks shall be 200, comprising 80 marks for internal assessment and 120 marks for the end semester examination. The end semester marks of 120 shall be awarded by both the Internal and External examiners, the project report shall carry a maximum of 40 marks (same mark must be awarded to every student of the project group) The viva-voce examination shall carry 80 marks (awarded to each student of the project group based on the individual performance in the viva-voce examination conducted by External examiner, and the Internal Examiner)

8 CLASS COMMITTEE

8.1 A Class Committee consists of teachers of the class concerned, student representatives and a chairperson selected from among the faculty who do not teach that class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Solving problems experienced by the students in the class room and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein particularly clauses 10, 11, 12 and 13 which should be displayed in the college Web site.
- Informing the student representatives the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- Informing the student representatives the details of Regulations regarding weightage used for each assessment. In the case of practical courses (laboratory / drawing / Project work / seminar etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of improving the slow learners.
- Identifying slow learner students, if any, and requesting the teachers concerned to provide additional help or guidance or coaching to such students.

8.2 The class committee for a class under a particular branch is normally constituted by the head of the department. However, if students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Principal.

8.3 The class committee shall be constituted within the first week of each semester.

8.4 At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

8.5 The chairperson of the class committee may invite the Faculty adviser(s) and the Head of the department to the meeting of the class committee.

8.6 The Principal may participate in any class committee of the institution.

8.7 The chairperson is required to prepare the minutes of every meeting, submit the same to Principal within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Head of the Institution the same shall be brought to the notice of Head of the institution by the head of the Department/Chief Faculty advisor.

8.8 The first meeting of the class committee shall be held within fifteen days from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments with the framework of the regulations. Two or three subsequent meeting may be held in a semester at suitable intervals. **The Class Committee Chairman shall put on the Notice Board the cumulative attendance particulars of each course of each student at the end of every such meeting to enable the students to know their attendance details to satisfy the clause 11 of this Regulation.** During these meetings the student members representing the entire class, shall meaningfully interact and express the opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

9 COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group shall have a ***"Course Committee"*** comprising the entire faculty teaching the common course, with one of them nominated as Course Coordinator. The nomination of the course Coordinator shall be made by the Head of the Department / Principal depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests.

10 PROCEDURE FOR AWARD OF MARKS FOR INTERNAL ASSESSMENT

10.1 Theory Courses

10.1.1 Unit Tests [75% weightage]: Three tests, each carrying FIFTY (50) marks, shall be conducted by the Department / Institution. The total marks of three tests shall be

reduced to 75 marks. However, a re-test, at the discretion of the Head of Department and approved by the Head of Institution, may be conducted for candidates with genuine reasons.

10.1.2 Assignment [12.5% weightage]: The total marks of Three assignments carrying 10 Marks each shall be reduced to 12.5 marks.

10.1.3 Tutorial / Objective Test [12.5% weightage]: The total marks of Three Tutorial / Objective Test carrying 10 Marks each shall be reduced to 12.5 marks.

The total of 100 marks shall be reduced to 40 marks (rounded off to the nearest integer).

10.2 Practical Courses with Laboratory Component

Every Practical exercise / experiment shall be evaluated based on conduct of exercise / experiment and records maintained.

There shall be atleast one test. The criteria for arriving at the internal assessment marks are:

Experiment / Record / Practical classes Performance : 60% Weightage

Practical Test : 40% Weightage

The total of 100 marks shall be reduced to 40 marks (rounded off to the nearest integer).

10.3 Project Work

There shall be three assessments during the semester by a review committee. The students shall make a presentation on the progress of the project before the committee. The Head of the Department shall constitute the review committee consisting of HOD, Guide and a senior member of faculty. The criteria for arriving at the internal assessment marks for the Project Work evaluated for 80 marks are:

Work assessed by the Project Guide : 50% Weightage

Work assessed by the Committee : 50% Weightage

The total of 100 marks shall be reduced to 80 marks (rounded off to the nearest integer).

10.4 Faculty incharge of the subject

Every teacher is required to maintain an **'ATTENDANCE AND ASSESSMENT RECORD'** for every semester which consists of attendance marked in each theory / Laboratory / EEC class, the assessment marks and the record of class work (topics covered), for each course handled by the teacher. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the records of assessment marks and attendance. The Head of the Department will affix his/her signature and date after due verification. At the end of the semester, the record should be verified by the Head of the Department who shall keep this document in safe custody (for seven years). The records of attendance and assessment of both current and previous semesters should be available for inspection.

10.5 Assessment for Industrial / Practical Training / Internship / Summer Project

The Industrial / Practical Training / Internship / Summer Project shall carry 100 marks and shall be evaluated through Continuous Assessment only. At the end of Assessment for Industrial /

Practical Training / Internship / Summer Project, the student shall submit a detailed report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a Viva-voce Examination, conducted internally by a three member Departmental Committee constituted by the HOD. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to COE by the HOD with due recommendations. The training will appear in the list of value Added Courses in the grade sheet with the credits (additional / extra credits) obtained.

10.6 Assessment for Value Added one Credit Course

The Value Added One Credit Course shall carry 100 marks and shall be evaluated through **Continuous Assessment only.** Two assessments shall be conducted during the semester by the Department concerned. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer. The HOD may identify a faculty member as Coordinator for the course. A committee consisting of the HOD, staff handling the course (if available), Programme Coordinator and a Senior Faculty nominated by the HOD shall monitor the evaluation process.

10.7 Assessment for Online Course

Students may be permitted to earn Online Courses (which are provided with certificate) with the approval of Board of Studies and HOD subject to a minimum of three credits. This Online Course of 3 credits can be considered instead of one Elective Course. Respective Boards of Studies will take a decision on the evaluation methodology for the online course. The BOS can decide whether to evaluate through End Semester Examination only and the same way be conveyed to the COE, at the beginning of the semester whenever the course is offered. The students need to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the Institution. The HOD may identify a Faculty member Coordinator for the course, who is responsible for the evaluation of Continuous Assessment.

10.8 Assessment for Self Study Course

The faculty members approved by the HOD shall be responsible for periodic monitoring and evaluation of the self study course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

10.9 Assessment for MOOC Courses

Students may be permitted to earn credits through MOOC Courses with the approval of Board of Studies and HOD subject to a maximum of six credits per semester. The credits earned from the MOOC courses can be transferrable subject to the approval of the respective Performance Analysis Committee and no additional assessment is required.

11 REQUIREMENTS FOR COMPLETION OF A SEMESTER

A candidate who fulfils the following conditions shall be deemed to have satisfied the requirements for completion of a semester.

11.1 He/She secures not less than 75% of attendance for each course with the total number of working hours specified in the respective curriculum.

11.2 Candidates representing University in State / National / International / Inter University Sports events, paper or project presentation in National / International Conference with prior permission from the Head of the Institution are given exemption upto 10% of the required attendance and such candidates shall be permitted to appear for the current semester examination on condonation (attendance 65% to 74%)

11.3 Candidates who could not attend classes continuously due to Trauma/Infectious diseases / Surgeries requiring continuous medical attention, on submission of a valid medical certificate in time, obtained from a Government doctor not below the rank of Assistant Surgeon, are given exemption upto 10% of the required attendance and shall be permitted to appear for the current semester examination on condonation (attendance 65% to 74%)

11.4 Permission mentioned in 11.2 and 11.3 can be allowed only twice during his/her entire course of study.

11.4.1 Fees for 1st time condonation Rs.1000/- for one course and Rs. 300/- for every additional course

11.4.2 Fees for 2nd time condonation Rs.5000/- for one course and Rs. 1000/- for every additional course

11.5 His/her conduct should be certified to be satisfactory by the Head of the Department concerned and Head of the Institution.

11.6 Candidate who does not secure 75% attendance in any one or more courses, will not be permitted to write the end semester examinations for that/those courses. However he will be permitted to move to the next semester and re-register for those courses in the next semester after earning attendance and internal marks from the course coordinator through contact hours.

11.7 Candidates who do not complete all the courses in that semester (as per clause 11.1, 11.2 and 11.3), will not be permitted to write the end-semester examination and are not permitted to move to next semester. However, they will be permitted to write the arrear examination, if any. They are required to repeat the incomplete semester in the next academic year getting the necessary permission from the authorities.

12 REQUIREMENTS FOR APPEARING FOR END SEMSTER EXAMINATION

A candidate shall normally be permitted to appear for the end semester examination of the current semester, if he/she has satisfied the semester completion requirements (subject to Clause 11.1 with 11.2 and 11.3) and has registered for examination in all courses of that semester. Registration is mandatory for arrear subjects along with current semester examinations, failing which the candidate will not be permitted to move to the higher semester.

12.1 Reappearance Registration

12.1.1 If a student fail in a theory course, the reappearance registration for that course in the subsequent semester is mandatory.

12.1.2 The student may attend the classes for the reappearance registration courses, if the student wishes. However, the attendance requirement (vide clause 11) is not compulsory for such courses.

13 END – SEMESTER EXAMINATION

13.1 There shall be one end – semester examination of 3 hour duration in each lecture – based course.

13.2 The Project report of B.E. programme will be evaluated based on the report and a viva-voce examination by an External Examiner and an Internal Examiner.

13.3 The following will be the weightage for different courses.

13.3.1 Theory courses	: Internal Assessment – 40%
	: End-Semester Examination – 60%
13.3.2 Laboratory based Courses	: Internal Assessment – 40%
	: End-Semester Examination – 60%
13.3.3 Project work [Maximum Marks: 200]	: Internal Assessment – 40%
	: End-Semester Examination – 60%
Internal Assessment – 80 marks	: End-Semester Examination – 120 Marks
[Supervisor: 40 marks, committee: 40 marks]	: [evaluation for project report (by External Examiners): 40 Marks and Viva-Voce: 80 marks (Internal and External Examiners]

14 PASSING REQUIREMENTS

14.1 The minimum number of total credits to be earned through successful completion of the courses of study of the respective branch by a candidate to qualify for the award of degree in the various branches of study is provided below.

Branch of study	Minimum number of credits to be earned through successful completion of the courses of study of the respective branch, for the award of degree	
	For regular entry (entry at first Semester)	For lateral entry (entry at third semester)
Civil Engineering	160	121
Computer Science & Engineering	159	120
Electronics & Communication Engineering	160	121
Electrical & Electronics Engineering	157	118
Mechanical Engineering	160	121
Metallurgical Engineering	161	122

14.2 For each theory and laboratory courses, examination will be conducted for 100 marks. A candidate who secures 50% marks and above in the end semester examination, and 50% in continuous assessment and end semester examination both put together, shall be declared to have passed the examination in that course.

14.3 A candidate who successfully completes the course requirements and passes all the prescribed examinations in all the eight semesters within a maximum period of 7 years (14 semesters), reckoned from the commencement of the first semester to which the candidate was admitted in regular stream and [six semesters within a maximum period of 6 years (12 semesters), reckoned from the commencement of the third semester to which the candidate was admitted for lateral entry], is eligible to get the degree.

15 REVALUATION

15.1 Copies of answer script for theory course(s) can be obtained from the Office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

15.2 A candidate can apply for revaluation or photo copy cum revaluation of his/her semester examination answer paper in a theory course, within a week from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations, as per norms given by the chairman, Academic Council. Revaluation is not permitted for Practical Courses and for Project work.

16 CHALLENGING THE REVALUATION

Challenging the revaluation is permitted for those students who have applied for photocopy of answer script. The copy of the answer script is to be valued by a competent authority and the valued script should be submitted to COE's office along with prescribed fee for challenging the revaluation within 2 days after declaration of the revaluation results.

17 MALPRACTICE

If a student indulges in malpractice in any of the end-semester examinations, he/she shall be liable to face punitive action as prescribed by the Controller of Examination, Government College of Engineering, Salem.

18 PROCEDURE FOR USING SCRIBE

If a candidate is physically challenged / meets with accident or suffers from ill health at the time of examination, then he/she may be permitted to use a scribe to write the examination on payment of a prescribed fee through proper application to the Office of the Controller of Examinations. In such case, maximum one hour extra time will be permitted. The scribe shall be a non-engineering student/ graduate.

19 PROVISION FOR WITHDRAWAL FROM EXAMINATION

19.1 A candidate who satisfies Clause 12, may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

19.2 Such withdrawal shall be permitted only ONCE during the entire period of study of the degree programme.

19.3 Withdrawal application is valid only it is made 10 days prior to the commencement of the examination in that course or courses and is recommended by the Head of the Department and approved by the Head of the Institution.

19.4 Notwithstanding the requirement of the mandatory TEN days notice, application of withdrawal for special case under extraordinary conditions will be considered on the merit of the case.

19.5 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is also applicable to those who seek withdrawal during VIII semester.

19.6 Withdrawal from the end semester examination is NOT applicable to arrear subjects of previous semesters.

19.7 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

20 AWARD OF THE LETTER GRADES

20.1 The letter grade and the grade point are awarded based on percentage of marks secured by a candidate in individual course as detailed below:

Range of Total Marks	Letter Grade	Grade Points (GP)
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	RA	0
Incomplete	I	0
Withdrawal	W	0
Withheld	WH	0

"RA" denotes "reappearance" in the course.

"I" denotes "incomplete" as per clause 11.1 and hence prevention from writing End Semester Examination.

"W" denotes "withdrawal" from the course.

"WH" denotes "withheld" due to malpractice etc.

20.2 For the Co–curricular activities such as National Cadet Corps (NCC)/ National Service Scheme (NSS) / SPORTS / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement before the completion of final semester. **A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.**

20.3 For zero credit courses Excellent / Good / Satisfactory grading will appear in the grade sheet.

21 PROCEDURE FOR COMPLETING THE PROGRAMME

21.1 A candidate, who, for some reason has discontinued the programme can join the programme of study in any semester only at the time of its normal commencement in the Institution for regular students, upon satisfying all the following conditions:

(a) He / she should have completed the course of study of the previous semesters.

(b) He / she should be eligible to register for the examinations and satisfy rule 11.1

(c) He / she should have registered for all the examinations of the previous semesters.

21.2 A candidate will be permitted to proceed from one semester to the next higher semester only if he / she satisfies the regulation for eligibility to appear for the end-semester examination in the semester concerned, subject to the condition that the candidate should register for all the arrear courses in the lower semesters along with the current (higher) semester courses.

21.3 A candidate should have completed the B.E Degree course within a period of SEVEN consecutive academic years (14 semesters) for regular stream [SIX consecutive academic years (12 semesters) for lateral entry] from the date of admission to the course, even if the candidate discontinues and rejoins subsequently, to be eligible for the award of the degree.

22 ISSUE OF GRADE SHEETS AND GPA, CGPA CALCULATION

Individual Grade sheet for each semester will be issued through the Head of the Department concerned, after the publication of the results with following details.

- The list of courses enrolled during the semester and the grade scored.
- The Grade Point Average (GPA) for the semester and
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

$$GPA = \frac{\text{Sum of } [CXGP]}{\text{Sum of } C}$$

Where C – credit of a particular subject/Course

GP – grade point obtained by the student in the respective subject/Course.

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. "RA", "I" and "W" grades will be excluded for calculating GPA and CGPA.

23 ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the B.E. Degree provided the candidate has

i) Successfully completed the course requirements and has passed all the prescribed examinations in all the 8 semesters within a maximum period of 7 years for regular stream (6 semesters within a maximum period of 6 years for lateral Entry) from the commencement of first semester (third semester) to which the candidate was admitted.

ii) No disciplinary action is pending against him/her.

iii) Successfully completed NCC/NSS/SPORTS/YRC requirements.

24 CLASSIFICATION OF THE DEGREE AWARDED

24.1 FIRST CLASS WITH DISTINCTION

A candidate who qualifies for the Degree by passing the examinations in all courses of the entire programme, in first attempt, within a period of eight semesters for regular stream (six semesters for lateral entry) from the date of admission to the programme with CGPA not less than 8.50 for the entire programme shall be declared to have passed the examination for the degree in FIRST CLASS WITH DISTINCTION. For this purpose the withdrawal from examination will not be construed as an appearance. Further, the authorized break of study will not be counted for the purpose of classification.

24.2 A candidate transferred from other Institution, who qualifies for the degree by passing the examinations in all courses of the entire programme in first attempt, within a period of eight Semesters for regular stream and six semesters for Lateral Entry stream from the date of admission to the programme with CGPA not less than 8.50 for the entire programme shall be declared to have passed the examination for the degree in FIRST CLASS WITH DISTINCTION. For this purpose the withdrawal from examination will not be construed as an appearance. Further, the authorized break of study will not be counted for the purpose of classification.

24.3 FIRST CLASS

A candidate who qualifies for the award of the Degree, having passed the examinations in all the courses of the entire programme (first to eight semesters) within a maximum period of NINE consecutive semesters for regular stream (third to eight semesters) for lateral entry stream within a maximum period of SIX semesters, from the date of admission to the programme with CGPA not less than 7.00 for the entire programme, shall be declared to have passed the

examination for the degree in FIRST CLASS. For this purpose, the authorized break of study will not be counted for the purpose of classification.

24.4 SECOND CLASS

All other successful candidates shall be declared to have passed the examinations for the Degree in SECOND CLASS.

24.5 A candidate who is absent for semester examination in a course / project work after having registered for the same shall be considered to have attempted that examination for the purpose of classification.

25 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

25.1 Break of study shall be granted only ONCE for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Head of the Institution (through Head of the Department) in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Principal of the Institution stating the reasons there for and the probable date of rejoining the programme.

25.2 The candidate permitted to rejoin the programme after the break shall be governed by the Curriculum and Regulations in force at the time of rejoining. If the Regulation is changed, then, those candidates may have to do additional courses as prescribed by the head of the department and approved by the Academic Council.

25.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (vide clause 23). However, additional break of study granted will be counted for the purpose of classification.

25.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified irrespective of the period of break of study (vide clause 4.1) in order that he/she may be eligible for award of the degree.

25.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' or 'Withdrawal' (clause 18 and 24) and is not applicable in this case.

26 DISCIPLINE

Every student is required to observe discipline and decorous behaviour both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the college. In

the event of an act indiscipline being reported, the Principal shall constitute a discipline committee consisting of three Heads of Department, of which one should be from the faculty of the student, to inquire into acts of indiscipline. The disciplinary action is subject to review by the University in case the student represents to the University. Any expulsion of the student from the college shall be with prior concurrence from Director of Technical Education / University.

27 RANK OF A STUDENT

A candidate who qualifies for the Degree by passing the examination in all courses of the entire programme in the first attempt within a period of EIGHT Semesters from the date of admission to the course can be given his/her position in the class as rank. The rank is determined from the I Semester to VIII Semester end semester examination mark percentage. Students transferred from other Institutions to Government College of Engineering, Salem and lateral entry students are not eligible for rank.

28 PERSONALITY AND CHARACTER DEVELOPMENT

All students shall enroll, on admission, in any one of the personality and character programmes (the **NCC / NSS / SPORTS / YRC)**. The programme shall include classes on hygiene and health awareness and also training in first-aid.

National Cadet Corps (NCC) programme will have about 20 parades.

National Service Scheme (NSS) will have social service activities in and around college/institution.

SPORTS Games, Drills, Physical exercises etc.

Youth Red Cross (YRC) will have activities related to social services in and around college/institution.

While the training activities will normally be during weekends, the camp will normally be during vacation period.

29 REVISION OF REGULATIONS CURRICULUM AND SYLLABI

The college may from time to time revise, amend or change the regulations, scheme of examinations and syllabus, if found necessary.

VISION OF THE DEPARTMENT:

To make ethically and emotionally strong Electrical Engineers of high caliber capable of meeting the national and global technological challenges for the well being of the Society.

MISSION OF THE DEPARTMENT:

- To Impart state of the art Knowledge in Electrical Science and Technology through under-graduate and graduate programmes
- To develop the Electrical Engineering Department as a centre of Excellence in Power Electronics and Industrial Drives.
- To provide Knowledge base and Consultancy services to the society at large and in particular for the upliftment and well being of the rural and tribal communities.

VISION AND MISSION OF THE INSTITUTION:

Vision

- We envision our students as excellent Engineers not only in the field of Science and Technology, but also in good citizenship and discipline.
-
- Our commitment lies in producing comprehensive knowledge seekers and humane individuals, capable of building a strong and developed nation.

Mission

- To impart update technical education and knowledge.
- To groom our young students to become professionally and morally sound engineers.
- To teach global standards in production and value based living through honest and scientific approach.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates will be employed electrical engineering profession as experts in solving electrical engineering problems by their depth of understanding in core electrical knowledge and/or completed/pursuing post graduate study or research.

PEO 2: Graduates will have awareness for lifelong learning and continued professional development

PEO 3: Graduates will demonstrate creativity in their engineering practices including entrepreneurial and collaborative ventures with strategic thinking, planning and execution

PEO 4 Graduates will communicate effectively, recognize and incorporate societal needs and constraints in their professional endeavors and practice their profession with high regard to legal and ethical responsibilities

PEO 5: Graduates will have necessary foundation on computational platforms and software applications related to the field of electrical and electronics engineering

PROGRAM OUTCOMES (POs):
Engineering Graduates will be able to

PO1 Apply knowledge of mathematics and engineering sciences to the solution of complex electrical engineering problems

PO2 Identify, formulate, and solve complex engineering problems using multidisciplinary knowledge.

PO3 Design solutions for complex engineering problems and system design to meet the needs of public considering the health, safety, cultural, societal, and environmental factors.

PO4 Apply research-based knowledge and research methods to complex problems including design, analysis, interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Create, select, and apply appropriate techniques, simulation tools for prediction and modeling of engineering activities with their limitations.

PO6 Assess societal, health, safety, legal and cultural issues relevant to the electrical engineering profession.

PO7 Provide the electrical engineering solutions for sustainable development.

PO8 Apply ethical principles and responsibilities for electrical engineering practice.

PO9 Function effectively as an individual member or leader in diverse teams, and in multidisciplinary projects.

PO10 Communicate effectively with the engineering community and with society at large, such as, write effective reports and design documentation, and make effective presentations.

PO11 Apply engineering and management principles to one's own work, or in a team, to manage projects in multidisciplinary environments.

PO12 Recognize the need of lifelong learning for professional development and personnel growth.

PROGRAM SPECIFIC OUTCOMES (PSOs):
Electrical and Electronics Engineering Graduates will be able to

PSO1: Apply knowledge of mathematics, engineering sciences and multidisciplinary knowledge to the solution of electrical and electronics engineering problems

PSO2: Apply research-based knowledge, appropriate techniques, IT tools to complex Electrical and Electronics Engineering problems including design, analysis, interpretation of data, and synthesis of the information to provide valid conclusions.

PSO3: Apply ethical principles, management skills and responsibilities for electrical and electronics engineering profession.

PSO4: Recognize the need of independent and lifelong learning for professional development and personnel growth

GOVERNMENT COLLEGE OF ENGINEERING: : SALEM – 636011
(NAAC Accredited)

Regulations 2018-Autonomous Courses
(For Students Admitted from 2018-2019)
B.E. Electrical and Electronics Engineering- Full Time

Course Code	Course Title	Category	Contact periods	Hours/week				Maximum Marks		
				L	T	P	C	CA	FE	Total
FIRST SEMESTER										
THEORY										
18EN101	Professional English	HS	2	2	0	0	2	40	60	100
18MA102	Matrices, Calculus and Differential Equations	BS	4	3	1	0	4	40	60	100
18CY101	Chemistry	BS	4	3	1	0	4	40	60	100
18CS101	Fundamentals of Problem Solving and C Programming	ES	3	3	0	0	3	40	60	100
PRACTICAL										
18EN102	Professional English Laboratory	HS	2	0	0	2	1	40	60	100
18CS102	Computer Practice Laboratory	ES	4	0	0	4	2	40	60	100
18ME102	Workshop/Manufacturing Practices	ES	5	1	0	4	3	40	60	100
18MC102	Induction Programme	MC					0	100	-	100
SECOND SEMESTER										
THEORY										
18MA204	Fourier Series and Transforms	BS	4	3	1	0	4	40	60	100
18PH202	Physics- Waves & Optics and Quantum Mechanics	BS	4	3	1	0	4	40	60	100
18ME101	Engineering Graphics and Design	ES	5	1	0	4	3	40	60	100
18CM201	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4	40	60	100
PRACTICAL										
18PH103	Physics Laboratory	BS	3	0	0	3	1.5	40	60	100
18CY102	Chemistry Laboratory	BS	3	0	0	3	1.5	40	60	100

18EN103	Professional Communication Laboratory	HS	2	0	0	2	1	40	60	100
18CE201	Basic Civil Engineering Laboratory	ES	2	0	0	2	1	40	60	100
THIRD SEMESTER										
THEORY										
18MA302	Statistics and Numerical Methods	BS	4	3	1	0	4	40	60	100
18EE301	Electric Circuit Analysis	PC	4	3	1	0	4	40	60	100
18EE302	Electromagnetic Fields	PC	4	3	1	0	4	40	60	100
18EE303	DC Machines and Transformers	PC	3	3	0	0	3	40	60	100
18EE304	Electron Devices and Circuits	PC	4	3	1	0	4	40	60	100
PRACTICAL										
18EE305	DC Machines and Transformers Laboratory	PC	3	0	0	3	1.5	40	60	100
18EE306	Electron Devices and Circuits Laboratory	PC	3	0	0	3	1.5	40	60	100
18CYMC01	Environmental Science	MC	1	0	0	1	0	100	-	100
FOURTH SEMESTER										
THEORY										
18EE401	Signals and Systems	PC	3	2	1	0	3	40	60	100
18EE402	Synchronous and Induction Machines	PC	3	3	0	0	3	40	60	100
18EE403	Measurements and Instrumentation	PC	3	3	0	0	3	40	60	100
18EE404	Analog and Digital Integrated Circuits	PC	3	3	0	0	3	40	60	100
18ME408	Engineering Mechanics	ES	3	2	1	0	3	40	60	100
PRACTICAL										
18EE405	Synchronous and Induction Machines Laboratory	PC	3	0	0	3	1.5	40	60	100
18EE406	Measurements and Instrumentation Laboratory	PC	3	0	0	3	1.5	40	60	100
18EE407	Analog and Digital Integrated Circuits Laboratory	PC	3	0	0	3	1.5	40	60	100

18MC301	Indian Constitution	MC	1	1	0	0	0	100	-	100
FIFTH SEMESTER										
THEORY										
18EE501	Power Generation, Transmission and Distribution System	PC	3	3	0	0	3	40	60	100
18EE502	Control Systems	PC	4	3	1	0	4	40	60	100
18EE503	Power Electronics	PC	3	3	0	0	3	40	60	100
18EE504	Microprocessor and Microcontroller	PC	3	3	0	0	3	40	60	100
18EEPXX	Program Elective – 1	PE	3	3	0	0	3	40	60	100
18EE0EXX	Open Elective-1	OE	3	3	0	0	3	40	60	100
PRACTICAL										
18EE505	Control System Laboratory	PC	3	0	0	3	1.5	40	60	100
18EE506	Power Electronics Laboratory	PC	3	0	0	3	1.5	40	60	100
18EE507	Microprocessor and Microcontroller Laboratory	PC	3	0	0	3	1.5	40	60	100
SIXTH SEMESTER										
THEORY										
18EE601	Power System Analysis and Stability	PC	3	3	0	0	3	40	60	100
18EE602	Electrical Drives and Control	PC	3	3	0	0	3	40	60	100
18EE603	Professional Ethics and Human Values	HS	3	3	0	0	3	40	60	100
18EEPXX	Program Elective – 2	PE	3	3	0	0	3	40	60	100
18EEPXX	Program Elective – 3	PE	3	3	0	0	3	40	60	100
18EE0EXX	Open Elective-2	OE	3	3	0	0	3	40	60	100
PRACTICAL										
18EE604	Mini Project	EEC	4	0	0	4	2	40	60	100
18EN501	Communication Skills Laboratory	HS	2	0	0	2	1	40	60	100
18EE605	Summer Internship	MC					0	100	-	100

SEVENTH SEMESTER										
THEORY										
18EE701	Power System Protection and Switch Gear	PC	3	3	0	0	3	40	60	100
18EE702	Industrial Management and Economics	HS	3	3	0	0	3	40	60	100
18EEPXX	Program Elective – 4	PE	3	3	0	0	3	40	60	100
18EE0EXX	Open Elective-3	OE	3	3	0	0	3	40	60	100
18EE0EXX	Open Elective-4	OE	3	3	0	0	3	40	60	100
PRACTICAL										
18EE703	Power Systems Laboratory	PC	3	0	0	3	1.5	40	60	100
18EE704	Electrical Drives and Control Laboratory	PC	3	0	0	3	1.5	40	60	100
EIGHTH SEMESTER										
THEORY										
18EEPXX	Program Elective – 5	PE	3	3	0	0	3	40	60	100
18EEPXX	Program Elective –6	PE	3	3	0	0	3	40	60	100
PRACTICAL										
18EE801	Project Work	EEC	16	0	0	16	8	40	60	100
Total Number of Credits									**157**	

B.E. Electrical and Electronics Engineering - Full Time

Programme Electives

S.No	Course Code	Course Title	Category	Contact	Hours/week & Credits				Maximum Marks			Preferred Semester
					L	T	P	C	CA	FE	Total	
1	18EEP01	Electrical Machine Design	PE	3	3	0	0	3	40	60	100	V
2	18EEP02	Biology for Electrical Engineers	PE	3	3	0	0	3	40	60	100	V
3	18EEP03	Digital Signal Processing	PE	3	3	0	0	3	40	60	100	V
4	18EEP04	Discrete Control Systems	PE	3	3	0	0	3	40	60	100	V
5	18EEP05	High Voltage Engineering	PE	3	3	0	0	3	40	60	100	VI
6	18EEP06	HVDC Transmission Systems	PE	3	3	0	0	3	40	60	100	VI
7	18EEP07	EHVAC Transmission Systems	PE	3	3	0	0	3	40	60	100	VI
8	18EEP08	FACTS Controllers	PE	3	3	0	0	3	40	60	100	VI
9	18EEP09	Power Quality	PE	3	3	0	0	3	40	60	100	VI
10	18EEP10	Utilization of Electrical Energy	PE	3	3	0	0	3	40	60	100	VI
11	18EEP11	Electrical Energy Conservation and Auditing	PE	3	3	0	0	3	40	60	100	VI
12	18EEP12	Power System Operation and Control	PE	3	3	0	0	3	40	60	100	VI
13	18EEP13	Distributed Generation and Micro Grid	PE	3	3	0	0	3	40	60	100	VII
14	18EEP14	Wind and Solar Energy Systems	PE	3	3	0	0	3	40	60	100	VII
15	18EEP15	Electrical and Hybrid Vehicles	PE	3	3	0	0	3	40	60	100	VII
16	18EEP16	Soft Computing and Machine Learning	PE	3	3	0	0	3	40	60	100	VII
17	18EEP17	Advanced Electric Drives	PE	3	3	0	0	3	40	60	100	VIII
18	18EEP18	Computational Electromagnetics	PE	3	3	0	0	3	40	60	100	VIII

19	18EEP19	Special Electrical Machines	PE	3	3	0	0	3	40	60	100	VIII
20	18EEP20	Electrical Wiring Estimation and Costing	PE	3	3	0	0	3	40	60	100	VIII
21	18EEP21	Total Quality Management	PE	3	3	0	0	3	40	60	100	VIII
22	18EEP22	Restructured Power System	PE	3	3	0	0	3	40	60	100	VIII
23	18EEP23	Industrial Electrical Systems	PE	3	3	0	0	3	40	60	100	VIII
24	18EEP24	Smart Grid	PE	3	3	0	0	3	40	60	100	VIII

B.E. Electrical and Electronics Engineering - Full Time

Open Electives

S.No	Course Code	Course Title	Category	Contact Hrs	Hours/week & Credits				Maximum Marks		
					L	T	P	C	CA	FE	Total
1	18EEOE1	Renewable Energy Sources	PE	3	3	0	0	3	40	60	100
2	18EEOE2	Smart Grid Technology	PE	3	3	0	0	3	40	60	100
3	18EEOE3	Energy Conservation and Management	PE	3	3	0	0	3	40	60	100
4	18EEOE4	Electric Vehicles	PE	3	3	0	0	3	40	60	100

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
GOVERNMENT COLLEGE OF ENGINEERING: : SALEM – 636011
(An Autonomous Institution Affiliated to Anna University)
Degree: B.E.
Branch: Electrical and Electronics Engineering
SUMMARY

Course Work	Credits recommended by AICTE	Credits % for AICTE recommendation	Credits	% Credits
Humanities and Social Sciences (HS)	12	7.59	11	7.00
Basic Sciences (BS)	26	16.45	23	14.64
Engineering Sciences (ES)	20	12.65	19	12.10
Program Core (PC)	53	33.54	64	40.76
Program Electives (PE)	18	11.39	18	11.46
Open Electives (OE)	18	11.39	12	7.64
Employment Enhancement Course (EEC)	11	6.96	10	6.36
Mandatory Courses (Zero Credit)	0	0	0	0
Total Credits	158	100	157	100

HS-Humanities and Social Sciences

BS-Basic Sciences

ES-Engineering Sciences

PC-Program Core

PE-Program Electives

OE-Open Electives

EEC-Employment Enhancement Course

18EN101	PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives:

1.	Master basic reading skills such as phonics, word recognition and meaningful division of sentences.
2.	Read fast, decode accurately and remove oral reading errors that affect text meaning.
3.	Acquire and develop writing skills for academic, social and professional purposes.
4.	Gain skills in academic and functional writing tasks.

Writing

1. Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices.
2. Email – Training Programme and related details, paper submission for seminars and conferences, Fixing an appointment, Arranging and Cancelling a meeting with team members, conference details, hotel accommodation, Reminder mails, Raising queries with team members, Congratulatory mails at work, arranging for a meeting with a foreign client, personal emails.
3. Letter Writing – Business and need based communication – Formats of official, personal and business letters, official leave and request applications (Bonafide certificate, course completion, conduct certificate, permission to arrange industrial visits) complaints, replies to queries from business customers, inviting dignitaries, accepting and declining invitations, placing orders, cover letter for a job application with resume.
4. Technical Report Writing – status reports – Work Done in the Project, Feasibility Reports on Office Accommodation, Introduction of New Products, Sales Promotion, Customers Feedback, Starting a New Company, Event Reports- Seminars, Conferences, Meeting, Recommendations and Checklists.
5. Charts- interpreting pie charts, graphs etc.,

READING:

1. Understanding notices, messages, timetables, adverts, graphs, etc.- understanding meaning and purpose of short texts
2. Gapped sentences – Meanings, collocations and meanings of individual words.
3. Reading passage with multiple choice questions – reading for gist and reading for specific information – skimming for general idea of and meaning and contents of the whole text.
4. Short reading passage; gap-filling – Grammar, especially prepositions, articles, auxiliary verbs, modal verbs, pronouns, relative pronouns and adverbs.
5. Short reading passages; sentence matching – Scanning – ability to pick out specific information in a short text.

METHODOLOGY:

Objective Type:

1. Vocabulary of business communication.
2. Collocations related to technical and business.
3. Coherence in paragraphs – use of sequence clues.
4. Conversations and appropriate responses.
5. Tenses with time makers.
6. Verbal phrases
7. Description of objects in a sentence or two
8. Products and likely slogans
9. Tone, vocabulary, expressions in formal and informal letters.
10. Email writing- tone, vocabulary, expressions, mail ID., creation, CC, BCC.

Descriptive Writing:

1. Skimming and scanning to look for specific information.
2. Spotting Errors.
3. Email writing in different work place/ profession based contexts with hints.
4. Letter writing in different business based contexts with hints.
5. Report writing: feasibility report, progress in project reports, accident reports and event reports.

6. Checklists in business, office and profession based context. 7. Recommendations in business, office and profession based context. 8. Resume and Cover letter. 9. Mind mapping visuals on social and environmental issues – essay writing based on the given mind map visual.		
Total (30+0)=30 Periods		
Course Outcomes:		
Upon completion of this course, the students will be able to		
CO1	:	Read and summarize the main ideas, key details and inferred meanings from a passage.
CO2	:	Internalize the grammar items such as prepositions, articles, tenses,verbs, pronouns, and adverbs adjectives through contexts andapply them to spot errors.
CO3	:	Develop the ability to classify, check information and prepare reports.
CO4	:	Apply the academic and functional writing skills in new contexts.
CO5	:	Interpret pictorial representation of data and statistic.

Text Books:

1.	Norman Whitby. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, Cambridge University Press, 2014.

Reference Books:

1	M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill.2017 ,2nd edition
2	Farhathullah, T.M. Communication Skills for Technical Students.2002
3	Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2015,3rd edition.
4	David F. Beer and David McMurray, Guide to Writing as an Engineer, John Willey. New York, 2019.
5	Collins Cobuild- Student's Grammar: Self-Study Edition with Answers (Collins Cobuild Grammar) paperback- 6 May 1991.
6	. Essential English Grammar paperback Raymond Murphy CUP 2015,3rd edition.
7	Speak Better Write Better English paperback – Nov 2012, Norman Lewis, Goyal Publishers and Distributors. Essential English Grammar Paperback Raymond Murphy CUP 2019.
8	English Reading Comprehension RPH Editorial Board.2020
9	Proficiency in Reading Comprehension Simplifying the 'Passage' for you, 2020 Ajay Singh.6

E-Reference

1	https://play.google.com/store/apps/details?id=com.zayaninfotech.english.grammar.
2	http://www.onestopenglish.com/grammar/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1		3		1		1	2	3	1	2
CO2		2		2				1	1	3	2	3
CO3		1		1		1		1	2	3	1	2
CO4		1		2		1		1		3	1	2
CO5		2		3				1	1	3	1	3

18MA102	MATRICES, CALCULUS AND DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To know the use of matrix algebra needed by engineers for practical applications.
2.	To understand effectively the geometrical application of differential calculus and integral calculus.
3.	To familiarize the solutions of ordinary differential equations of higher order.
4.	To obtain the knowledge of solving partial differential equations of higher order with constant coefficients.
5.	To acquire the knowledge of vector differentiation and integration and its applications

Unit I	MATRICES	9	+	3

Symmetric, Skew Symmetric and Orthogonal Matrices – Characteristic equation of a Matrix – Eigen values and Eigen vectors – Properties – Cayley-Hamilton theorem (excluding proof) – Diagonalization of Matrices - Reduction of quadratic form to canonical form by orthogonal transformation.

Unit II	MULTI VARIABLE CALCULUS	9	+	3

Maxima, Minima and Saddle point- – Method of Lagrangian multipliers- Multiple integrals- Double integrals – Change of order of integration in double integrals – Change of variables (Cartesian to Polar) – Application to Areas – Evaluation of Triple integrals – Application to volumes.

Unit III	ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER	9	+	3

Second order linear differential equations with constant and variable coefficients –Cauchy-Euler equation and Cauchy- Legendre's linear equation - Method of variation of parameters –Simultaneous first order linear equations with constant coefficients

Unit III	PARTIAL DIFFERENTIAL EQUATIONS	9	+	3

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

Unit V	VECTOR CALCULUS	9	+	3

Vector differentiation- Gradient- Directional derivative - Divergence - Curl , Vector integration- Line integration- work done – Surface and Volume integrals - Green's theorem , Gauss divergence and Stokes theorem (without proof) – Simple applications involving cubes and rectangular parallelopipeds.

Total (45+15)=60 Periods

Course Outcomes:

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

CO1	:	Learn the fundamental knowledge of Matrix theory.
CO2	:	Familiar with the concept of the differentiation and integration and its applications.
CO3	:	Acquire skills in applications of Vector Calculus.

Text Books:

1.	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, (2015).
2.	Veerarajan T., "Engineering mathematics for first year", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009

Reference Books:

1	James Stewart, "Essential Calculus", Cengage Learning, New Delhi, 2nd edition, 2013.
2	P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year B.E., B.Tech)", Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010.
3	Srimanta pal and Subath.C.Bhumia, "Engineering Mathematics", Oxford university publications, New Delhi, 2015
4	Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006.

5	Sivaramakrishnadas.P, Ruknmangadachari.E. “Engineering Mathematics”, Pearson, Chennai & Delhi, 2nd edition, 2013

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	1	2	1	1	1	1	1
CO2	3	2	2	2	1	1	2	1	2	1	1	2
CO3	3	2	2	2	1	1	2	1	1	1	1	2

18CY101	CHEMISTRY	L	T	P	C
		3	1	0	4

Course Objectives:

1	Analyze microscopic chemistry in terms of atomic and molecular orbitals.
2	Rationalize periodic properties of elements and the knowledge of acids and bases.
3	Analyze the stereo chemical aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules
4	Rationalize bulk properties and processes in thermodynamic aspects and its extension in electrochemical processes.
5	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

Unit I **MOLECULAR STRUCTURE** **9 + 3**

Formation of molecular orbitals of diatomic molecules - energy level diagrams of – H2, He2, N2, O2, CO and NO- bond order, bond length, bond energy, magnetic behavior and relative stability ;

Aromaticity- Huckel rule - concept of aromaticity - aromatic, non-aromatic and anti-aromatic molecules- benzenoid, non-benzenoid and annulenes only;

Crystal field theory – postulates-d-orbital splitting in octahedral and tetrahedral complexes-strong field and weak field ligands-spectrochemical series-high spin and low spin complexes-magnetic properties of complexes-crystal field stabilization energy(CFSE) and its calculations for octahedral and tetrahedral complexes

Unit II **PERIODIC PROPERTIES & ACID-BASE CONCEPTS** **9 + 3**

Effective nuclear charge – shielding effect, penetration of orbitals - variations of s, p, d and f orbital energies of atoms –Aufbau principle - electronic configuration of elements – periodic properties - atomic and ionic size, ionization energy, electron affinity and electro negativity - anomalous properties of second period elements - diagonal relationship;

Acids and bases - Bronsted-Lowry concept - Lewis concept - pH and pKa – problems – HSAB - buffer solutions – types- mechanism of buffer action- Henderson–Hasselbalch equation- derivation and problems.

Unit III **STETEROCHEMISTRY & ORGANIC REACTIONS** **9 + 3**

Stereoisomerism – geometrical isomerism – cis-trans and E-Z nomenclature – optical isomerism – symmetry, chirality, optical activity, enantiomer and diastereomers – absolute configuration - R-S notation - conformational analysis – Ethane, butane, cyclohexane;

Addition reaction – hydrogenation, halogenations - Markovnikov rule – Kharasch effect - hydration, hydrohalogenation, hydroboration;

Aliphatic nucleophilic substitution reaction –SN_1, SN_2 and SN_imechanism – electrophilic substitution reaction in benzene– mechanism - nitration, halogenations, sulfonation, alkylation and acylation;

Elimination reaction –E_1, E_2 and E_1CB- mechanism- Saytzeff rule – examples.

Unit IV **USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA** **9 + 3**

Thermodynamic functions- internal energy, enthalpy, entropy and free energy- first and second law of thermodynamics - partial molar properties - Gibbs Duhem equation – variation of chemical potential with temperature and pressure – Third and Zeroth law of thermodynamics – definition only;

Free energy and EMF relation - single electrode potential - electrochemical series and its significance.- cell potential and its measurement (Poggendorff method only) - Nernst equation-derivation and problems-Standard cell potential and equilibrium constant relation- problems.

Unit V **SPECTROSCOPY TECHNIQUES & APPLICATIONS** **9 + 3**

Beer-lambert's law (problem)- UV visible spectroscopy: principle, chromophores, auxochrome, electronic transitions and instrumentation (no application);

IR Spectroscopy: principles-instrumentation and applications of IR in H_2O,CO_2 and NH_3;

Flame photometry-principle-instrumentation-estimation of sodium by flame photometer;

Atomic absorption spectroscopy-principles-instrumentation-estimation of nickel by atomic absorption spectroscopy.

		Total (45+15)=60 Periods
Course Outcomes:		
Upon completion of this course, the students will be able to		
CO1	:	Understand in-depth knowledge of atomic and molecular orbitals based chemical aspects.
CO2	:	Realize the nature of periodic properties of elements and the knowledge of acids and bases.
CO3	:	Grasp the knowledge of 3D structural aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules.
CO4	:	Substantiate the various processes involved in thermodynamic considerations and its involvement in electrochemical aspects.
CO5	:	Aware of spectroscopic techniques in the field of molecular identification of materials.

Text Books:	
1.	P.R. Puri, L.R.Sharma and Madan S. Pathania,"Principle of physical chemistry" 47th Vishal Publishing Co, Jalandhar-8
2.	C. N. Banwell and E. M. Mccash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2009.
3	Raj. K. Bansal – "A Text Book of Organic Chemistry" Revised 4th Ed.,(2005), New Age International Publishers Ltd., New Delhi.
4	P.S. Kalsi – "Stereochemistry conformation and Mechanism", 6th Ed., (2005), New Age International Publishers Ltd., New Delhi.
5	J.D. Lee – "A New Concise Inorganic Chemistry", 5th Edn., Oxford University Press, 2011.
6	Wahid Malik, G.D.Tuli and R.D.Madan, "Selected Topic in Inorganic Chemistry",S.Chand& Co., Ltd (2011).

Reference Books:	
1	David.W.Ball, Physical Chemistry, Cengage Learning India Pvt. Ltd., New Delhi, 2009.
2	G.Aruldhas, Molecular structure and spectroscopy, second edition, PHI learning Pvt. Ltd., New Delhi, 2008.
3	Cotton and Wilkinson – "Advanced Inorganic Chemistry", 6th Ed., John Wiley & Sons, New York-2004.
4	James E. Huheey, Ellen A. Keiter and Richard L. Keiter – "Inorganic Chemistry-Principles of Structure and Reactivity", 4 thEdn., Pearson Education, 11th Impression, 2011.
5	F.A. Carey and R.J. Sund berg – "Advanced organic chemistry" Vol. I and II– 3rd Ed.,(1984), Plenum Publications.
6	Ernest. Eliel and Samuel H. Wilen – "Stereochemistry of Organic Compounds" – Wiley Student Ed., (2006). John Wiley and Sons Pvt. Ltd., Singapore.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3							2			
CO2	3	3							2			
CO3	3	3								2		
CO4	3	3										
CO5	3	3			2					2		

18CS101	FUNDAMENTALS OF PROBLEM SOLVING AND C PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To express problem solving through programming.
2.	To practice the basic concepts of C programming language.
3.	To provide the basics knowledge about array and strings to solve simple applications.
4.	To use pointers and functions in the simple applications.
5.	To review the elementary knowledge of structures and unions.

Unit I	**Introduction to Computer and Problem Solving**	**9**	**+**	**0**

Problem formulation, Problem Solving methods, Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart- Need for computer languages, Generation and Classification of Computers- Basic Organization of a Computer.

Unit II	**C Programming Basics and Control Statements**	**9**	**+**	**0**

C Character set- Identifies and Keywords- Data Type- Declarations-Expressions-Statements and Symbolic constants- Operators – Arithmetic Operators – Unary operators – Relational and Logical Operators – Assignment operators – Conditional operators- Managing Input and Output operations- Decision Making-Branching and Looping statements.

Unit III	**Arrays and Strings**	**9**	**+**	**0**

Pre-processor directives-Storage classes-Arrays – Initialization – Declaration – one dimensional and two dimensional arrays. Strings - String operations – String handling functions-Simple programs-sorting-searching.

Unit IV	**Functions and Pointers**	**9**	**+**	**0**

Function – Library functions and user-defined functions – Function prototypes and function definitions – Call by value –Call by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays.

Unit V	**Structures, Unions and File**	**9**	**+**	**0**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures-Union-basic file operation.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Formulate and apply logic to solve basic problems.
CO2	:	Write, compile and debug programs in C language.
CO3	:	Apply the concepts such as arrays, decision making and looping statements to solve real time applications.
CO4	:	Solve simple scientific and statistical problems using functions and pointers.
CO5	:	Write programs related to structures and unions for simple applications.

Text Books:

1.	Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011. (Unit-I).
2.	E.Balagurusamy, “Programming in ANSI C” fourth Edition, Tata McGraw-Hill, 2008. (Unit II-V).

Reference Books:

1.	Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill,2006.
2.	Kernighan,B.W and Ritchie,D.M, “The C Programming language”, 2nd Edition, Pearson Education, 2006.

3.	Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	1	1	1	3	3
CO2	3	3	3	3	3	2	2	1	1	1	3	3
CO3	3	3	3	3	3	2	2	1	1	1	3	3
CO4	3	3	3	3	3	2	2	1	1	1	3	3
CO5	3	3	3	3	3	2	2	1	1	1	3	3

18EN102	PROFESSIONAL ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To acquire and develop listening skills for academic, social and professional purposes.
2.	To understand short conversations or monologues
3.	To master basic reading skills such as phonics, word recognition, and fluency
4.	Acquire and develop pre-intermediate level fluency in oral skills such as discourse management, grammar and vocabulary, pronunciation and interactive communication for academic, social and professional purposes
5.	Address an audience and present a topic.
6.	Express an opinion and justify it

Exercises

Methodology - Listening

1. Job Responsibilities
2. Conversation between two employees on company culture
3. Emails
4. Description of gadgets
5. Interview with a leading industrialist
6. Office procedures – applying for permission, placing an order for office equipment,
7. Enquiries about orders and deliveries
8. Conversation between two people on general topics
9. Telephone Messages
10. Fixing and Cancelling appointments
11. Asking for directions
12. Rescheduling a travel plan
13. Tones : Rude and Polite
14. Conversation : Statements, Discussions, Debating, Accepting, Negotiating
15. Conferences ; Announcements about changes in schedules andsessions
16. Motivational Speech
17. TED Talk on Team Work
18. Describing charts and data
19. Presentation at an office
20. Short self-descriptions

METHODOLOGY: - Speaking

1. Self-Introduction – Personal information –Name, Home background, study details, area of interest, hobbies, strengths and weaknesses, projects and paper presentations if any, likes and dislikes in food, clothes, Special features of home town, Personal role models in life, goals and dreams, favorite inspirational quote.
2. Situational Role Play between Examiner and Candidate – Customer and Sales Manager, Hotel Manager and Organiser, Team Leader and Team member, Bank Manager and Candidate, Interviewer and Applicant, Car Driver and Client, Industrialist and Candidate, Receptionist and Appointment Seeker, New Employee and Manager, Employee and Employee, P.A. and Manager Schedule for training, Asking for directions, Seeking help with office equipment, Clarifying an error in the bill, Quality of Products, Buying a Product, Selling a Product, cancelling and fixing appointments, hotel accommodation, training facilities, dress code, conference facilities, faculty advisors and student, student and student, college Office personnel and student.

Total (0+30)= 30 Periods

Course Outcomes:

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

CO1	:	Infer, interpret and correlate routine, classroom-related conversation.
CO2	:	Use a range of common vocabulary and context based idioms.
CO3	:	Comprehend native speakers when they speak quickly to one another, although the student might still have trouble.
CO4	:	Identify the most important words in a story/article.

CO5	:	Summarize the main ideas, key details, and inferred meanings from listening passages of up to five minutes.
CO6	:	Vocalize words without the aid of pictures
CO7	:	Make effective self-introductions.
CO8	:	Study options, compare and contrasts the options.
CO9	:	Exercise a choice, justify it by giving examples and illustrations.
CO10	:	Construct a situation and to participate in conversations

Text Book:

1.	Norman Whitby. Business Benchmark – Pre-Intermediate to Intermediate, Students book,Cambridge University Press, 2014.

Reference Books:

1	Spoken English: A Self-Learning Guide. V.Sasikumar and P V Dhamija
2	English Conversation Practice: Grant Taylor Paperback 1976ly. Krishna Mohan, N P Singh
3	Discussions that Work. Penny Ur.CUP, 1981.
4	Speak Better Write Better English Paperback – November 2012 Norman Lewis, GoyalPublishers and Distributors.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3		3		1		1	2	3	1	2
CO2		2		2				1	1	3	2	3
CO3		1		1		1		1	2	3	1	2
CO4		1		2		1		1		3	1	2
CO5		2		3				1	1	3	1	3
CO6		1		1		1		2		3	1	3
CO7		2		1						3	2	3
CO8		2		2		1			1	3		2
CO9		1		1		2		1	2	3		3
CO10		3		1					3	3	1	3

18CS102	COMPUTER PRACTICE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To provide basic knowledge of creating Word documents and also producing mail merge.
2.	To make use of basic functions, formulas and charts in Spread sheet.
3.	To implement problem solving techniques.
4.	To promote the programming ability to develop applications for real world problems.

List of experiments

A	**Word Processing** 1. Document creation, Text manipulation with Scientific notations, Table creation, Table formatting and Conversion 2. Letter preparation using Mail merge and Draw flow Charts using tools
B	**Spread Sheet** 3. Chart - Line, XY, Bar and Pie. 4. Formula - formula editor, Sorting and Import and Export features. 5. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
C	**Simple C Programming** 6. Program using Control statements. 7. Program using Looping. 8. Program using Array. 9. Program using String. 10. Program using Function. 11. Program using Structures. 12. Program using Pointers. 13. Program using Files. *** For programming exercises Flow chart and pseudo code are essential**

Total (0+60)=60 Periods

Course Outcomes:

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

CO1	:	Demonstrate the basic mechanics of Word documents and working knowledge of mail merge.
CO2	:	Demonstrate the use of basic functions and formulas in Spread sheet.
CO3	:	Apply good programming methods for program development.
CO4	:	Implement C programs for simple applications.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	1	1	1	3	3
CO2	3	3	3	3	3	2	2	1	1	1	3	3
CO3	3	3	3	3	3	2	2	1	1	1	3	3
CO4	3	3	3	3	3	2	2	1	1	1	3	3

18ME102	WORKSHOP MANUFACTURING PRACTICES	L	T	P	C
		1	0	4	3

Course objectives:

1.	To provide an exposure of basic engineering practices to the student
2.	To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering

Experiments

1.	Introduction to Safety measures and First aid.
2.	Study of Lathe -Welding methods and equipment's- Casting process and tools- Sheet metal and fitting tools- Carpentry tools and joints.
3.	Fitting: V-fitting, Square fitting, Curve fitting.
4.	Lathe: Facing, turning, taper turning and knurling.
5.	Welding: BUTT, LAP and T- joints.
6.	Foundry: Green sand preparation- mould making practice.
7.	Sheet metal: Cone, tray, cylinder.
8.	Carpentry: CROSS, T and DOVETAIL joints.
9.	Drilling: simple exercises.

Total (15+60)=75 Periods

Course outcomes:

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

CO1	:	Prepare fitting of metal and wooden pieces using simple fitting and carpentry tools manually.
CO2	:	Prepare simple lap, butt and tee joints using arc welding equipment.
CO3	:	Prepare green sand moulding.
CO4	:	Prepare sheet metal components.
CO5	:	Prepare simple components using lathe and drilling machine.

Reference books:

1.	Bawa, H.S, "Work shop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
2.	Jeyachandran, K, Natarajan, K and Balasubramanian, S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3.	Jeyapoovan, T, SaravanaPandian, M and Pranitha, S, "Engineering Practices Lab Manual", VikasPuplishing House Pvt. Ltd, 2006.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2							1		2
CO2	1		2			2						2
CO3	2	1	2			2						1
CO4	1		1			2						1
CO5	1	1				1						1

18MA204	FOURIER SERIES AND TRANSFORMS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To obtain the knowledge with expansion of a function as a Fourier series.
2.	To impact analytical skills in the areas of boundary value problems and transform techniques.
3.	To familiarize with the techniques of Laplace transform for solving second order differential equations.
4.	To understand the concepts of Fourier transform and its applications
5.	To obtain the solution of difference equation by Z-transform technique.

Unit I	FOURIER SERIES	9	+	3

Drichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's Identity – Harmonic Analysis.

Unit II	BOUNDARY VALUE PROBLEMS	9	+	3

Classification of second order quasi linear partial differential equations – Solutions of onedimensional wave equation – One dimensional heat equation – Steady state solution of twodimensionalheat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates

Unit III	LAPLACE TRANSFORM	9	+	3

Laplace Transform- Conditions for existence – Transform of elementary functions – Basic Properties– Transform of derivatives and integrals – Initial and Final value theorems- Transform of periodic Functions – Inverse Laplace Transform- solutions of linear ODE of second order with constant coefficients using Laplace transformation techniques- statement and application of convolution theorem

Unit IV	FOURIER TRANSFORM	9	+	3

Statement of Fourier integral theorem – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's Identity

Unit V	Z -TRANSFORM AND DIFFERENCE EQUATIONS	9	+	3

Z-transform of simple functions and properties – Inverse Z – transform –initial and final value theorems-Convolution theorem -Formation of difference equations – Solution of difference equations using Z – transform technique.

Total (45+15)= 60 Periods

Course Outcomes:

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

CO1	:	Acquire the knowledge about Fourier series.
CO2	:	Learn the techniques of solving boundary value problems
CO3	:	Familiar with the transform techniques.

Text Books:

1.	Veerarajan T, "Engineering Mathematics (For Semester III)" , 3rd Edition, Tata McGraw Hill Education Pvt.Ltd. , New Delhi, 2009.
2.	P.Kandasamy, K.Thilagavathy and K.Gunavathy, "Engineering Mathematics, Volume III", S. Chand & Company ltd., New Delhi, 1996.

Reference Books:

1.	Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi,2014
2.	Wylie C. Ray and Barrett Louis, C., "Advanced Engineering Mathematics", Sixth Edition, McGraw-Hill, Inc., New York, 1995.
3.	Srimanta pal and Subath.C.Bhumia, "Engineering Mathematics", Oxford university publications, New Delhi, 2015
4	Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006
5	Narayanan, S., Manicavachagom Pillai, T.K. and Ramaniah, G., "Advanced Mathematics for

	Engineering Students", Volumes II and III, S. Viswanathan (Printers and Publishers) Pvt.Ltd. Chennai,2002.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	1	1	2	1	2
CO2	3	3	2	2	2	1	1	1	1	2	1	1
CO3	3	3	2	2	2	1	1	1	1	2	1	2

18PH202	PHYSICS – WAVE & OPTICS AND QUANTUM MECHANICS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To make the students to understand Simple harmonic motion and Waves
2.	To understand the Propagation of light
3.	To get clear idea of wave optics
4.	To understand the Principle and working of laser with applications
5.	To know the basic concepts of quantum Mechanics and Matter Waves

Unit I **SIMPLE HARMONIC OSCILLATION AND WAVES** **9 + 3**

Simple harmonic motion ; Damped Simple harmonic motion ; Forced vibrations – resonance; Wave motion- types and characteristics - velocity of a transverse wave along a stretched string -frequency of a vibrating string – harmonics and overtones - progressive waves & stationary waves – wave equation for progressive and Stationary waves

Unit II **THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS** **9 + 3**

Fermats Principle - laws of reflection and refraction ; Mirage effect ; Total internal reflection ; Matrix method - imaging by a spherical refracting surface - imaging by a coaxial optical system; Optical Instruments - simple and compound microscope - astronomical telescope.

Unit III **WAVE OPTICS** **9 + 3**

Huygens Principle ; Principle of superposition ; Interference of Light – Youngs double slit experiment - Newtons rings - experimental arrangement to determine the wavelength of sodium light ; Michelson Interferometer ; Fraunhofer diffraction from a single slit ; Diffraction grating –determination of wavelength of light and dispersive power ; Polarisation - Polarisation by reflection - Brewsters Law

Unit IV **LASERS** **9 + 3**

Properties of Laser beams - monochromacity , coherence , directionality and brightness ; Einstiens theory of matter radiation interaction and A&B coeffiecients - amplification of light by population inversion - pumping methods ; Different types of laser - Ruby , Nd-YAG , He-Ne,CO_2 laser - Energy level diagrams ; Applications of lasers in science ,engineering and medicine.

Unit V **QUANTUM MECHANICS** **9 + 3**

Introduction - matter waves - Debroglie's equation - Davisson-Germer experiment-G.P.Thomson experiment; Time independent and dependent Schroedinger equation; Wave packet; Uncertainity Principle; Schroedinger equation for Particle in a one dimensional box; Physical Significance of wavefunction.

Total (45+15)= 60 Periods

Course Outcomes:

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

CO1	:	Understand Simple harmonic oscillation and propagation of waves.
CO2	:	Apply matrix method to analyse system of reflecting and refracting surfaces.
CO3	:	Know various experimental techniques in wave optics.
CO4	:	Understand the concept of laser and its applications.
CO5	:	Gain knowledge in the basics of quantum mechanics.

Text Books:

1.	AjoyGhatak,'Optics', Tata Mc Graw Hill Publishing Co.Ltd, Fourth Edition,2009
2.	Gupta Kumar Sharma, 'Quantum Mechanics', Jai Prakash Nath & co, 25th Edition, 2005
3	Gaur R.K and Gupta S.L,'Engineering Physics', Dhanpat Rai Publishers,2009

Reference Books:

1.	PalanisamyP.K,'Engineering Physics', Scitech Publications,2011
2.	Rajendran V and Marikani A, 'Engineering Physics', PHI learning PVT, India, 2009

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	3	2			1		3	2
CO2	3	2	1	2	3	1	2		2		3	1
CO3	2	3	1	3	2	2	1		2		2	1
CO4	3	2	1	3	3	1	1		2		3	1
CO5	3	3	1	2	3	1	1		2		3	1

18ME101	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
		1	0	4	3

Course objectives:

1.	To impart knowledge on concepts, ideas and design of engineering products and to provide an exposure to CAD Modelling.
2.	Standards of Engineering Drawing: Size, layout and folding of drawing sheets, lettering - Use of drafting instruments

UNIT I	PROJECTION OF POINTS, LINES AND PLANE SURFACES	3	+	12

General principles of orthographic projection- Projection of points, located in all quadrants – Projection of straight lines located in first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II	PROJECTION OF SOLIDS	3	+	12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular to one reference plane and also inclined to one reference plane by change of position method.

UNIT III	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	3	+	12

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to other – solids inclined position with cutting planes parallel to one reference plane- Obtaining true shape of section.
Development of lateral surfaces of simple and truncated solids – Prisms, pyramids cylinders and cones- Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.

UNIT IV	ISOMETRIC PROJECTION	3	+	12

Principles of isometric projection –isometric scale - isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

UNIT V	PERSPECTIVE PROJECTION	3	+	12

Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

Total (15+45)= 60 Periods

Note: Study of drafting software – Auto CAD – Coordinate System (Absolute, relative and polar)
Creation of simple figures like polygon, Drawing a plan of residential building, Creation of 3-D Models of simple objects and obtaining 2-D multi view drawing from 3-D model. (**Internal Assessment only)**

Course outcomes:

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

CO1	:	Understand the conventions and the methods of engineering drawing.
CO2	:	Understand the fundamental concepts of theory of projection.
CO3	:	Understand the development of different surfaces.
CO4	:	Develop the relationships between 2D and 3D environments.
CO5	:	Demonstrate computer aided drafting.

Text books:

1.	Bhatt N.D, “Engineering Drawing”, Charotar publishing House, 2003
2.	Natarajan, K.V, “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, 2006.

Reference books:

1.	Gopalakrishnana K.R, “Engineering Drawing", Vol. I and II, Subhas Publications, 1999.
2.	Dhananjay A. Jolhe, “Engineering Drawing with an Introduction to AutoCAD”, Tata McGraw Hill Publishing Company Limited, 2008.

3.	Venugopal, K and Prabhu Raja, V., “Engineering Graphics”, New Age International (P) Ltd, 2008.
4.	Gill, P.S, “Engineering Drawing-Geometrical Drawing”, S.K Kataria and Sons, 2008.
5.	CAD Software Theory and User Manuals

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			2					1		
CO2	2	1			2							
CO3	3	2		2	2							1
CO4	2	2		1	1					2		1
CO5	2	2		1	1					1		2

18CM 201	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		4	0	0	4

Course Objectives:

1.	The objective of the course is to impart knowledge on different fields of civil engineering and various materials used for construction

Unit I	CIVIL ENGINEERING MATERIALS AND SURVEYING	12	+	0

Mechanics : Mechanical properties of materials – Stress – Strain – Types of stresses and strains – Elasticity – Hooke's law – stress strain curve of ductile material.
Civil Engineering Materials : Bricks – Stones – Sand - Cement – Concrete – Steel Surveying : Objects – Principles – Classification – Measurement of Distances

Unit II	BUILDING COMPONENTS AND STRUCTURES	12	+	0

Foundations : Functions of foundation – Types Superstructure : Brick Masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering.Dams : Types of Dams – cross section details of gravity dam. Introduction to Green Building Concept .

UNIT III	BOILERS, TURBINES AND PUMPS	12	+	0

Boilers- Classification of boilers- Working Principle of various types of boilers – Horizontal boiler, Vertical boiler - Description of: Lancashire boiler, Locomotive boiler, Babcock andWilcox boiler, Cochran boiler, simple vertical boiler only)- Boiler Mountings and Accessories. Turbines- Classification- Working Principle of Impulse and Reaction turbines, Pumps-working principle of reciprocating (single and double acting) and centrifugal pumps.

UNIT IV	INTERNAL COMBUSTION ENGINES	12	+	0

Introduction, terminologies, classification and components – working principles of petrol and diesel engines – comparison of four stroke and two stroke cycle engines – applications of IC engines.

UNIT V	REFRIGERATION AND AIR CONDITIONING SYSTEM	12	+	0

Definition of refrigeration and air conditioning – terminology; refrigerants – definition, classification, working principle of vapour compression system and vapour absorption system – window and split type room air conditioner.

Total (60+0)=60 Periods

Course Outcomes:

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

CO1	:	Students will acquire the basic knowledge in different fields of civil engineering.
CO2	:	Materials used in construction.
CO3	:	Understand the different parts of the buildings
CO4	:	Gain the knowledge about the working of IC engine, its components and its application.
CO5	:	Gain the knowledge about various types of boilers, turbines and pumps and also able to demonstrate the working of Refrigeration and Air conditioning.

Text Books:

1.	Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", TMH Publishing Co., New Delhi, (1996).
2.	Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd (1999).
3.	Shanmugam G and Palanisamy M S, "Basic Civil and Mechanical Engineering", TMH publishing Co, New Delhi, 1996.
4.	Ramamrutham.S,"Basic Civil Engineering", DhanpatRai publishing Co.(p) Ltd.1999.

Reference Books:

1	SeetharamanS."BasicCivilEngineering",AnuradhaAgencies,(2005).
2	Venugopal K and Prahu Raja V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, (2000).
3	Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, (2000).

4	Seetharaman S, , “Basic Civil Engineering”,Anuradha Agencies,(2005).
5	Venugopal K and Prabu Raja V, “Basic Civil Engineering”,Anuradha publishers, Kumbakonam,2000.
6	Shantha Kumar S R J, “Basic Civil Engineering”,Hi-tech publications, Mayiladuthurai,2000.

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2		2								
CO2			2	2								
CO3		2	2	2								
CO4												
CO5												

18PH103	PHYSICS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To handle different measuring instruments.
2.	To understand the basic concepts of interference, diffraction, heat conduction and to measure the important parameters

Experiments

1	Newton's rings – Determination of radius of curvature of a Plano convex lens.
2	Carey Foster's bridge – Determination of specific resistance of the material of the wire.
3	Poiseuille's flow – Determination of Coefficient of viscosity of a liquid.
4	Spectrometer – Grating – Normal incidence – Determination of Wavelength of Mercury lines.
5	Lee's disc – Determination of thermal conductivity of a Bad conductor.
6	Ultrasonic interferometer – Determination of velocity of Ultrasonic Waves in Liquid
7	Non-uniform bending – Determination of young's modulus of the material of the Bar.
8	Determination of Band gap of a given semi conductor
9	Determination of Wavelength of laser using grating and determination of particle size using Laser
10	Determination of Acceptance angle and Numerical Aperture of fiber.

Total (0+45)=45 Periods

Course Outcomes:

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

CO1	:	Handle different measuring instruments and to measure different parameters.
CO2	:	Calculate the important parameters and to arrive at the final result based on the experimental measurements.

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2	3	1	1		3	2	3	3
CO2	3	3		2	3	1	1		3	2	3	3

18CY102	CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To gain practical knowledge by applying theoretical principles and performing the followinexperiments

Experiments

1	Estimation of hardness of Water by EDTA
2	Estimation of Copper in brass by EDTA
3	Estimation of Alkalinity in water
4	Estimation of Chloride in water sample (Iodimetry)
5	Conductometric titration of Strong Acid and Strong Base
6	Conductometric titration of Mixture of acids and Strong base
7	Determination of strength of Iron by Potentiometric method
8	Estimation of Iron by Spectrophotometry
9	Determination of molecular weight and degree of Polymerisation by Viscometry

Total (0+45)=45 Periods

Course Outcomes:

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

CO1	:	To know the applicability of the practical skill gained in various fields.
CO2	:	To know the composition of brass quantitatively and the molecular weight of polymers.
CO3	:	To understand the principle and applications of conductometric titrations, spectrometer and potentiometric titrations

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1									
CO2	3	3	1									
CO3	3	3	1									

18EN103	PROFESSIONAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To improve their reading skills.
2	To address an audience and present a topic
3	To acquire speaking competency in English.
4	To strengthen their fluency in speaking.

List of experiments

1	**Methodology – Reading** 1) Reading a story aloud with exact pronunciation, with intonation, and with expressing sense. 2) Reading poems for improving verbal skills, memory, and critical thinking. 3) Reading newspaper articles for strengthening the vocabulary and writing skills. 4) Reading homophones with exact pronunciation for expressing different meaning
2	**Methodology – Speaking** 1) Power point presentation – on general topics - for organising and structuring presentation. 2) Oral presentation -on basic technical ideas related to engineering. 3) Speaking on a given topic – current affairs, expressing opinion on social issues. 4) Describing a process – booking Ticket online, survey for starting a new office, sending an e-mail, etc. 5) Organising official events –compering,presenting welcome address, proposing vote of thanks.

Total (0+30)=30 Periods

Course Outcomes:

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

CO1	:	Read short passages fluently, avoiding mispronunciation, substitution, omission and transposition of word-pairs.
CO2	:	Vocalize words without the aid of pictures.
CO3	:	Develop a well-paced, expressive style of reading.
CO4	:	Make effective oral presentations on technical and general contexts.
CO5	:	Describe a process with coherence and cohesion.

Text Books:

1.	Norman Whitby. Business Benchmark – Pre-Intermediate to Intermediate, Students book, Cambridge University Press, 2014.

Reference Books

1	Spoken English: A Self-Learning Guide. V.Sasikumar and P V Dhamija
2	English Conversation Practice: Grant Taylor Paperback 1976ly. Krishna Mohan, N P Singh
3	Discussions that Work. Penny Ur.CUP, 1981.
4	Speak Better Write Better English Paperback – November 2012 Norman Lewis, GoyalPublishers and Distributors.

E-Reference

1	http://www.onestopenglish.com/skills/speaking/speaking-matters/

CO/PO Maping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2				1		2	2	3	2	2
CO2	1	1		2					1	3	1	3
CO3		3		2		1			2	3		2
CO4		2		1		1		1		3	2	3
CO5		2		2				1	1	3	1	3

18CE201	BASIC CIVIL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To understand the fundamental concept on visual inspection and standard parameters about the materials used in the field of civil engineering
2.	To obtain basic knowledge in testing of the materials widely used for construction

EXPERIMENTS

1	Cement Tests a) Visual inspection b) Consistency c) Initial and final setting time
2	Bricks Test a) Visual examination b) Crushing strength test
3	Aggregate Test a) Specific gravity of fine aggregate b) Specific gravity of coarse aggregate
4	Concrete – Compression strength Test
5	Steel – Tension Test

Total (0+30)=30 Periods

Course Outcomes:

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

CO1	:	Testing the basic materials used in the field of civil engineering
CO2	:	n-depth knowledge about their standard specifications and applications

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2		2								
CO2		2		2								

18MA302	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

Course objectives:

1	To understand the statistical averages and fitting of curves.
2	To gain the knowledge of significance test for large and small samples
3	To obtain the knowledge about numerical interpolation, differentiation and integration
4	To acquire knowledge of numerical solution to first order ordinary differential equations using single step and multi step methods.
5	To gain the knowledge of numerical solution to second order partial differential equations by using explicit and implicit methods

Unit I	**BASIC STATISTICS**	**9**	**+**	**3**

Measures of Central tendency: Moments, Skewness and Kurtosis, Curve fitting by the Method of Least Squares –Fitting of straight lines, second degree parabolas and curves reducible to linear forms.

Unit II	**TEST OF HYPOTHESIS**	**9**	**+**	**3**

Test of significance: Large Sample tests for Single proportion, difference of proportions, single mean and difference of means- Small Sample test for single mean, difference of means and correlation co-efficient, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Unit III	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9**	**+**	**3**

Solution of Algebraic and Transcendental equations by Newton-Raphson method- Solution of system of equations by Gauss Elimination and Gauss Seidal iterative methods - Interpolation using Newton's Forward and Backward formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae Numerical Differentiation and Integration: Trapezoidal rule and Simpson's 1/3 rule, Simpson's 3/8 rule.

Unit IV	**NUMERICAL SOLUTION FOR ORDINARY DIFFERENTIAL EQUATIONS**	**9**	**+**	**3**

Ordinary differential equations: Taylor series method- Euler and modified Euler's method- Runge-Kutta method of fourth order for solving first and second order differential equations- Milne's and Adam's predictor - corrector methods.

Unit V	**NUMERICAL SOLUTION FOR PARTIAL DIFFERENTIAL EQUATION**	**9**	**+**	**3**

Partial differential equations: Finite difference solution of two dimensional Laplace and Poisson equations- Implicit and Explicit methods for one dimensional heat equation (Bender Schmidt and Crank-Nicholson methods) - Finite difference explicit method for wave equation.

Total (45+15)=60 Periods

Course Outcomes:

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

CO1	:	Learn about statistical averages and fitting the curves by Least Square Method
CO2	:	Acquire the techniques of interpolation.
CO3	:	Familiar with the numerical differentiation and integration
CO4	:	Solve the initial value problems for ordinary differential equations.
CO5	:	Find the numerical solution of partial differential equation by using Finite difference method.

Text Books:	
1.	Veerarajan T, “Probability and Random Process (With Queuing theory)”, 4th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2016.
2.	Kandasamy.P, Thilagavathy.K, Gunavathi.K, “Numerical Methods” S.Chand& Co., New Delhi, 2005.
3	Gupta, S.C. and Kapur, V.K., “Fundamentals of Mathematical Statistics”, S.Chand and Sons, New Delhi, 11th Edition 2014
Reference Books:	
1.	Fruend John, E. and Miller Irwin, “Probability and Statistics for Engineers”, 8thEdition, Prentice Hall India (P) Ltd, 2010.
2	Gerald, C. F. and Wheatley, P.O., “Applied Numerical Analysis” , Sixth Edition , Pearson Education Asia , New Delhi – 2002
3	M.K.Venkataraman, “Numerical Methods”, National Publishing Company,2000
4	Jain M.K.Iyengar, K & Jain R.K., “Numerical Methods for Scientific and Engineering Computation ”, New Age International (P) Ltd, Publishers 2003
5	Manish Goyal, “Numerical Methods and Statistical techniques Using “C” ”, 1st Edition, Laxmi Publications (P) Ltd, 2009.
E-Reference :	
1.	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	1	1	2	2	1	2	2
CO2	3	3	1	1	1	1	1	1	1	1	1	1
CO3	3	3	1	2	1	1	1	2	2	1	2	2
CO4	3	3	2	2	1	1	1	2	2	1	1	1
CO5	3	3	2	2	2	1	1	1	1	1	1	1

18EE301	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	1	0	4

Course Objectives:

To expose basic circuit concepts, circuit modelling and methods of circuit analysis in time domain and frequency domain for solving simple and multi dimensional circuits including coupled circuits

Unit I	BASIC CIRCUITS ANALYSIS	9	+	3

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits –Mesh current and node voltage method of analysis for DC and AC Circuits – Sinusoidal voltage and current – instantaneous, peak, average and effective values – form factor and peak factor (derivations for sine wave) – pure resistive, inductive and capacitive circuits – RL, RC, RLC series circuits – impedance – phase angle – phasor diagram – power and power factor – power triangle – apparent power, active and reactive power – parallel circuits (two branches only) – conductance, susceptance and admittance

Unit II	NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS	9	+	3

Network reduction: voltage and current division, source transformation- star and delta transformation, Superposition Theorem - Thevenin's and Norton's Theorem –– Maximum power transfer theorem – Reciprocity Theorem - substitution theorem-Millman's theorem.

Unit III	RESONANCE AND COUPLED CIRCUITS	9	+	3

Series and parallel resonance – frequency response - Effects of varying inductance and capacitance – Selectivity – 'Q' factor – Resonance Frequency – Bandwidth – Half power frequencies. Self and mutual inductance – Coefficient of coupling – dot rule – analysis of coupled circuits – coupled circuits in series and parallel – Tuned circuits – analysis of Single and double tuned circuits.

Unit IV	TRANSIENT RESPONSE ANALYSIS	9	+	3

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and AC sinusoidal input.

Unit V	THREE PHASE CIRCUITS	9	+	3

Significance of 3 phase circuits – Star, Delta connections – Phase sequence – Balanced load-Three phase balanced/ unbalanced voltage sources – analysis of three phase three wire and four wire circuits with star and delta connected with balanced and unbalanced loads – phasor diagrams of voltages and currents –power and power factor measurements in three phase circuits

Total (45+15) =60 Periods

Course Outcomes:

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

CO1	:	Understand the basic concept of circuit elements, circuit laws and network reduction technique
CO2	:	Solve the electrical network using mesh, nodal analysis and applying network theorems.
CO3	:	Understand the resonance in series and parallel circuits.
CO4	:	Analyze the coupled circuits.
CO5	:	Analyze the transient response for DC input and AC sinusoidal input
CO6	:	Comprehend the concept of balanced and unbalanced three phase circuits

Text Books:	
1.	William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuit Analysis”, Seventh Edition, TMH publishers, New Delhi, 2013
2.	Sudhakar. A., and Shyammohan. S. Palli , 'Circuits & Networks Analysis and Synthesis', Fourth Edition , Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2015.
Reference Books:	
1.	A. Chakrabarti, 'Circuit Theory Analysis and Synthesis', Seventh Revised Edition, Dhanpat Rai & Co., New Delhi, 2018
2	Dr. M. Arumugam & N. Premkumar, ” Electric circuit theory”, Khanna Publishers, New Delhi,1991.
3	Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2013.
4	Mahmood Nahvi& Joseph Edminister, “Electric Circuits”, Schaum’s Outline Series, McGraw Hill Publications, Seventh Edition,2018
E-Reference :	
1.	NPTEL Courses on Basic Electrical Circuits, IIT Madras
2	NPTEL Courses on Circuit theory, IIT Delhi

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2			1					
CO2	2	3	1	2			1					
CO3	3	1	2				1					
CO4	3	1	2				1					
CO5	1	3	2		3		1					
CO6	1	2	1	1	3		1					

18EE302	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To introduce the basic mathematical concepts related to electromagnetic vector fields
2.	To impart knowledge on the concepts of Electrostatic fields, electrical potential, energy density and their applications.
3.	To impart knowledge on the concepts of Magneto static fields, magnetic flux density, vector potential and its applications.
4.	To impart knowledge on the concepts of Different methods of emf generation and Maxwell's equations.
5.	To impart knowledge on the concepts of Electromagnetic waves and characterizing parameters.

Unit I	ELECTROSTATICS – I	9	+	3

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

Unit II	ELECTROSTATICS – II	9	+	3

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization- Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

Unit III	MAGNETOSTATICS	9	+	3

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

Unit IV	ELECTRODYNAMIC FIELDS	9	+	3

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

Unit V	ELECTROMAGNETIC WAVES	9	+	3

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

Total (45+15) = 60 Periods

Course Outcomes:

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

CO1	:	Understand the basic mathematical concepts related to electromagnetic vector fields.
CO2	:	Understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
CO3	:	Apply knowledge in magneto static fields, magnetic flux density, vector potential and its applications.
CO4	:	Understand the different methods of emf generation and Maxwell's equations
CO5	:	Apply knowledge in concepts of electromagnetic waves and characterizing parameters.
CO6	:	Understand and compute Electromagnetic fields and apply them for design and analysis of electrical equipment and systems.

Text Books:	
1.	Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2.	William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3.	Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
Reference Books:	
1.	V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.
2.	J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.2013
3.	Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2013,4th edition.
4.	S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.
5.	K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint : 2015.
E-Reference :	
1.	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	1	1	1	1	1
CO2	1	3	2	2	2	1	1	1	1	1	1	1
CO3	1	3	2	2	2	1	1	1	1	1	1	1
CO4	1	1	3	3	2	2	1	1	1	1	1	1
CO5	1	1	1	3	3	2	2	1	1	1	1	1
CO6	1	1	3	2	2	2	1	1	1	1	1	1

18EE303	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the concepts of electromechanical energy conversion and to gain the knowledge on single and multiply-excited magnetic systems.
2.	To gain the knowledge on construction and principles of operation of DC machines and transformers.
3.	To analyze the performance characteristics of different types of DC machines and transformers.
4.	To appreciate the applications of DC machines and transformers.
5.	To analyze the performance of DC machines and transformers by conducting various tests.

Unit I	**ELECTROMECHANICAL ENERGY CONVERSION**	**9**	**+**	**0**

Magnetic circuits – Magnetically induced EMF and force – AC operation of magnetic circuits – Energy in magnetic systems – Field energy & mechanical force – Single and Multiply-excited magnetic field systems.

Unit II	**DC GENERATORS**	**9**	**+**	**0**

Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Types of excitation – No load and load characteristics of DC generators – Commutation - Armature reaction – Parallel operation of DC generators - Applications.

Unit III	**DC MOTORS**	**9**	**+**	**0**

Principle of operation of DC motors - Back EMF – Torque equation – Types of DC motors - Speed – Torque characteristics of DC motors – Starting of DC motors: 3- point starter, 4- point starter – Speed control: Field control, Armature voltage control – Applications.

Unit IV	**TRANSFORMERS**	**9**	**+**	**0**

Principle of operation – Constructional features of single phase transformers – EMF equation – Transformer on No- load and Load – Phasor diagrams -- Equivalent circuit – Regulation - Auto transformers - Three phase transformer connections.

Unit V	**TESTING OF DC MACHINES AND TRANSFORMERS**	**9**	**+**	**0**

Losses and efficiency – Condition for maximum efficiency – Testing of DC machines: Swinburne's test and Hopkinson's test - Testing of transformer: open circuit and short circuit tests, Sumpner's test – All day efficiency.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the concepts of electromechanical energy conversion principles.
CO2	:	Understand the basic concepts of DC machines and transformers.
CO3	:	Evaluate the performance characteristics of DC machines and transformers.
CO4	:	Conduct various tests on DC machines.
CO5	:	Apply the concepts of transformers for testing.

Text Books:

1.	D.P. Kothari, I.J. Nagrath, "Electric Machines", 3rd edition, Tata McGraw-Hill Company Ltd., New Delhi, 2017,5th edition.
2.	Dr. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers, Delhi, 2021,2nd edition.

Reference Books:

1.	B.L. Theraja& A.K. Theraja, "Electrical Technology", Vol.II, S.Chand& Company Ltd., New Delhi, 2006.
2.	A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Tata McGraw Hill Publishing Company Ltd, 2017.

3.	Dr. K. Murugesh Kumar, “DC Machines & Transformers”, Vikas Publishing House Pvt Ltd., 2nd edition, 2003.
E-References:	
1.	www.onlinecourses.nptel.ac.in
2.	www.class-central.com
3.	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	3	1	1	1	1	2
CO2	3	2	2	2	1	2	3	1	1	2	1	2
CO3	1	2	2	2	2	1	1	1	1	3	1	1
CO4	2	2	2	2	1	1	2	2	1	2	2	2
CO5	2	2	2	2	1	1	2	3	1	2	2	2

18EE304	ELECTRON DEVICES AND CIRCUITS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To understand the characteristics of diode. and transistors.
2.	To understand the characteristics of transistors.
3.	To design amplifier circuits
4.	To design the oscillator circuits.

Unit I	DIODES	9	+	3

Structure – Equilibrium conditions – Energy Band Concepts – Zero bias – Forward Bias – Reverse bias – Junction capacitances – one sided and Non- uniformly doped junctions – Ideal PN junction current, P-N junction diode, V-I characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, voltage regulator using zener diode, clamping and clipping circuits

Unit II	TRANSISTORS	9	+	3

Bipolar Junction Transistor-structure, V-I characteristics and Biasing, Input and output characteristics of CE, CB and CC configurations – Transistor hybrid model - Junction field effect transistor – structure, JFET V-I characteristics and Biasing - MOSFET structure and V-I characteristics- UJT- structure and characteristics

Unit III	AMPLIFIER CIRCUITS	9	+	3

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

Unit IV	MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER	9	+	3

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers – Types (Qualitative analysis).

Unit V	FEEDBACK AMPLIFIERS AND OSCILLATORS	9	+	3

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

Total (45+15)= 60 Periods

Course Outcomes:

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

CO1	:	Understand overview of power semiconductor switches.
CO2	:	Analyse the fundamentals and characteristics of BJT and UJT.
CO3	:	Analyse the fundamentals and characteristics of FET andMOSFET.
CO4	:	Design and analyze the amplifiers
CO5	:	Design and analyze the differential amplifiers
CO6	:	Design and analyze the oscillator circuits

Text Books:

1.	Sedra and smith, “Microelectronic Circuits “ Oxford University Press, 2017,7th edition
2.	David A. Bell, “Electronic Devices and Circuits”, New Delhi: Oxford University Press, 5th Edition, 2008.
3.	Robert L.Boylestad, “Electronic Devices and Circuit theory”, 2014,10th edition.

Reference Books:

1.	Rashid, “Micro Electronic Circuits” Thomson publications, 1999.
2.	Donald L.Schilling and Charles Belove, 'Electronic Circuits', 3 Edition, Tata McGraw Hill, 2010.
3.	Jacob Millman, Christos C.Halkias, ‘Electronic Devices and circuits ’,Tata McGraw Hill, 2003

E –References	
1.	https://electronicsforum.com/resources/electronic-devices-and-circuit-theory
2.	https://nptel.ac.in/courses/117103063/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	3	1	1	1	1	
CO2	2	3	3	3	2	1	2	1	1	1	1	
CO3	3	2	2	3	2	1	2	1	1	1	1	
CO4	2	3	2	3	3	1	2	1	1	1	1	
CO5	2	2	3	3	3	1	2	1	1	1	1	
CO6	2	3	3	3	2	1	2	1	1	1	1	

18EE305	DC MACHINES AND TRANSFORMERS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To understand the performance characteristics of DC machines and transformers
2.	To gain knowledge on experimental skill of testing different types of DC machines and transformers.
3.	Rig up circuits for testing a given machine.

Experiments:

1	Open circuit and load characteristics of separately excited DC generator.
2	Open circuit and load characteristics of DC shunt generator.
3	Load characteristics of DC long shunt and short shunt compound generator with cumulative and differential connections.
4	Load test on DC shunt motor.
5	Load test on DC series motor.
6	Swinburne's test on DC machines.
7	Speed control of DC shunt motor.
8	Hopkinson's test on two identical DC machines.
9	Load test on single-phase transformer.
10	Equivalent circuit of a single-phase transformer.
11	Sumpner's test on transformers.
12	Study of DC motor starters and 3-phase transformer connections.

Total (0+45)= 45 Periods

Course Outcomes:

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

CO1	:	Obtain the performance characteristics of DC generators.
CO2	:	Obtain the load characteristics of DC compound generator.
CO3	:	Acquire knowledge on performance characteristics of DC shunt and series motors.
CO4	:	Acquire knowledge on performance characteristics of DC machines using direct and indirect methods.
CO5	:	Acquire knowledge on performance characteristics of transformers using direct and indirect methods.

Reference Books:

1.	G.P. Chhalotra, 'Experiments in Electrical Engineering', 3rd Ed., Khanna Publishers, Delhi, 2004.
2.	C.S. Indulkar, 'Laboratory Experiments in Electrical Power', 3rd Ed., Khanna Publishers, Delhi, 2010.
3.	DC machines and transformers laboratory manual prepared by the department.

E-References:

1.	www.onlinecourses.nptel.ac.in
2.	www.class-central.com
3.	www.mooc-list.com

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	1	3	1	2	1	1	2
CO2	3	3	3	3	2	2	3	1	1	2	1	1
CO3	3	3	3	2	2	1	1	2	1	3	1	1
CO4	3	3	3	1	1	1	2	2	1	2	2	2
CO5	2	3	2	3	1	1	1	3	1	2	2	2

18EE306	ELECTRON DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To design analog electronic circuits using Diode, BJT and MOSFET
2.	To design amplifiers and oscillators.

Experiments:

1	Static characteristics of semiconductor diode, zener diode and study of simple voltage regulator circuits.
2	Single phase half wave and full wave rectifiers with inductive and capacitive filters.
3	Static Characteristics of BJT under CE, CB, CC and determination of hybrid parameters.
4	Static characteristics of JFET.
5	Static and Switching Characteristics of MOSFET
6	Static characteristics of UJT.
7	Frequency response of CB/CE/CC amplifiers.
8	Frequency response of CD/CS amplifiers.
9	Differential amplifiers using FET.
10	Design of RC Phase shift oscillators.
11	Design of Wien bridge oscillators.
12	Design of Hartley/Colpitts oscillators.

Total (0+45)= 45 Periods

Course Outcomes:

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

CO1	:	To design analog electronic circuits using Diode
CO2	:	To design analog electronic circuits using BJT
CO3	:	To design analog electronic circuits using MOSFET
CO4	:	To design analog electronic circuits using FET
CO5	:	To design oscillator circuits
CO6	:	To design Wave generating circuits

Reference Books:

1	David A. Bell, “Electronic Devices and Circuits”, New Delhi: Oxford University Press, 5th Edition, 2008.
2	Jacob Millman, Christos C.Halkias, ‘Integrated Electronics - Analog and Digital circuits system’,Tata McGraw Hill, 2003.
3	Robert L.Boylestad, “Electronic Devices and Circuit theory”, 2002.

E –References

1	https://electronicsforu.com/resources/electronic-devices-and-circuit-theory
2	https://nptel.ac.in/courses/117103063/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	1	1	3	1	1	1	1	
CO2	2	3	3	3	2	1	3	1	1	1	1	
CO3	3	2	2	3	2	1	3	1	1	1	1	
CO4	2	3	2	3	3	1	3	1	1	1	1	
CO5	2	2	3	3	3	1	3	1	1	1	1	
CO6	2	3	3	3	2	1	2	1	1	1	1	

18CYMC01	ENVIRONMENTAL SCIENCE	L	T	P	C
		0	0	1	0

Course objectives:

1	They are part of the environment
2	To have an ancient wisdom drawn from Vedas
3	Activities based knowledge to preserve environment, Conservation of water and its optimization.

Experiments

	Environmental Awareness **6 hours**
1	Group activity on water management
2	Group discussion on recycle of waste (4R's)
3	Slogan making contest.
4	Poster making event.
5	Expert lecture on environmental awareness.
6	Imparting knowledge on reduction of electricity usage
	Environmental activities **8 hours**
1	Identification and segregation of biodegradable and non biodegradable waste
2	Campus cleaning activity
3	Plantation of trees in the college campus and local waste lands.
4	Identification of varieties of plants and their usage
5	Shutting down the fans and ACs of the campus for an hour
6	Field work on growing of kitchen garden for mess.
	Total (14+0)= 14 Periods

Course Outcomes:

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

CO1	:	Use and save water effectively
CO2	:	Reuse the waste effectively
CO3	:	Save electricity for future generation
CO4	:	Classify biodegradable and non biodegradable waste
CO5	:	Plant trees in the college campus and local waste lands.

Reference Books:

1	D K Asthana "A Text book on Environmental studies", S.Chand Publications, 5th Edition, 2010
2	Rajesh Gopinath," Environmental Science and Engineering", Cengage, 2011.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2						
CO2						2						
CO3							2	3				
CO4					1							
CO5			3									

18EE401	SIGNALS AND SYSTEMS	L	T	P	C
		2	1	0	3

Course objectives:

1.	Understand the concepts of continuous time and discrete time systems.
2.	Analyze systems in complex frequency domain.
3.	Understand sampling theorem and its implications.

UNIT I	INTRODUCTION TO SIGNALS AND SYSTEMS	6	+	3

Signals and systems- Signal properties: periodicity, absolute integrability, deterministic and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals. System properties: linearity, additivity and homogeneity, shift-invariance, causality, stability, realizability, Examples.

UNIT II	CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS	6	+	3

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

UNIT III	FOURIER AND LAPLACE TRANSFORMS	6	+	3

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior.

UNIT IV	Z- TRANSFORMS	6	+	3

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z transform, application to discrete systems - Stability analysis, frequency response – Convolution.

UNIT V	SAMPLING AND RECONSTRUCTION	6	+	3

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Total (30+15)= 45 Periods

Course Outcomes:

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

CO1	:	Determine if a given system is linear/causal/stable
CO2	:	Capable of determining the frequency components present in a deterministic signal
CO3	:	Capable of characterizing LTI systems in the time domain and frequency domain
CO4	:	Compute the output of an LTI system in the time and frequency domains
CO5	:	Capable of determining the frequency response of discrete system using Z transform
CO6	:	Understand the concepts and importance of sampling

Text Books:

1.	Allan V.Oppenheim, S.Wilsky and S.H.Nawab, —Signals and Systems‖, Pearson, 2015.
2.	J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.

3.	B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.
4.	A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall,2009.
Reference Books:	
1.	H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
2.	S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
3.	M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
4.	R.E.Zeimer, W.H.Tranter and R.D.Fannin, —Signals & Systems - Continuous and Discrete‖, Pearson, 2007.
E -References	
1	https://nptel.ac.in/courses/117104074/

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	1	1	2	1	1	1	1	
CO2	2	3	1	1	2	1	2	1	1	1	1	
CO3	2	3	2	3	2	1	3	1	1	1	1	
CO4	2	3	2	3	3	1	3	1	1	1	1	
CO5	2	3	3	3	3	1	3	1	1	1	1	
CO6	2	3	3	3	2	1	2	1	1	1	1	

18EE402	SYNCHRONOUS AND INDUCTION MACHINES	L	T	P	C
		3	0	0	3

Course Objectives:

This course provides understanding of AC machinery fundamentals, machine parts and helps to develop the skills for operating AC machines, and equips students to analyze the equivalent circuits of Induction and Synchronous Machines.

Unit I	ALTERNATOR	9	+	0

Construction, types, practical rating of synchronous generators, winding factors, production of EMF, armature reaction, Synchronous reactance, phasor diagram, Methods of pre-determination of voltage regulation-Synchronous impedance, ampere turn, Potier triangle methods. Two reaction theory–Slip test, synchronization - Change of excitation and mechanical input

Unit II	SYNCHRONOUS MOTOR	9	+	0

Theory of operation–phasor diagrams, Torque equation – Operation on infinite bus bars, variation of current and power factor with excitation. Hunting and its suppression, V and inverted V curves, Synchronous condenser, method of starting.

Unit III	THREE PHASE INDUCTION MACHINES	9	+	0

Constructional details, types, production of rotating magnetic field-principle of operation and practical rating of induction motors. Need for starting – Types of starters – DOL, Rotor resistance and Auto transformer starters. Generator action: self-excitation, operation, and applications.

Unit IV	ANALYSIS AND TESTING OF THREE PHASE INDUCTION MOTORS	9	+	0

Phasor diagram, equivalent circuit, Torque equation-starting and maximum-torque, maximum-output, slip for maximum-output, Torque-slip characteristics, losses and efficiency. Testing-no load and blocked rotor tests-equivalent circuit parameters, circle diagram.

Unit V	SINGLE PHASE INDUCTION MOTOR	9	+	0

Constructional details of single-phase induction motor – Double field revolving theory and operation – Equivalent circuit – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor.

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Familiarize with construction, working principle, synchronizing techniques and performance of Synchronous Generator.
CO2	:	Understand the working principle, torque equation, and excitation control for Synchronous Motor.
CO3	:	Operate three phase Induction machine as motor and as a generator.
CO4	:	Analyze the performance of three phase induction motor with testing.
CO5	:	Know double field revolving theory and starting mechanisms for single-phase induction motors
CO6	:	Use synchronous and induction motors in practical domain with specified ratings.

Text Books:

1.	D.P. Kothari, I.J. Nagrath, “Electric Machines”, 5th edition, Tata McGraw-Hill Company Ltd., New Delhi, 2017.
2.	Dr.P.S.Bimbhra, “Electrical Machinery”, Khanna Publishers, Delhi, 2021,2nd edition.
3.	A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, ‘Electric Machinery’, Tata McGraw Hill Publishing Company Ltd, 2017,5th edition.

Reference Books:

1.	B.L.Theraja& A.K. Theraja, “Electrical Technology”, Vol.II, S.Chand& Company Ltd., New Delhi, 2015.

2.	Alexander S. Langsdorf, Theory of Alternating-Current Machinery, Tata McGraw Hill Publications, 2009.
E-Reference	
1	www.nptel.ac.in

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1					2					2
CO2		1			2							1
CO3	3						2				1	
CO4	2			3		1			2			
CO5					1					2		2
CO6			2	3							2	

18EE403	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To introduce the basic functional elements of instrumentation
2.	To introduce the fundamentals of electrical and electronic instruments
3.	To educate on the various magnetic measurement techniques
4.	To be familiarized with the various bridge circuits for measurement of R, L, C
5.	To introduce various transducers and the data acquisition systems.

Unit I	ANALOG INSTRUMENTS	9	+	0

Elements of a Generalized Measurement System- Measurement System performance – Static Characteristics – Dynamic Characteristics – Classification of Analog instruments – Principle of operation – operating forces – constructional details – types of control systems – types of damping systems. Operation – torque equation for deflection – errors – extension range of – PMMC – MI – Electrodynamometer – induction type instruments.

Unit II	MEASUREMENT OF POWER AND ENERGY	9	+	0

Measurement of power in DC circuits, power in AC circuit- single and three phase- electrodynamometer, induction type watt meters – Construction, operation – torque equation for deflection – errors- measurements of high power using instrument power transformer – measurement of energy for AC circuits- induction type watt-hour meters – construction theory and operation – torque equation – adjustment in energy meter

Unit III	MAGNETIC MEASUREMENTS	9	+	0

Measurement of flux density – magnetizing force – magnetic potentiometer- testing of ring specimens determination of B-H curve –determination of hermistor loop by step by step method and method of reversal – testing of bar specimens – Hopkinson permeameters – Illiovici permeameters – alternating current magnetic testing varying with form factor and frequency – wattmeter method of iron loss measurements method.

Unit IV	MEASUREMNT OF R, L, C AND POTENTIOMETERS	9	+	0

Balance equations – Wheatstone bridge – Kelvin double Bridge – Maxwell's inductance bridge – Maxwell's inductance capacitance bridge – Hay's bridge – Anderson's bridge – Schering bridge and Wien's bridge. DC potentiometer – lab type hermist's potentiometer, Duo range potentiometer – precision type potentiometer – AC potentiometer– Drysdale polar potentiometer- Gall Tinsley co-ordinate type - Campbell – Larsen type.

Unit V	MEASUREMENT OF NON-ELECTRICAL QUANTITIES	9	+	0

Classification of transducers – factor influencing the choice of transducers. Resistive transducers, Inductive Transducers – potentiometers. Linear Variable Differential Transformer – RVDT – Capacitive transducers using change in Area of Plates. Photoelectric transducers, Piezoeletrci transducers – Measurement of angular velocity – Tachogenerator – Photoelectric tachometerMeasurement of temperature – hermistor – thermocouple – pyrometer – Measurement of flow – hot wire anemometers – turbine meters – electromagnetic flow meters.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Measure current and voltage in AC and DC circuits
CO2	:	Measure Power and energy AC and DC circuits and magnetic measurements.
CO3	:	Calculate R,L,C using various bridges
CO4	:	Measure non-electrical quantities
CO5	:	Share knowledge on electrical instruments and measurements.
CO6	:	Teach the Instrumentation techniques and its applications.

Text Books:	
1.	A.K. Sawhney, 'A Course in Electrical & Electronics Measurement & Instrumentation', Dhanpat Rai and Co, 2015
2.	E.O. Doebelin, 'Measurements Systems- Application and Design', Tata McGraw Hill publishing company, 2015.
Reference Books:	
1.	D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt. Ltd, 2010.
2.	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 2017,3rd edition.
3.	Martin Reissland, ' Electrical Measurements', New Age International(P) Ltd., Delhi, 2011.
4.	J.B. Gupta, 'A Course in Electronic and Electrical Measurements', S.K. Kataria& Sons, Delhi,2015
E References:	
1	https://nptel.ac.in/courses/108105064/
2	https://nptel.ac.in/courses/108106074/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2		2	1		2	1	1		1	1
CO2	1	2		2	1		2	1	1		1	1
CO3	1	2		2	1		2	1	1		1	1
CO4	1	2		2	1		2	1	1		1	1
CO5	2	2	2	3	2	2	1	2	1	3	3	3
CO6	2	2	2	3	2	2	1	2	1	3	3	3

18EE404	ANALOG AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study the characteristics and applications of Operation Amplifier.
2.	To gain knowledge about functional diagram and applications of linear Ics
3.	To simplify the switching functions.
4.	To design combinational logic circuits.
5.	To design of sequential logic circuits

Unit I	CHARACTERISTICS OF OP-AMP	9	+	0

Ideal OP-AMP: characteristics-Inverting and non-inverting amplifier- voltage follower – differential amplifier – DC characteristics – AC characteristics. Basic applications: summer- multiplier- divider- differentiator and integrator-instrumentation amplifier – V/I and I/V converters

Unit II	APPLICATIONS OP-AMP AND LINEAR Ics	9	+	0

Applications of OP-AMP: comparators – multivibrators – Peak detector- Sample and Hold circuit – first and second order low pass and high pass active filters.
Functional block diagram and Applications of Linear Ics: IC 555 Timer – IC 566 Voltage controlled oscillator – IC 565 Phase-locked loops – IC LM317 voltage regulators.

Unit III	COMBINATIONAL LOGIC CIRCUITS	9	+	0

Representation of logic functions: SOP and POS forms – Simplification of switching functions: K-map method and Quine McCluskey (Tabulation) method.
Design: Adder – Subtractor – 2 bit Magnitude Comparator – Multiplexer- Demultiplexer- Encoder – Priority Encoder – Decoder – Code Converters. Implementation of combinational logic circuits using multiplexers and Decoder**.**

Unit IV	SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	9	+	0

Flip-flops: SR, D, JK and T – Conversion of flip-flops; Classification of sequential circuits: Moore and Mealy models – Analysis and design of synchronous sequential circuits – Design of synchronous counters – Universal shift register.

Unit V	ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	9	+	0

fundamental mode and pulse mode circuits , Analysis procedure of asynchronous circuits with /without using of SR latches- primitive state / flow table – Reduction of state and flow table – state assignment – Design Procedure of asynchronous circuits with /without using of SR latches – Problems in asynchronous sequential circuits: cycles – Races – Hazards.

Total (L+T)=45/0 Periods

Course Outcomes:

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

CO1	:	Explain the OP-AMP characteristics
CO2	:	Understand the applications of OP-AMP and other linear Ics.
CO3	:	Utilize K-map and Tabulation methods to simplify the switching functions
CO4	:	Design and implement of combinational logic circuits
CO5	:	Analysis and design of synchronous sequential logic circuits
CO6	:	Analysis and design of asynchronous sequential logic circuits

Text Books:

1.	D.Roy Chowdhury and Shail B. Jain , “Linear Integrated Circuits”, Fourth Edition, New Age International (P) Ltd Publishers, 2014.
2.	M. Morris Mano, “Digital Design” , Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2010 .

3.	S. Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, Third Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2011.
Reference Books:	
1.	Ramakant A Gayakward, “Op-Amps and Linear Integrated Circuits”, Fourth Edition, Pearson Education, 2003.
2	Jacob Millman, Christos C.Halkias, “Integrated Electronics- Analog and Digital circuits system”, Tata McGraw Hill 2003.
3	R.P.Jain, “Modern Digital Electronics”, Third Edition, Tata McGraw–Hill Publishing company limited, New Delhi, 2011.
4.	Thomas L. Floyd, “Digital Fundamentals”, Pearson Education, Inc, New Delhi, 2015
5.	Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.
E-Reference	
1	NPTEL courses on Analog Integrated Circuits, IIT Madras- web: http://nptel.ac.in/courses/108106068/
2	NPTEL courses on Analog Circuits, IIT Bombay https://nptel.ac.in/courses/108/101/108101094/
3	NPTEL courses on Digital Electronic Circuits, IIT Kharagpur. Web:https://nptel.ac.in/courses/108/105/108105132/
4	NPTEL courses on Digital Circuits, IIT Kharagpur. Web: https://nptel.ac.in/courses/108/105/108105113/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	3	2	1	1								
CO3	3	2			2							
CO4	3	2			2							
CO5	3	2			2							
CO6	3	2			2							

18ME408	ENGINEERING MECHANICS	L	T	P	C
		2	1	0	3

Course Objectives:

1.	To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
2.	To analyze the force systems, friction and to study the dynamics of particles, impulse and momentum.

UNIT I	STATICS OF PARTICLES	6	+	3

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.

UNIT II	EQUILIBRIUM OF RIGID BODIES	6	+	3

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III	PROPERTIES OF SURFACES AND SOLIDS	6	+	3

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections.

UNIT IV	FRICTION	6	+	3

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.

UNIT V	KINETICS OF PARTICLES AND RIGID BODIES	6	+	3

Equations of motion- Rectilinear motion-curvilinear motion- Relative motion- D'Alembert's Principle-work-Energy equation-Conservative forces and principle of conservation of energy-Impulse- momentum- Impact- Direct central impact and oblique central impact. Plane motion- Absolute motion- Relative motion- work and energy- impulse and momentum.

Total (30+15) = 45 Periods

Course Outcomes:

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

CO1	:	Illustrate the vectorial and scalar representation of forces and moments
CO2	:	Analyze the rigid body in equilibrium
CO3	:	Evaluate the properties of surfaces and solids
CO4	:	Determine the friction and the effects by the laws of friction
CO5	:	Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems

Text Books:

1.	A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications, 2015,5t edition.
2.	Engineering Mechanics, R.S. Khurmi, S.Chand Publishing, 2018.

Reference Books:

1.	Engineering Mechanics, D.S. Bedi, Khanna Book Publishing Co. (P) Ltd.
2.	Rajasekaran S and Sankarasubramanian G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., 2017 ,3rd edition.
3.	Palanichamy M.S. and Nagam S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, 2001

4.	Engineering Mechanics, DP Sharma, Pearson,2010.
5.	F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I – Statics, Vol II, – Dynamics, 12th Ed, Tata McGraw Hill, 2019.
E-Referencce	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1					2		
CO2	2	1	1	0	1					2		
CO3	2	1	1	0	0							
CO4	1	1	1	1	0							
CO5	2	2	1	1	0							

18EE405	SYNCHRONOUS AND INDUCTION MACHINES LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1	To expose the students to operate of synchronous machines and induction motors and strength their experimental skill.

Experiments:

1	Predetermination of Voltage Regulation of three-phase alternator by EMF and MMF methods.
2	Predetermination of Voltage Regulation of three-phase alternator by ZPF method.
3	Slip test on three-phase salient pole alternator.
4	V and inverted V curves of synchronous motors
5	Load test on three-phase induction motor.
6	Circle diagram for three phase induction motor with No load and blocked rotor test data.
7	Three Phase Induction Generator action with self-excitation.
8	Synchronization of three-phase alternator
9	Separation of losses in three phase induction motor.
10	Load test on single-phase induction motor.
11	Equivalent circuit and pre-determination of performance characteristics of single-phase induction motor.
12	Separation of losses in single phase transformer using alternator

Total(0+45)= 45Periods

Course Outcomes:

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

CO1	:	Analyze the voltage regulation of a given alternator using different methodologies
CO2	:	Analyze the performance of a given synchronous motor under various excitation Conditions
CO3	:	Analyze the characteristics of a induction motor under various load conditions
CO4	:	Analyze the load sharing capability of given alternators
CO5	:	Develop the equivalent circuit and analyze the characteristics of single-phase induction motor
CO6	:	Do loss analysis in AC machines.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2			1		2				2	
CO2		2			2							1
CO3	3			2							1	
CO4	2				3		2		2			
CO5				1	1					2		2
CO6		2	2	3							2	

18EE406	MEASUREMENTS AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To study the use of Transducer.
2.	To measure the resistance, capacitance and inductance using bridges.
3.	To calibrate voltage and current using measuring equipment.
4.	To calibrate the efficiency of PV modules.

Experiments:

1	Measurement of displacement using transducers.
2	Measurement of pressure using transducers.
3	Measurement of inductance by Maxwell's bridge.
4	Measurement of inductance by Anderson's bridge
5	Measurement of resistance by Wheatstone bridge.
6	Measurement of capacitance, Inductance by schering bridge.
7	Study of Instrumentation amplifiers.
8	A/D converters.
9	D/A converters.
10	Study of transients.
11	Calibration of single phase and three phase energy meter.
12	Calibration of AC, DC voltmeter and Ammeter.
13	Calibration of current transformer and potential transformer.
14	Measurement of three phase power and power factor.
15	Calibration and Voltage – Current Measurement of solar light.
16	Study of PLC.
17	Calibration of series and parallel connection of PV modules.
18	Calculation of efficiency for PV system modules, Battery and Inverter.

2Total(0+45)= 45Periods

Course Outcomes:

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

CO1	:	Explain analog instruments.
CO2	:	Measure power in AC and DC circuits
CO3	:	Calculate R,L,C using various bridges.
CO4	:	Know about basic of PLC.
CO5	:	Measure the efficiency of PV modules
CO6	:	Calibrate ammeter, voltmeter, energy meter and transformers.

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	2		2	1		2	1	1		1	1
CO2	1	2		2	2		2	1	1		2	1
CO3	1	2		2	1		2	2	1		1	1
CO4	1	2		2	1		2	1	1		1	1
CO5	1	2		2	1		2	1	2		1	1
CO6	1	3		3	1		3	1	1		1	1

18EE407	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To Expose the characteristics and applications of Linear Ics.
2.	To study various digital electronics circuits used in simple system configuration

List of Experiments: (Any 10 Experiments)

1	Verification of IC 741 characteristics: inverting and non-inverting amplifier – voltage follower.
2	Verification of IC 741 Applications circuits: summer, differentiator and integrator.
3	Design of zero crossing detector and Schmitt trigger circuit using OP-AMP.
4	Design and testing of first order Low Pass and High Pass Active filters.
5	Design of Wien bridge oscillator and RC phase shift oscillator using OP-AMP.
6	Design of astable and monostable multivibrator circuits using NE/SE 555 timer.
7	Design of Voltage controlled oscillator using NE/SE 566.
8	Design of Voltage regulator using IC723.
9	Design of +5V, 1A regulated Power supply using IC 7805.
10	Design of variable power supply using IC LM317.
11	Design of dual power supply using LM 320 / LM340.
12	Realize the switching functions using minimum number of NAND/NOR gates.
13	Design of code converter circuits.
14	Study of different types of Flip-Flops.
15	Design of 3-bit synchronous counters.
16	Implementation of multipliexers and demultiplexers – encoders and decoders
17	Design of 4-Bit shift registers using flip-flop.
18	Testing of asynchronous counters using flip-flops.

Total (0+45)= 45 Periods

Course Outcomes:

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

CO1	:	Study the characteristics and mathematical applications of op-amp
CO2	:	Design and verify waveform generator circuits and filter circuits using op-amp.
CO3	:	Design voltage regulator and power supply circuits using Linear Ics.
CO4	:	Realize the switching function using universal gates.
CO5	:	Realize the various types of combinational logic circuits
CO6	:	Implement the various types of sequential logic circuits

Reference Books:

1.	Department Integrated Circuits Laboratory Manual
2.	Roy Choudhury. D and Shail. B. Jain, “Linear Integrated Circuits”, New Age International 4th Edition, 2011.
3	Gayakwad. R.A, “Op-amps & Linear Integrated Circuits”, Pearson education, 4th Edition, 2015

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3	3	2		1		3			
CO2			3	3	2		1		3			
CO3			3	3	2		1		3			
CO4			3	3	2		1		3			
CO5			3	3	2		1		3			
CO6			3	3	2		1		3			

18MC301	INDIAN CONSTITUTION	L	T	P	C
		1	0	0	0

Course Objectives:

1.	Learn the salient features of the Indian Constitution
2.	List the fundamental rights and fundamental duties
3.	Present a systematic analysis of all dimensions of the Indian political Systems
4.	Understand the power functions of Parliament, the legislature and Judiciary.

Unit I		**3**	**+**	**0**

Union and its Territory – Citizenship – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties.

Unit II		**3**	**+**	**0**

The Union – The States – The Union Territories –The Panchayats – the Municipalities

Unit III		**3**	**+**	**0**

The Co-operative Societies – The Scheduled and Tribal Areas – Relations between the Union and the States – Finance, Property, Contracts and Suits – Trade and Commerce within the territory of India.

Unit IV		**3**	**+**	**0**

Service under the Union, the States – Tribunals –Elections –Special provisions –Relating to certain classes.

Unit V		**2**	**+**	**0**

Languages - Emergency provisions –Miscellaneous – Amendment of the Constitution.

Total (14+0)= 14 Periods

Course Outcomes:

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

CO1	:	Understand the emergence and evolution of the Indian Constitution.
CO2	:	Explain the key concepts of Indian Political System
CO3	:	Describe the role of Constitution in a democratic society
CO4	:	Present the structure and functions of the central and state Governments, the legislature and Judiciary.

Reference Books:

1.	Subhash C. Kashyap , Our Constitution , national Book trust, 2017
2.	Durga Das basu, Introduction to the History of Modern India.Lexis Nexis, 2015.
3.	M.V.Pylee, Constitutional History of India, S.Chand Publishing, 2010.
4.	Granville Austin, The Indian Constitution, Cornerstone of a nation, Oxford university Press, 1999.

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									1	1		1
CO2									1	1		1
CO3									1	1		1
CO4									1	1		1

18EE501	POWER GENERATION, TRANSMISSION AND DISTRIBUTION SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study the characteristics of load curve, power tariff methods and the various power generating systems.
2.	To become familiar with the different components used in Transmission and Distribution levels of power systems and modeling of these components

Unit I	POWER GENERATION SYSTEMS	9	+	0

Structure of electric power system: Various levels such as generation, transmission and distribution, Load curve-load duration curve - tariff- types of tariff- Power generating Station: layout- selection of site of Thermal power plant, Hydroelectric power plant and Nuclear power plants - major power stations in India.

Unit II	TRANSMISSION LINE PARAMETERS	9	+	0

Line resistance- Inductance and capacitance calculations of single phase and 3- phase transmission lines with single and double circuits – Inductance of composite conductors- Effect of bundling and earth on the capacitance – Skin and proximity effects-Inductive interference between power and communication lines.

Unit III	MODELING AND PERFORMANCE OF TRANSMISSION LINES	9	+	0

Representation of Lines-Performance of Short line, medium line and long line; equivalent circuits, phasor Diagrams, transmission efficiency and voltage regulation and ABCD constants-surge-impedance loading-power transmission capability-Ferranti effect and corona loss.

Unit IV	OVERHEAD LINE INS ULATORS AND CABLES	9	+	0

Insulators: Types, Potential distribution over a string of suspension insulators- improvement of string efficiency. Underground cables: Constructional features of LT and HT cables, capacitance of single core and 3- core cables, dielectric stress in a single core cable- grading of cables, thermal resistance of dielectric of a single core cable**.**

Unit V	SUBSTATION, GROUNDING SYSTEM AND DISTRIBUTION SYSTEM	9	+	0

Substation: Classification-bus-bar arrangements in sub stations- Neutral grounding: Effectively grounded system-Underground system –Resonant grounding- Methods of neutral grounding-Distribution system: Radial and ring-main distribution systems-Methods of solving AC distributed problems.

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Design the layout of various types of power generating systems such as thermal, Hydro, nuclear, diesel and MHD.
CO2	:	Develop expression for computation of fundamental parameters off lines.
CO3	:	Categorize the lines into different classes and develop equivalent circuits.
CO4	:	Analyze the voltage distribution in insulator strings and cables and methods to improve the same.
CO5	:	Comprehend the substation components and grounding techniques.
CO6	:	Grasp the different distribution system

Text Books:

1.	M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, ‘A Text Book on Power System Engineering’, DhanpatRai& Co.,2013.
2.	C.L. Wadhwa, ‘Electrical Power Systems’, Newage International (P) Ltd., 2017.
3.	Singh,”Electric Power Generation,Transmission and Distribution”, IIndEdition,PHIPvt. Ltd., New Delhi, 2012.

Reference Books:	
1.	Ray, “Electrical Power systems: Concepts, Theory and Practice”, PHI Pvt.Ltd., New Delhi,2014,2nd edition.
2.	V.K. Mehta, Rohit Mehta, “Principles of Power System”, S.Chand& Company Ltd., New Delhi, 2012
3.	Dr. S.L.UPPAL, ‘ELECTRICAL POWER’, Khanna publishers, New Delhi, 1987.
E-Reference	
1	www.onlinecourses.nptel.ac.in/noc18_ee41
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	1	2	3	1	1	1	1	2
CO2	2	3	3	3	2	1	1	1	1	1	1	1
CO3	2	2	2	2	2	1	1	1	1	1	1	1
CO4	2	2	2	2	2	1	1	1	1	1	1	2
CO5	1	1	2	2	1	1	1	1	1	1	1	1
CO6	2	1	1	1	1	1	1	1	1	1	1	2

18EE502	CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To understand the methods of representation of systems and getting their transfer function models.
2.	To provide adequate knowledge in the time response of systems and steady state error analysis.
3.	To give basic knowledge in obtaining the open loop and closed loop frequency response of systems.
4.	To understand the concept of stability of control system and methods of stability analysis.
5.	To study the three ways of designing compensators for a control system.

Unit I	SYSTEMS AND THEIR REPRESENTATION	9	+	3

Basic elements in control systems – Open and closed loop systems – Mathematical model and Electrical analogy of mechanical systems – Transfer function – Synchro – AC and DC servo-motors – Block diagram reduction techniques – Signal flow graphs.

Unit II	TIME RESPONSE ANALYSIS	9	+	3

Standard test signals – Time response of first order and second order systems – Steady-state errors and error constants – Types of control systems – Effect of adding poles and zeros to transfer functions – Response with P, PI, PD and PID controllers.

Unit III	FREQUENCY RESPONSE ANALYSIS	9	+	3

Correlation between time and frequency response: Second order systems – Polar plots – Bode plots – Computation of Gain Margin and Phase Margin – Frequency domain specifications – Constant M and N-circles – Nichols chart.

Unit IV	STABILITY OF CONTROL SYSTEM	9	+	3

BIBO stability – Necessary conditions for stability – Routh-Hurwitz stability criterion – Root locus concepts – Rules for the construction of Root loci – Nyquist stability criterion – Assessment of relative stability using Nyquist criterion.

Unit V	COMPENSATOR DESIGN	9	+	3

Need for compensation – Types of compensators – Electric network realization and frequency characteristics of basic compensators: Lag, lead and lag-lead compensators – Cascade compensation in frequency domain.

Total (45+15)= 60 Periods

Course Outcomes:

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

CO1	:	Derive the transfer function models of any electrical and mechanical systems.
CO2	:	Develop the time response and steady state error analysis of the control systems.
CO3	:	Analyze the frequency response of the systems.
CO4	:	Analyze the stability of closed loop control systems.
CO5	:	Construct the root locus plot and analyze system stability.
CO6	:	Design the compensators using conventional techniques.

Text Books:

1.	A. Anand Kumar, “Control Systems”, PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2015.
2.	I.J. Nagrath& M. Gopal, “Control Systems Engineering”, New Age International Publishers, Delhi, 5th Edition, 2015.

Reference Books:

1.	K. Ogata, “Modern Control Engineering”, Pearson Education, New Delhi, 2010.
2.	M. Gopal, “Control Systems: Principles and Design”, TMH, New Delhi, 4th Edition, 2012.

E-References:

1.	www.onlinecourses.nptel.ac.in/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	2	1	1	1	1	1	2
CO2	3	3	2	2	1	2	1	1	1	2	1	2
CO3	3	3	1	1	2	1	1	1	1	2	1	1
CO4	3	3	2	1	1	1	2	2	1	2	2	2
CO5	3	1	2	2	1	1	2	3	1	2	2	2
CO6	3	1	2	2	1	1	2	3	1	2	2	2

18EE503	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study an overview of power semiconductor devices, principles of controlled rectifiers, DC-DC converters, inverters, AC voltage controller circuits and their analysis.

Unit I	POWER SEMICONDUCTOR DEVICES	9	+	0

Concept of power electronics- Structure, Operation, Static and Switching characteristics of power semiconductor devices: Power Diode, SCR, MOSFET, IGBT, IGCT –- Thyristor ratings and protection, Gate drive circuits for MOSFET and IGBT, Switching and Conduction losses in a generic power semiconductor device.

Unit II	PHASE CONTROLLED RECTIFIERS	9	+	0

Single phase and three phase fully controlled rectifiers – Power circuit, Operation, Waveform analysis and performance parameters – Effect of source and load inductance –Single phase and Three phase dual converters- Introduction to PWM rectifiers

Unit III	DC TO DC CONVERTER	9	+	0

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage– control strategy – Power Circuit and steady state analysis of Buck converter, Boost converter, Buck – boost converter and SEPIC converter- Design of inductor and capacitors for DC-DC converters.

Unit IV	INVERTERS	9	+	0

Power circuit of single-phase voltage source inverter, square wave operation of the inverter, bipolar and unipolar sinusoidal modulation, modulation index and output voltage, Power circuit of a three-phase voltage source inverter, operation, switch states, instantaneous output voltages, three-phase sinusoidal modulation -Space vector modulation

Unit V	AC TO AC CONVERTERS	9	+	0

Introduction and principle of operation of Single phase and Three phase AC voltage controllers – Multistage sequence control –Applications of AC Voltage Controllers–Introduction to Matrix converters.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Select the Power Semiconductor Devices based on Characteristics.
CO2	:	Evaluate the performance of phase-controlled rectifier.
CO3	:	Design and analyze the DC/DC converter circuits
CO4	:	Analyze the inverter operation and its control techniques.
CO5	:	Know the operation and applications of AC voltage controller and matrix converters

Text Books:

1.	M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI 4th Edition New Delhi, 2014.
2.	P .S.Bimbra "Power Electronics" Khanna Publishers, New Delhi 2018.

Reference Books:

1.	Ned Mohan, Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applicationsand Design', John Wiley and sons, 2007.
2.	R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
3.	M.D. Singh and K.B. Khanchandani, "Power Electronics," McGraw Hill India, 2013.

E-Reference

1	www.onlinecourses.nptel.ac.in/
2	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1	3		2				1		1
CO2	2			1	2			1				
CO3	1	2					2					
CO4	1	2		3		1	2					
CO5			1		2				2		2	2

18EE504	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

Course Objectives:

1.	A thorough understanding in establishing a digital control system
2	Learn different digital communications and their applications
3	Get ideas to apply digital controls for different electrical applications

Unit I	8085 8 BIT MICROPROCESSOR	9	+	0

Fundamentals of microprocessors – Architecture of 8085 – Groups of Instructions - Addressing modes – Basic timing diagram – Organization and addressing of Memory and I/O systems –Interrupt structure – Stack and sub-routines - Simple 8085 based system design and programming.

Unit II	8051 8 BIT MICROCONTROLLER	9	+	0

Fundamentals of microcontrollers – Architecture of 8051 – Groups of Instructions - Addressing modes – Organization of Memory systems – I/O Ports – Timers/Counters – Serial Port - Interrupt structure – Simple programming concepts using Assemblers and Compliers

Unit III	INTERFACING WITH 8051 MICROCONTROLLER	9	+	0

Need and requirements of interfacing – Interfacing – LED, 7 segment and LCD Displays – Tactile switches, Matrix keyboard – Parallel ADC – DAC – Interfacing of Current, Voltage, RTD and Hall Sensors.

Unit IV	EXTERNAL COMMUNICATION INTERFACE	9	+	0

Synchronous and Asynchronous Communication. RS232, RS 485, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Unit V	APPLICATIONS OF MICROCONTROLLERS	9	+	0

Stepper motor interfacing, DC Motor interfacing, Data Acquisition System, Measurement of Electric Power, Powe factor. Solid State Relays

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand any other types of modern microprocessor and microcontroller,
CO2	:	Select appropriate digital system based on applications
CO3	:	Design simple controls using software programs
CO4	:	Design and interface communications between digital systems
CO5	:	Apply the digital concepts to measure and control simple electrical systems

Text Books:

1.	R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applicat ions with the 8085”, Penram International Publishing, 2013, 6th edition.
2.	K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.
3.	M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.

Reference Books:

1.	R. Kamal, “Embedded System”, McGraw Hill Education,2017
2.	D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 2005

E-Reference

1	www.onlinecourses.nptel.ac.in/
2	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1		1	1		1	1	1
CO2	1	1	1	1	1		1	1		1	1	1
CO3	1	1	1	1	1		1	1		1	1	1
CO4	1	1	1	1	1		1	1		1	1	1
CO5	1	1	1	1	1		1	1		1	1	1

18EE505	CONTROL SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To provide a platform for understanding the basic concepts of linear control theory and its application to practical systems.

Experiments:

1	Transfer function of separately excited DC generator.
2	Transfer function of self-excited DC generator.
3	Transfer function of armature-controlled DCmotor.
4	Transfer function of field-controlled DC motor.
5	Transfer function of AC servo-motor.
6	Frequency response of Lag, Lead and Lag-lead networks.
7	Study of Synchros.
8	Study of Stepper motor.
9	Ward Leonard method of speed control of DC motor.
10	Study of DC position control system.
11	Study of P, PI and PID controllers (First-order).

Total (0+45)= 45 Periods

Course Outcomes:

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

CO1	:	Design the transfer function of DC and AC machines.
CO2	:	Design compensators for control system.
CO3	:	Gain knowledge about Synchros.
CO4	:	Gain knowledge about Stepper motor.
CO5	:	Design controllers for control systems.

Reference Books:

1.	A. Anand Kumar, “Control Systems”, PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2015.
2.	I.J. Nagrath& M. Gopal, “Control Systems Engineering”, New Age International Publishers, Delhi, 5th Edition, 2015.
3.	K. Ogata, “Modern Control Engineering”, Pearson Education, New Delhi, 2010.

E-References:

1.	www.onlinecourses.nptel.ac.in/
2.	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	1	3	1	2	1	1	2
CO2	3	3	3	3	2	2	3	1	2	2	1	1
CO3	3	3	3	2	2	1	1	2	1	3	1	1
CO4	3	3	3	1	1	1	2	2	1	2	2	2
CO5	2	3	2	3	1	2	1	3	1	2	2	2

18EE506	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1	To simulate and analyze the performance of different power electronic converter circuits.

Experiments:

1	V-I Characteristics of power diode and SCR
2	Static and Switching Characteristics of Power MOSFET and IGBT
3	Single phase AC to DC fully controlled converter
4	Single phase PWM rectifiers
5	Buck and Boost Converters
6	MOSFET based single-phase PWM inverter
7	IGBT based three-phase PWM inverter
8	Single phase AC voltage controller
9	Simulation for Single phase and three phase dual converters
10	Simulation of Buck – boost converter and SEPIC converter
11	Simulation of three phase voltage source inverters with sinusoidal modulation
12	Simulation of Matrix converter

Total(0+45) = 45 Periods

Course Outcomes:

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

CO1	:	Analyze the characteristics of MOSFET, SCR and IGBT.
CO2	:	Evaluate the performance of DC-DC Converters and inviters.
CO3	:	Design and control of inverters with different modulations.
CO4	:	Analyze the performance of power converters with simulation studies
CO5	:	Demonstrate the operation of power converters

Text Books:

1.	M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI Third Edition, New Delhi, 2009.
2.	P.S.Bimbra "Power Electronics" Khanna Publishers, New Delhi 2016.

Reference Books:

1.	Ned Mohan, Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, 2007.
2.	R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
3.	M.D. Singh and K.B. Khanchandani, "Power Electronics," McGraw Hill India, 2013.

E-References:

1.	www.onlinecourses.nptel.ac.in/
2.	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2		3		2			1			1
CO2	2		3	1			2				1	
CO3		1	2		2		2			2		
CO4	1			3		1					2	
CO5					2			1	2			2

18EE507	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	Able to write own programs for different applications
2.	Interface and program for interconnected digital systems

Experiments:

1	Simple arithmetic operations: addition / subtraction / multiplication / division.
2	Programming with control instructions: a. Ascending / Descending order, Maximum / Minimum of numbers b. Programs using Rotate instructions c. Hex / ASCII / BCD code conversions.
3	Interface Experiments: with 8085 a. A/D Interfacing. & D/A Interfacing.
4	Traffic light controller.
5	I/O Port / Serial communication
6	Programming Practices with Simulators/Emulators/open source
7	Keyboard interfacing
8	LCD interfacing 4bit/8bit mode
9	Demonstration of basic instructions with 8051 Micro controller execution, including: a. Conditional jumps, looping b. Calling subroutines.
10	Programming I/O Port 8051 a. Interface with external A/D & D/A b. Interface with stepper motor
11	Interrupt programming with external sensors/ devices
12	Programming for communication using Zigbee protocol.

Total (0+45)= 45 Periods

Course Outcomes:

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

CO1	:	Write coding to implement different types of algorithms
CO2	:	Design and implement simple controllers
CO3	:	Use simulators and emulators for debugging and verifying codes
CO4	:	Write efficient codes using interrupts for time critical applications
CO5	:	Interface any application module to microprocessor/microcontroller.

Text Books:

1.	R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applicat ions with the 8085”, Penram International Publishing, 1996
2.	K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.
3.	M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.

Reference Books:

1.	R. Kamal, “Embedded System”, McGraw Hill Education,2009
2.	D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991

E-References:

1.	www.onlinecourses.nptel.ac.in/
2.	www.class-central.com

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	0	1	1	1	1	0	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	0	1	1	1	1	0	1
CO4	1	1	1	1	1	0	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1

18EE601	POWER SYSTEM ANALYSIS AND STABILITY	L	T	P	C
		3	0	0	3

Course Objectives:

1	To model the power system under steady state operating condition
2	To apply efficient numerical methods to solve the power flow problem
3.	To model and analyze the power systems under abnormal (or) fault conditions
4.	To model and analyse the transient behaviour of power system when it is subjected to a fault.

Unit I	**POWER SYSTEM OVERVIEW AND MODELLING**	**9**	**+**	**0**

Basic components of modern power system - Per-phase analysis: Generator model - Synchronous motor model- - Three-phase transformer model - Three-winding transformer model - Line model- per unit quantities - Changing the base of per-unit quantities - representation of load impedance - Single line diagram -Impedance and reactance diagrams.

Unit II	**POWER FLOW ANALYSIS**	**9**	**+**	**0**

Bus classification – Bus admittance matrix Formulation: Direct inspection method and Singular transformation method -Development of power flow model - solution of load flow equations: Gauss Seidel method - Newton Raphson method- Fast decoupled method – flowcharts – Comparison of the three power flow solution methods.

Unit III	**FAULT ANALYSIS - BALANCED FAULT**	**9**	**+**	**0**

Introduction – Balanced three phase fault – Short circuit capacity - Algorithm for formation of the Bus Impedance matrix- Systematic fault analysis using Bus Impedance matrix -Selection of circuit breakers.

Unit IV	**FAULT ANALYSIS - UNBALANCED FAULT**	**9**	**+**	**0**

Fundamentals of symmetrical components – Sequence impedances – Construction of sequence networks – Unsymmetrical faults on power system: Single line-ground fault, line-line fault – Double line-ground fault- Unbalanced Fault analysis using bus impedance matrix.

Unit V	**STABILITY STUDIES**	**9**	**+**	**0**

Importance of stability studies – Classification of power system stability – Stability limits – Power angle equation- Inertia constant- Swing equation of single-machine connected to infinite bus – Solution of Swing equation by step-by-step method-II – Modified Euler's method – Runge-Kutta method – Equal area criterion – Critical clearing angle and time -Factors affecting transient stability – Techniques for transient stability improvement.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Develop the single line diagram for the power system.
CO2	:	Perform and analyze load flow computations using bus admittance matrix
CO3	:	Perform and analyze balanced fault using bus impedance matrix
CO4	:	Develop computational models for unsymmetrical fault analysis in power systems
CO5	:	Understand the transient stability studies.

Text Books:

1.	Hadi Saadat, "Power System Analysis", Tata McGraw Hill Publishers, New Delhi, 21st reprint 2010
2.	D.P.Kothari, and I.J.Nagrath, "Modern Power System Analysis", Tata McGraw Hill Education Private limited, New Delhi, Fourth Edition, 2011.

Reference Books:

1.	John J. Grainger and W.D. Stevenson Jr., "Power System Analysis", McGraw Hill Inc., New Delhi, 2017.
2.	B.R. Gupta, "Power System Analysis and Design", S.Chand& Co. Ltd., New Delhi, 2012
3.	C. L. Wadhwa, "Electrical Power Systems", New Age International Publishers, New Delhi, 2010.

E-References	
1.	https://onlinecourses.nptel.ac.in/, for power system analysis course, IIT Kharagpur
2.	NPTEL courses on Power System Generation, Transmission and Distribution, IIT Delhi.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	1	3	1	3		1					
CO2	2	2	3	2	3		1					
CO3	2	2	3	2	3		1					
CO4	2	2	3	2	3		1					
CO5	2	2	3	2	3		1					

18EE602	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To know about the Analyze the operation of the chopper fed dc drive, both qualitatively and quantitatively.
2.	To understand the Operation and performance of AC motor drives.

UNIT I	DC MOTOR CHARACTERISTICS & CHOPPER FED DC DRIVES	9	+	0

Review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, exampleload torque-speed characteristics, operating point, armature voltage control for varying motorspeed. Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper

UNIT II	MULTI-QUADRANT & CLOSED-LOOP CONTROL OF DC DRIVE	9	+	0

Review of Four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, current controller specification and design, speed controller specification and design.

UNIT III	INDUCTION MOTOR CHARACTERISTICS	9	+	0

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

UNIT IV	SCALAR CONTROL OR CONSTANT V/F CONTROL OF INDUCTION MOTOR	9	+	0

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

UNIT V	CONTROL OF SLIP RING INDUCTION MOTOR	9	+	0

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

Total (45+0)= 45 Periods

Course outcomes:

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

CO1	:	Understand the characteristics of dc motors and induction motors.
CO2	:	Understand the principles of speed-control of dc motors and induction motors.
CO3	:	Understand the power electronic converters used for dc motor and induction motor speed control.
CO4	:	Gain knowledge on the Scalar control or constant V/f control of induction motor
CO5	:	Gain knowledge on chopper fed DC drives.

Text Books:

1.	G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2.	R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall,2015

Reference Books:

1.	G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2010.
2.	W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

E-referencess

1	https://www.iith.ac.in/~ketan/drives.htmL

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3			2	1	1			1	2
CO2	3	3	1	3		1	1	1				1
CO3	3	3	3	3	3	1	1	1				1
CO4	1	3	3	2	3	1	1	1				1
CO5	3	3	3	3	3	1	1	1			1	1

18EE603	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To create awareness on Engineering Ethics and providing basic knowledge about engineering Ethics, Variety of moral issues and Professional Ideals.
2.	To provide basic familiarity about Engineers as responsible Experimenters, Codes of Ethics, Industrial Standards.
3.	To inculcate knowledge and exposure on Safety and Risk, Risk Benefit Analysis.

UNIT I	HUMAN VALUES	9	+	0

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

UNIT II	ENGINEERING ETHICS	9	+	0

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action – Self-interest- customs and religion - uses of ethical theories.

UNIT III	ENGINEERING AS SOCIAL EXPERIMENTATION	9	+	0

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law – the challenger case study.

UNIT IV	SAFETY, RESPONSIBILITIES AND RIGHTS	9	+	0

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest – occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V	GLOBAL ISSUES	9	+	0

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME,ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India.

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Understand the importance of ethics and values in life and society.
CO2	:	Understood the core values that shape the ethical behavior of an engineer.
CO3	:	Expose awareness on professional ethics and human values.
CO4	:	Analyse a person based on human value concepts
CO5	:	Analyse our responsibility and rights to social problems

Text Books:

1.	Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2.	Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1.	Tripathi A N, "Human values" , New Age international Pvt. Ltd., New Delhi, 2002.
2.	Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004.
3.	Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000.
4.	John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1			2			3		3	2			3
CO2			2			3		3	1			2
CO3			2			2		3				2
CO4			2			3		3	1	1		2
CO5			2			2		2		1		2

18EN501	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	Communicate effectively with interviewers
2.	Express opinions, illustrate with examples, elucidate and conclude in group discussions
3	Write error free letters and prepare reports
4	Speak fluently and avoid pitfalls in pronunciation and grammatical errors

WRITING SKILLS **(15 hours)**

- Letter seeking permission to go on industrial visit
- Letter of invitation
- Resume and Cover Letter
- Report Writing – Progress in project work

SPEAKING SKILLS **(15 hours)**

- Welcome Address and Vote of Thanks
- Analysing and presenting business articles
- Power Point Presentation
- Group Discussion

SOFT SKILLS **(15 hours)**

- Psychometric profile
- Self-Introduction
- Interview skills
- Conducting a board meeting

VERBAL ABILITIES **(15 hours)**

- Error Spotting
- Listening Comprehension
- Rearranging Jumbled sentences
- Vocabulary

Lab Record

1. Group Discussion - Literature survey
2. Group Discussion - Transcripts
3. Group Discussion - Assessment forms
4. Interview Skills – Psychometric profile
5. Interview Skills - Self-introduction
6. Interview Skills – Resume and Cover Letter
7. Interview Skills - Transcription of interview
8. Interview Skills - Assessment sheet signed by interview panel
9. Power Point Presentation
10. Error spotting worksheet
11. Jumbled sentences worksheet
12. Welcome Address
13. Vote of Thanks
14. Letter seeking permission to go on industrial visit
15. Report Writing – Progress in project work
16. Presentation of business articles - Transcription

Total (0+30)= 30 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Write error free letters and prepare reports
CO2	:	Deliver welcome address and vote of thanks
CO3	:	Speak coherently with proper pronunciation and accent
CO4	:	Avoid common Indianisms and grammatical errors
CO5	:	Improve repertoire of passive vocabulary
CO6	:	Answer questions posed by interviewers confidently
CO7	:	Participate in group discussion effectively
CO8	:	Undertake online psychometric and IQ test to understand their strengths and weaknesses

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1				2		1	3	3	1	2
CO2	1	3		1				1	1	3	1	3
CO3		1		3		1		2	1	3	1	2
CO4		1		1		2			1	3		3
CO5				2				1		3	2	3
CO6		1		1		1		1	1	3	1	2
CO7				1		1		2	2	3	1	2
CO8	1	2		2		1				3		2

18EE701	POWER SYSTEM PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To know about the power system protection and switchgear components.
2.	To understand the concepts of various protection schemes.
3.	To know about numerical protection schemes.

Unit I	PROTECTIVE RELAYS	9	+	0

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 overcurrent 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	9	+	0

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 – Autoreclosure. 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	EQUIPMENT PROTECTION SCHEMES	9	+	0

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.

Unit IV	STATIC RELAYS	9	+	0

Introduction - Advantages of static relays - Basic construction - Phase and amplitude comparators - Static directional relay - Directional overcurrent relay – Static differential relays and differential protective schemes.

Unit V	NUMERICAL PROTECTION	9	+	0

Introduction – Block diagram – Sampling theorem – Fourier analysis of analogue signals – Least error squared technique – Digital filtering – Over current protection – Differential protection – Distance protection.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the concepts and applications of protective relays.
CO2	:	Acquire knowledge about different types of circuit breakers
CO3	:	Understand the protection schemes of various power components.
CO4	:	Understand numerical protection schemes.
CO5	:	Design protection scheme for any electrical system

Text Books:

1.	Badri Ram and Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill, 2017,2nd edition.
2.	Arun Ingole, “Switchgear and Protection”, Pearson India, 2018.

Reference Books:

1.	Rao, T. S. M, “Power System Protection Static Relays with Microprocessor Applications”, Tata McGraw-Hill, 2017,2nd edition.
2.	Paithankar, Y. G and Bhide, S. R, “Fundamentals of Power System Protection”, Prentice Hall, 2013.

3.	Uppal, S.L, “Electrical Power", Khanna Publishers, New Delhi, 2019.
4.	Ravindranath. B and Chander, N, “Power System Protection and Switchgear”, New Age International, 2018 ,2nd edition.
E-References:	
1.	NPTEL Course: Power System Protection - Prof. S.A. Soman, IIT-B.
2.	NPTEL Course: Power System Protection – organized by IIT-B.
3.	www.cdeep.iitb.ac.in. (Electrical Engineering)

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	1	2	3	2	1	2	3	2
CO2	1	1	3	2	2	1	3	2	2	2	2	2
CO3	2	2	2	3	1	2	3	3	1	2	3	1
CO4	2	1	1	2	3	1	3	2	3	2	2	2
CO5	1	1	2	1	2	2	3	3	2	3	2	1

18EE702	INDUSTRIAL MANAGEMENT AND ECONOMICS	L	T	P	C
		3	0	0	3

Course Objectives:

1	To understand the concept of management , economics and Indian financial system

Unit I	MODERN CONCEPT OF MANAGEMENT	9	+	0

Scientific management-Functions of management-Planning-Organising- Staffing-Directing- Motivating-Communicating- Co-ordinating- Controlling-Organisational structures- Line, Line and staff and Functional relationships- Span of control- Delegation- Management by Objectives.

Unit II	PERSONNEL MANAGEMENT	9	+	0

Objectives and functions of personnel management- Recruitment-Selection and training of workers- Labour Welfare- Industrial Fatigue- Industrial disputes-Trade Unions- Quality circles. Formation of companies: Proprietory-Partnership-Joint stock companies- Public sector- Joint sector and Co-operative sector.

Unit III	MARKETING MANAGEMENT	9	+	0

Pricing- Promotion- Channels of distribution- Market research-Advertising. Production Management: Batch and mass production- Inventory control- EOQ-Project planning by PERT/CPM- Construction of Network (Basic ideas only).

Unit IV	BASICS OF ECONOMICS	9	+	0

Theory of demand and supply- Price mechanism- Factors of production- Land, labour, capital and organization-National income- Difficulties in estimation- Taxation- Direct and indirect taxes- Progressive and regressive- Black money- Inflation-Causes and consequences.

Unit V	INDIAN FINANCIAL SYSTEM	9	+	0

Reserve bank of India: Functions- Commercial banking system-Development financial institutions- IDBI- ICICI-SIDBI- IRBI- NABARD- Investment institutions-UTI- Insurance companies- Indian capital market- Stock market-Functions- Role of the public sector- Privatisation- Multinational corporations and their impact on the Indian economy

Total 45+0)=45 Periods

Course Outcomes:

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

CO1	:	Understand the conceptsof managment
CO2	:	Understand various types of managment.
CO3	:	Understand the Indian economics
CO4	:	Manage an organization efficiently for its upliftment
CO5		Apply marketing concept to any organization to earn more profit.

Text Books:

1.	O P Khanna , “Industrial Management” , Dhanpat Rai Publications,4th edition, 1980.
2.	Philip Kotler, Kevin Lane Keller, SweeHoon Ang, Chin Tiong Tan, Siew Meng Leong, “Marketing Management: An Asian Perspective” Pearson Education Limited, 7th Edition, 2017
3	A. N. Agrawal, “Indian Economy”,Vikas Publishing House PVT, 4th edition, 1978.

Reference Books:

1	K. K. Ahuja, “Industrial management” Khanna Publishers, 1978.
2	K.K Dewett, Shyam Lal , “Modern economic theory” S Chand and Company Limited, 2008

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			2	1		3	2	3	2
CO2			1			2	1		3	2	3	2
CO3				1		1		2				1
CO4			1			2		1	3	2	3	2
CO5			1			2		1	3	2	3	2

18EE703	POWER SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	Hands - on and computational experiments related to various power system problems.
2.	Programming of numerical methods for solution of various power system operation and control problems.

Experiments

1.	Formation of bus admittance matrix.
2.	Bus impedance matrix formulation.
3.	Load flow analysis using Gauss Seidel method.
4.	Power flow analysis using Newton Raphson method.
5.	Transient stability analysis: Single machine infinite bus system.
6.	Transient stability analysis of multi machine power systems.
7.	Load frequency control of single area and two area power systems.
8.	Economic dispatch by lambda iteration method.
9.	Solution to combined economic emission dispatch problems.
10.	Thermal unit commitment using priority list method.

Total (0+45) = 45 Periods

Course Outcomes:

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

CO1	:	Formulate power system network matrices.
CO2	:	Get knowledge about power flow analyses.
CO3	:	Analyse power system stability problems.
CO4	:	Formulate and solve power system operational problems.
CO5	:	Allocate system load to various generators in the system economically

Reference Books:

1.	Hadi Saadat, “Power System Analysis”, Tata McGraw Hill, 2010.
2.	Kothari D.P and Dhillon J.S, “Power System Optimization”, Prentice Hall of India, New Delhi, 2004.

E-References:

1.	NPTEL Course: Power Systems Engineering – Prof. Debapriya Das, IIT-K.
2.	NPTEL Course: Computer Aided Power System Analysis – Prof. Biswarup Das, IIT-R.
3.	www.cdeep.iitb.ac.in. (Electrical Engineering)

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	2	2	1	1	1	2	1	1	1	2	2
CO2	1	2	1	1	1	1	1	1	1	1	2	2
CO3	1	2	2	2	1	1	1	1	2	2	1	2
CO4	1	2	2	2	1	1	2	1	1	2	2	2
CO5	1	2	2	2	1	1	2	1	1	2	2	2

18EE704	ELECTRICAL DRIVES AND CONTROL LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics
2.	To impart industry oriented learning
3.	To evaluate the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation

Experiments:

1	Study of thysistor controlled DC Drive using PSPICE / MATLAB / PSIM Software
2	Study of Chopper fed DC Drive using PSPICE / MATLAB / PSIM Software
3	Study of AC Single phase motor-speed control using TRIAC.
4	PWM Inverter fed 3 phase Induction Motor control using PSPICE / MATLAB / PSIM Software
5	VSI / CSI fed Induction motor Drive analysis using MATLAB/DSPICE/PSIM Software
6	Study of V/f control operation of 3F induction motor drive using PSPICE / MATLAB / PSIM Software
7	Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software
8	Regenerative / Dynamic braking operation for DC Motor - Study using software
9	Regenerative / Dynamic braking operation of AC motor - Study using software

Total (0+45) = 45 Periods

Course Outcomes:

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

CO1	:	Set up control strategies to synthesize the voltages in dc and ac motor drives
CO2	:	Develop testing and experimental procedures applying basic knowledge in electronics, electrical circuit analysis, electrical machines, microprocessors, and programmable logic controllers
CO3	:	Use standard methods to determine accurate modeling/simulation parameters for various general-purpose electrical machines and power electronics devices required for designing a system and solve drives related problems
CO4	:	Combine the use of computer-based simulation tools relevant to electrical Drives with practical laboratory experimentation.
CO5	:	Design VSI/CSI for induction motor using any simulation software.

Text Books:

1.	Seung-Ki Sul, “Control of Electric Machine Drive Systems” , John Wiley & Sons, Ltd., 2011.
2.	ShaahinFilizadeh ,”Electric Machines and Drives,”, CRC Press,2013.
3	Haitham Abu-Rub, Atif Iqbal, JaroslawGuzinski,”High Performance Control of AC Drives with Matlab/Simulink Models”John Wiley & Sons, Ltd., 2012.

Reference Books:

1	Werner Leonhard ,“Control of Electrical Drives”,Springer, 2006.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	2	1	1				1	1
CO2	1	2	2	2	2	1	1				1	1
CO3	1	2	2	2	2	1	1				1	1
CO4		1	2	2	2	1	1				1	1
CO5		1	2	2	2	1	1				1	1

PROGRAMME ELECTIVES

18EEP01	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To Study mmf calculation and thermal rating of various types of electrical machines
2.	To Design armature and field systems for D.C. machines.
3.	To Design core, yoke, windings and cooling systems of transformers.
4.	To Design stator and rotor of induction machines.
5.	To Design stator and rotor of synchronous machines and study their thermal behaviour

UNIT I	INTRODUCTION	9	+	0

Major considerations – Limitations – Electrical Engineering Materials – Space factor – temperature gradient – Heat flow in two dimensions – thermal resistivity of winding – Temperature gradient in conductors placed in slots – Rating of machines – Eddy current losses in conductors – Standard specification

UNIT II	DC MACHINES	9	+	0

Magnetic circuit calculations – Net length of Iron –Real & Apparent flux densities – Design of rotating machines – D.C machines output equations – Main dimensions-Selection of number of poles – Armature design – Design of commutator and brushes-Design of slot, air gap, field coils.

UNIT III	TRANSFORMERS	9	+	0

KVA output for single and three phase transformers – Window space factor – Overall dimensions – Operating characteristics – Regulation – No load current – Temperature rise of Transformers– Design of Tank with & without cooling tubes – Thermal rating – Methods of cooling of Transformers – Design of chokes – Design of welding Transformers – Design of CTs &PTs.

UNIT IV	INDUCTION MOTORS	9	+	0

Output equation of 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-Operating characteristics –Short circuit current –Dispersion co efficient – relation between D & L for best power factor.

UNIT V	SYNCHRONOUS MACHINES	9	+	0

Runaway speed – construction – output equations – choice of loadings – 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 – Introduction to computer aided design – Program to design main dimensions of Alternators.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Know the philosophy of design and thermal rating of Electrical machines.
CO2	:	Remember for the component of magnetic and electrical loading of AC and DC Machines.
CO3	:	Design Armature and Field Systems for DC Machines.
CO4	:	Design core, windings and cooling system of transformers.
CO5	:	Design Stator and rotor of Induction Machines.
CO6	:	Design Rotor of synchronous machines and understand their thermal behaviour.

Text Books:

1.	Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 2010,6th edition.

2.	Sen.,S.K., 'PrinciplesofElectricalMachineDesignswithComputerProgrammes', OxfordandIBHPublishingCo.Pvt.Ltd.NewDelhi,2014,3rd edition.
Reference Books:	
1.	R.K.Agarwal, Principles of Electrical Machine design, S.K. Kataria and Sons, Delhi 2014 5th edition.
2.	V.N. Mittle, ' Design of Electrical Machines', Standard Publications and Distributors, Delhi, 2002.
E- References	
1	http://cusp.umn.edu/machine_design.php

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	1	1				1
CO2	3	3	3	3	3	1	1	1				1
CO3	3	3	3	3	3	1	1	1				
CO4	3	3	3	3	3	1	1	1				1
CO5	3	3	3	3	3	1	1	1				1
CO6	3	3	3	3	3	1	1	1				1

18EEP02	BIOLOGY FOR ELECTRICAL ENGINEERS	L	T	P	C
		3	0	0	3

Course Objectives:

The purpose of this course is to provide a basic and easy understanding of modern biology to engineers as it is a multi – disciplinary field. It emphasis on the basic engineering principles of bimedicalequipments. In addition, the course is expected to encourage the engineering students to think about solving biological problems with engineering tools. These will be gained by the following:

1.	An understanding of biological mechanisms of living organisms from the perspective of engineers.
2.	To Understand the principles of Biomedical Equipments.
3.	An understanding of the function and regulation of human system and acquire knowledge about biological problems that requires engineering expertise to solve them.
4.	An Understanding of the basics of molecular biology and genetics.
5.	To know about the radiation safety instruments and X Ray examinations.
6.	To evaluate the kinetics and thermodynamics of enzymatic process.

Unit I	BIOMOLECULES AND METABOLISM	9	+	0

Carbohydrates- classification - Glycolysis- definition- flow chart- steps involved in glycolysis- preparatory phase and pay off phase- kinds of reactions in glycolysis. Photosynthesis- definition- significance photosynthetic-pigments types- structure of pigments factors affecting photosynthesis- external and internal factors.

Unit II	BASICS OF ENZYMES, MACROMOLECULES AND NUCLEIC ACIDS	9	+	0

Introduction - Enzymes – Proteases and amylases. Proteins- classification- structure of proteins- primary, secondary, tertiary and quaternary structure- properties of proteins- physical and chemical properties: protein synthesis. Types-Structural components of nucleic acids- acid, pentose sugar and nitrogenous base- nucleoside – nucleotide and its functions - single and double helical structure of DNA-comparison between DNA and RNA-types of RNA -mRNA, tRNA and rRNA and their function.

Unit III	X RAY EXAMINATIONS	9	+	0

Blood cell counter – Electron microscope – radiation detectors – photo meters and colorimeters – digital thermometer – audio meters – X-ray tube – X-ray machine – Radiography and fluoroscopy – image intensifiers – angiography – applications of X-ray examination.

Unit IV	HUMAN PHYSIOLOGY	9	+	0

Cells and their structure – Transport of ions through the cell membrane – resting and action potential – bio-electric potential. Physiology of Human body- Brain, heart, lungs - Cardiovascular system - Respiratory system - nervous system. Design of medical instruments components of biomedical instrument systems – electrodes – micro, needle, surface electrode - transducers.

Unit V	BIOMEDICAL EQUIPMENTS AND RADIATION SAFETY INSTRUMENTS	9	+	0

Pacemakers – Pacemaker batteries – Defibrillators – heart lung machine. Surgical diathermy – short wave diathermy – microwave diathermy – ultrasonic diathermy – therapeutic effect of heat – range and area of irritation of different diathermy techniques – Ventilators – oxymeters.

Radiation safety instrumentation – physiological effects due to 50 Hz current passage – Micro shock and macro shock – electrical accidents in hospitals – Devices to protect against electrical hazards. Nuclear imaging techniques – computer tomography – thermography – ultrasonic imaging system – Magnetic resonance imaging – Positron emission tomography – digital subs traction angiography.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Be aware that all types of life have the identical structural units.
CO2	:	Explain, analyze, diagnose, and develop new therapies to treat disease and heal damaged tissues and organ systems.
CO3	:	To teach the working principles of biomedical equipments.

CO4	:	Explain human physiological systems.
CO5	:	Share knowledge in genetics and molecular biology.
CO6	:	Know about the applications and implementation of medical equipments as it is a challenging interdisciplinary process

Text Books:

1.	FJ.L.Jain, Sanjay jain and Nitin jain- "Fundamentals of Biochemistry" - Sixth edition, S.Chand and company Ltd., Ram nagar, 2005.
2.	Dr.A.V.S.S.Rama Rao-" Text book of Biochemistry"- Text book of Biochemistry- First edition- UBS Publishers' Distributors Pvt. Ltd., 2019
3.	U. Satyanarayana –" Biochemistry"-5th edition – Sri Padmavathi Publications Ltd.,2017.
4.	N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
5.	Dr.M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2012.
6.	Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation andMeasurements', II edition, Pearson Education, 2011 / PHI.

Reference Books:

1.	Stent, G. S.; and Calender-" Molecular Genetics"- Second edition - R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
2.	By Nelson, D. L.; and Cox- "Principles of Biochemistry"- V Edition- M. M.W.H. Freeman and Company
3.	Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H-" Outlines of Biochemistry"- John Wiley and Sons
4.	Quillin, Allison Scott Freeman, Kim Quillin and Lizabeth Allison, 'Biological Science', Pearson Education India, 2016.
5.	Reinhard Renneberg, Viola Berkling and Vanya Loroch, 'Biotechnology for Beginner's', Academic Press, 2017.
6.	S Balaji, S Lakshminarayanan, "Conceptual comparison of metabolic pathways with electronic circuits", Journal of Bionics Engineering, Vol 1, Issue 3, pg 175-182, 2004
7.	R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd.,2012.
8.	L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley &Sons, 2011.
9.	C.Rajarao, 'Medical Instrumentation', John Wiley & Sons,2013.
10.	C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation',Universities press (India) Ltd, Orient Longman ltd, 2012.

E-Reference:

1	www.onlinecourses.nptel.ac.in/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	2	1	1	1	1	1	1	1
CO2	3	1	1	3	1	1	1	1	1	1	1	1
CO3	1	2	2	1	1	1	1	1	1	1	1	1
CO4	3	1	1	3	2	1	1	1	1	1	1	1
CO5	2	1	1	2	1	1	2	1	1	1	1	1
CO6	2	2	1	1	1	1	1	1	1	1	1	1

18EEP03	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To classify signals and systems & their mathematical representation.
2.	To analyze the discrete time systems.
3.	To study various transformation techniques & their computation.
4	To study about filters and their design for digital implementation.
5	To study about a programmable digital signal processor & quantization effects.

UNIT I	INTRODUCTION TO SIGNALS AND SYSTEMS	9	+	0

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II	DISCRETE TIME SYSTEM ANALYSIS	9	+	0

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z transform, application t discrete systems - Stability analysis, frequency response –Convolution – Discrete TimeFouriertransform magnitude and phase representation.

Unit III	DISCRETE FOURIER TRANSFORM & COMPUTATION	9	+	0

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FF algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

Unit IV	DESIGN OF DIGITAL FILTERS	9	+	0

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice c windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIF Filters, digital design using impulse invariant and bilinear transformation - mWarping, pre warping.

Unit V	DIGITAL SIGNAL PROCESSORS	9	+	0

Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DSP Processors.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the types of systems and signals.
CO2	:	Solve problems in digital system using Z transform.
CO3	:	Apply Fourier transforms for processing of digital signals.
CO4	:	Analyze digital systems using Fast Fourier transform.
CO5	:	Design digital filters algorithms in digital signal processor platforms
CO6	:	Gain knowledge about DSP processors.

Text Books:

1.	J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2007.
2.	S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
3.	Robert Schilling & Sandra L.Harris, "Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.

Reference Books:

1.	Poorna Chandra S, Sasikala. B ,Digital Signal Processing, Vijay Nicole/TMH,2013.
2.	B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010.
3.	Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2012.
4.	Sen M.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013.

E -References	
1	https://nptel.ac.in/courses/108105055/34
2	https://books.google.co.in/books/isbn=8131710009

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	2	1	1	1	1	
CO2	3	3	2	1	2	1	2	1	1	1	1	
CO3	3	3	3	3	2	1	3	1	1	1	1	
CO4	3	3	3	3	3	1	3	1	1	1	1	
CO5	2	3	3	3	3	1	3	1	1	1	1	
CO6	1	1	1	3	2	1	3	1	1	1	1	

18EEP04	DISCRETE CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the digital signal processing.
2.	To study the design of sampled data control systems in state space.
3.	To impart knowledge on digital control algorithms and stability study.

Unit I	INTRODUCTION	9	+	0

Review of frequency and time response analysis and specifications of continuous time systems - need for controllers - continuous time compensations - continues time PI, PD, PID controllers, Realization of basic compensators: Lag, Lead and Lag-Lead compensation schemes - problems.

Unit II	SIGNAL PROCESSING IN DIGITAL CONTROL	9	+	0

Need for digital control – Configuration of basic digital control scheme – Principles of signal conversion – Basi discrete-time signals – Time domain and frequency domain models for discrete-time systems - Aliasing - Reconstruction of analog signals – Practical aspects of the choice of sampling rate – Discretization based o bilinear transformation.

Unit III	MODELING AND ANALYSIS OF SAMPLED DATA CONTROL SYSTEM	9	+	0

Differential equation description – Z-transform method of description– Z-transform analysis of sampled data control systems –Jury's stability test – Routh stability criterion on the r-plane – State variable concepts: First companion – Second companion – Jordan canonical models – Discrete state variable models – Elementary principles.

Unit IV	DESIGN OF DIGITAL CONTROL ALGORITHMS	9	+	0

Introduction – z-plane specifications of control system design –Digital lead , lag and lag-lead compensator desig using frequency response plots - Digital lead lag compensator design using Root locus plots – z-plane synthesi – Digital controllers for deadbeat performance - Examples.

Unit V	PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS	9	+	0

Development and implementation of digital PID control algorithms – Tunable PID controllers - Digital temperature control system: Control algorithm – Digital position control system: Digital measurement of shaft position/speed, control algorithm – Stepping motors and their controls: Torque-speed curves, Interfacing of stepper motors to microprocessors

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Get knowledge about digital control scheme.
CO2	:	Get knowledge about sampling techniques.
CO3	:	Design the various digital control algorithms.
CO4	:	Design the various types of digital controllers.
CO5	:	Design the various types of digital compensators.
CO6	:	Get knowledge about applications of digital control.

Text Books:

1.	M.Gopal, "Digital Control and Static Variable Methods", Tata McGraw Hill, New Delhi, 2003,2nd edition.
2.	I.J.Nagrath&M.Gopal, "Control Systems Engineering", New Age International Publishers, New Delhi, 2009,5th edition.

Reference Books:

1.	B.C.Kuo, Digital Control Systems,Oxford University Press,2nd Edition,2007.
2.	K. Ogata, Modern Control Engineering, Pearson Education, 2010 5th edition.

3.	Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and Applications", Penram International, 2nd Edition, 1996.
E -References	
1	https://nptel.ac.in/courses/108103008/
2	https://www.sciencedirect.com/topics/engineering/digital-control-system

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	2	1	1	1	1	
CO2	3	3	2	1	2	1	2	1	1	1	1	
CO3	3	3	3	3	2	1	3	1	1	1	1	
CO4	3	3	3	3	3	1	3	1	1	1	1	
CO5	2	3	3	3	3	1	3	1	1	1	1	
CO6	1	1	1	3	2	1	3	1	1	1	1	

18EEP05	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To expose the various types of over voltage transients and their effect on power system.
2.	To introduce the concept of insulation co-ordination technique.
3.	To provide an overview of solid, liquid and gaseous dielectrics breakdown mechanism
4.	To show how to generate over voltages in the HV testing laboratory
5.	To show how to measure of high voltage and current quantity in HV testing laboratory
6.	To introduce testing procedure of HV power apparatus.

Unit I	OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS AND INSULATION CO-ORDINATION	9	+	0

Causes of over voltages and its effect on power system – Lightning, switching surges and temporary over voltages – Bewley lattice diagram-protection against over voltages; Principle of Insulation Coordination on High voltage and Extra high voltage power systems.

Unit II	ELECTRICAL BREAKDOWN IN GASES, LIQUIDS AND SOLIDS DIELECTRICS	9	+	0

Properties of Dielectric materials- Gaseous breakdown in uniform and non-uniform fields – corona discharges – Vacuum breakdown - conduction and breakdown in pure and commercial liquids dielectrics – breakdown mechanisms in solid and composite dielectrics- Application of insulating materials in electrical equipments.

Unit III	GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS	9	+	0

Generation of High DC voltages: Rectifiers, voltage multipliers and Vande Graff generator- Generation of High AC voltages: cascaded transformer, resonant transformer and tesla coil- Generation of High impulse voltages: single and multistage Marx circuits - Generation of switching voltages - Generation of impulse currents. Tripping and control of impulse generators.

Unit IV	MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS	9	+	0

Measurement of high DC, AC, impulse voltages – Measurement of high currents: Direct, Alternating and Impulse – digital techniques in impulse voltage and current measurements**.**

Unit V	HIGH VOLTAGE TESTING OF ELECTRICAL POWER APPARATUS	9	+	0

Overviews of International and Indian standards- laboratory test procedure: multi-level method, Up and Down method - HV Testing of Insulators and Bushings, Isolators and Circuit Breakers, Power transformers, Surge Arresters, Power capacitors and Cables.

Total (45+0)=45Periods

Course Outcomes:

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

CO1	:	Understand various types of over voltages and its effect on power system.
CO2	:	Know generation of various over voltages in HV testing laboratories.
CO3	:	Know measurement of high voltage DC, AC and impulse quantities.
CO4	:	Know measurement of high current DC, AC and impulse quantities.
CO5	:	Understand high voltage breakdown phenomena in insulating materials.
CO6	:	Comprehend the test procedures as per the Indian standards.

Text Books:

1.	M.S. Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill Publishing Company Ltd, New Delhi ,Fifth Edition, 2013.

Reference Books:

1.	E. Kuffel W.S. Zaengl, and J.Kuffel , 'High Voltage Engineering Fundamentals', Newnes Publishers, second Edition, Elsevier, New Delhi,2005.

2.	C.L. Wadhwa, 'High Voltage Engineering', New Age International (P) Ltd Publishers, Third Edition, 2012
3.	Rakosh Das Begamudre, 'Extra High Voltage AC Transmission Engineering', New Age International (P) Ltd Publishers, 4th Edition, 2011.
E-references	
1	www.onlinecourses.nptel.ac.in/noc18_ee41
2	NPTEL courses on High Voltage Engineering, IIT Kanpur.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2				1					
CO2	3	2	2	1		1						
CO3	3	2	3		1							
CO4	3	2	3		1							
CO5	3		2		1		1					
CO6	3	2	3	2	1	1	2		1		1	

18EEP06	HVDC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the concept, planning of DC power transmission and comparison with AC power transmission.
2.	To analyze HVDC converters.
3.	To study about the HVDC system control.
4.	To analyze harmonics and design of filters.
5.	To model and analysis the DC system under steady state.

Unit I	INTRODUCTION	9	+	0

DC Power transmission technology – Comparison of AC and DC transmission–Application of DC transmission – Description of DC transmission system– Planning for HVDC transmission–Modern trends in HVDC technology – DC breakers – Operating problems– HVDC transmission based on VSC –Types and applications of MTDC systems.

Unit II	ANALYSIS OF HVDC CONVERTERS	9	+	0

Line commutated converter-Analysis of Graetz circuit with and without overlap-Pulse number–Choice of converter configuration–Converter bridge characteristics–Analysis of 12 pulse converters –Analysis of VSC topologies and firing schemes

Unit III	CONVERTER AND HVDC SYSTEM CONTROL	9	+	0

Principles of DC link control–Converter control characteristics–System control hierarchy– Firing angle control– Current and extinction angle control–Starting and stopping of DC link–Power control –Higher level controllers – Control of VSC based HVDC link

Unit IV	REACTIVE POWER AND HARMONICS CONTROL	9	+	0

Reactive power requirements in steady state–Sources of reactive power–SVC and STATCOM–Generation of harmonics –Design of AC and DC filters –Active filters

Unit V	POWER FLOW ANALYSIS IN AC/DC SYSTEMS	9	+	0

Per unit system for DC quantities–DC system model –Inclusion of constraints –Power flow analysis–Case study.

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Basic principles and types of HVDC system are studied.
CO2	:	Analyze the converters used in HVDC system are studied.
CO3	:	Familiarize with the HVDC control.
CO4	:	Gain knowledge about the reactive power management.
CO5	:	Design the filters to overcome harmonics.
CO6	:	Familiarize with the power flow analysis of HVDC system.

Text Books:

1.	Padiyar,K.R.,"HVDCpower transmission system",NewAg eInternational(P) Ltd., New Delhi, Second Edition, 2015
2.	Edward Wilson Kimbark,"DirectCurrent Transmission",Vol.I, Wiley Interscience, New York, London, Sydney,1971

Reference Books:

1.	Colin Adamson and HingoraniNG, "High Voltage Direct Current Power Transmission", Garraway Ltd, London,1977.
2.	Arrillaga,J.,"HighVoltage Direct Current Transmission",PeterPregrinus, London,1998,2nd edition

E- Reference:	
1	www.onlinecourses.nptel.ac.in/noc18_ee41

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	2	1	1	1	1	1	1	2
CO2	1	2	3	2	2	1	1	1	1	1	1	1
CO3	3	2	1	1	1	1	1	1	1	1	1	2
CO4	2	2	2	2	2	1	1	1	1	1	1	1
CO5	2	3	3	2	2	1	1	1	1	1	1	1
CO6	2	2	1	1	1	1	1	1	1	1	1	1

18EEP07	EHVAC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the concept and planning of HVAC power transmission.
2.	Evaluate EHVAC transmission system with all parameters
3.	Understand electrostatic effects in EHVAC transmission
4.	Understand effects of Corona in EHVAC transmission
5.	Select a suitable voltage controller for an EHVAC transmission system

Unit I	INTRODUCTION	9	+	0

Necessity of EHV AC transmission, advantages and problems, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – problems.

Unit II	LINE AND GROUND REACTIVE PARAMETERS	9	+	0

Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.

Unit III	VOLTAGE GRADIENTS OF CONDUCTORS	9	+	0

Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on Humans, animals and plants.

Unit IV	CORONA EFFECTS	9	+	0

Power loss and corona loss, corona-loss formulae, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona loss, audible noise: generation and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example.

Unit V	POWER FREQUENCY VOLTAGE CONTROL	9	+	0

Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system.

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Learn about the trends in EHV AC Transmission and calculate Line inductance and capacitances of bundled conductors.
CO2	:	Calculate voltage gradient of bundled conductors
CO3	:	Understand the effects of corona like Audible noise
CO4	:	Understand the effect of Radio Interference and analyze travelling waves
CO5	:	Calculate electrostatic field of EHV AC lines
CO6	:	Analyze compensated devices for voltage control.

Text Books:

1.	R. D. Begamudre, “EHVAC Transmission Engineering” New Age International(P)Ltd., Third Edition,2014.
2.	S. Rao,“HVAC and DC Transmission 7 practice”,Khanna Publishers, Delhi, Third Edition, 1993.

Reference Books:

1.	Shobhit Gupta and Deepak Gupta,“ EHV AC/DC Transmission”,Engineering Books Publishers, 2014.

E- References:	
1	www.onlinecourses.nptel.ac.in
2	www.electrical-engineering-portal.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	1	1	1	1	1	1	2
CO2	2	3	2	2	2	1	1	1	1	1	1	1
CO3	2	2	2	2	2	1	1	1	1	1	1	1
CO4	2	2	2	2	2	1	1	1	1	1	1	1
CO5	2	3	3	2	2	1	1	1	1	1	1	1
CO6	2	2	3	3	2	1	1	1	1	1	1	1

18EEP08	FACTS CONTROLLERS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To Introduce the Reactive Power Control Techniques.
2.	To Educate on Static VAR Compensators and Their Applications
3.	To Provide Knowledge on Thyristor Controlled Series Capacitors
4.	To Educate on STATCOM Devices
5.	To Provide Knowledge on FACTS Controllers

Unit I	INTRODUCTION	9	+	0

Reactive Power Control in Electrical Power Transmission Lines -Uncompensated Transmission Line – Series Compensation – Basic Concepts of Static Var Compensator (SVC) – Thyristor Controlled Series Capacitor (TCSC) – Unified Power Flow Controller (UPFC).

Unit II	STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS	9	+	0

Voltage Control by SVC – Advantages of Slope in Dynamic Characteristics – Influence of SVC on System Voltage – Design of SVC Voltage Regulator –Modelling of SVC for Power Flow and Fast Transient Stability – Applications: Enhancement of Transient Stability – Steady State Power Transfer – Enhancement of Power System Damping.

Unit III	THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS	9	+	0

Operation of The TCSC – Different Modes of Operation – Modelling of TCSC – Variable Reactance Model – Modelling for Power Flow and Stability Studies. Applications: Improvement of the System Stability Limit – Enhancement of System Damping

Unit IV	VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS	9	+	0

Static Synchronous Compensator (STATCOM) – Principle of Operation – V-I Characteristics. Applications: Steady State Power Transfer-Enhancement of Transient Stability – Prevention of Voltage Instability. SSSC-Operation of SSSC and the Control of Power Flow –Modelling of SSSC In Load Flow and Transient Stability Studies.

Unit V	CO-ORDINATION OF FACTS CONTROLLERS	9	+	0

Controller Interactions – SVC – SVC Interaction – Co-Ordination of Multiple Controllers Using Linear Control Techniques – Control Coordination Using Genetic Algorithms.

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Analyze Power System Operation, Stability, Control and Protection.
CO2	:	Analyze and develop analytical model of FACTS controller for power system application.
CO3	:	Apply knowledge in load compensation techniques.
CO4	:	Analyze the performance of steady state and transients of facts controllers.
CO5	:	Apply knowledge in advanced FACTS controllers.

Text Books:

1.	R.Mohan Mathur, Rajiv K.Varma, “Thyristor – Based Facts Controllers For Electrical Transmission Systems”, IEEE Press And John Wiley & Sons, Inc, 2011.
2.	Narain G. Hingorani, “Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors, Delhi- 110 006, 2011.
3.	K.R.Padiyar,” FACTS Controllers in Power Transmission and Distribution”, New Age International(P) Limited, Publishers, New Delhi, 2014.

Reference Books:	
1.	A.T.John, “Flexible A.C. Transmission Systems”, Institution of Electrical and Electronic Engineers (IEEE), 2019.
2.	V.K.Sood,”HVDC And FACTS Controllers – Applications of Static Converters in Power System”, APRIL 2004 , Kluwer Academic Publishers, 2004.
3.	Xiao – Ping Zang, Christian Rehtanz And Bikash Pal, “Flexible AC Transmission System: Modelling and Control” Springer, 2012.
E-Reference:	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2	3	1	1	1	1	1	1	1
CO2	1	3	2	2	2	1	1	1	1	1	1	1
CO3	3	1	1	3	2	1	1	1	1	1	1	1
CO4	2	1	1	3	2	2	1	1	1	1	1	1
CO5	1	1	1	3	1	1	2	1	1	1	1	1

18EEP09	POWER QUALITY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Introduce the power quality terms and definitions
2.	Understand the sources and issues of various power quality problems.
3.	Gain in-depth knowledge of the mitigation/ suppression techniques of voltages sags, interruptions and harmonics.
4.	Introduce the computer tools for transient's analysis.
5.	Expose the various methods of power quality monitoring.

Unit I	INTRODUCTION TO POWER QUALITY	9	+	0

Terms and definitions of Power quality, General classes of power quality problems: transients- long duration voltage variations- short duration voltage variations, voltage Imbalance, waveform distortion, voltage fluctuation, Power frequency variations-International standard of power quality-CBEMA and ITI curves.

Unit II	VOLTAGE SAGS AND LONG DURATION VOLTAGE VARIATIONS	9	+	0

Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of voltage sag Protection –voltage sag mitigation solution at the End-User level- Evaluating the economics of different ride-through alternatives –Motor Starting sags.

Long Duration voltage variations: Principles of regulating the voltage – devices for voltage regulation-utility voltage regulator application- capacitor for voltage regulation- End user capacitor application-–**Flicker**: sources and mitigation techniques.

Unit III	TRANSIENT OVERVOLTAGE	9	+	0

Sources of transientover voltage- Principles of overvoltage Protection- Devices for mitigation of over voltages – Utility capacitor-switching transients – Utility system lightning protection - Managing Ferro resonance- switching transients problems with loads - computer tools for transients analysis: PSCAD and EMTP.

Unit IV	HARMONICS	9	+	0

Fundamentals of Harmonics: Harmonic Distortion, voltage versus current distortion, Harmonics versus transients- harmonics phase sequences- triplen harmonics -harmonic indices, harmonic sources from commercial and industrial loads. Locating harmonic sources - power system response characteristics – Effects of Harmonics Distortion –Interharmonics - harmonic distortion evaluations, Principles and devices for controlling harmonic distortion, IEEE and IEC standards on harmonics.

Unit V	POWER QUALITY MONITORING AND DISTRIBUTED GENERATION	9	+	0

Monitoring considerations - power quality measurement equipment: disturbance analyser, spectrum and harmonics analysers, flicker meters, applications of Intelligent system for power quality monitoring Distributed Generation: perspectives - DG technologies - power quality issues by DG - operating conflicts

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the definitions and characterization of various power quality issues.
CO2	:	Comprehend the sources of sag & long duration voltage variations and its control methods
CO3	:	Comprehend the sources of transient overvoltage and principle of control methods
CO4	:	Analyse harmonics problem and apply filters to suppress harmonics in distribution system
CO5	:	Understand the operation and application of power quality measuring equipment.
CO6	:	Know PQ issues by Distributed Generation integration with grid.

Text Books:

1.	Roger. C. Dugan, Mark. F. McGranaghan, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", Tata McGraw Hill Publishing Company Ltd, New Delhi, Second Edition, 2012.

Reference Books:	
1.	C. Sankaran ,“Power quality”, CRC Press, First Indian Edition, 2019.
2.	G.T.Heydt, “Electric power quality”, Stars in a Circle publishers, Second Edition, 1994.
3.	Arindam Ghosh **and** Gerald **Led wich**, “Power Quality Enhancement Using Custom Power Devices”, Springer-Verlag Publishers, New York Inc., Second Edition.2009.
E-Reference:	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1			1				1	
CO2	3	2	1	1			1				1	
CO3	3	1	1	1			1				1	
CO4	3	1	2	1		2	2				1	
CO5	3	1	2	1		2	2				1	
CO6	3	1	2	1		1	3				1	

18EEP10	UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Course Objectives

1.	To understand the generation of electrical power by conventional and non-conventional methods.
2.	To impart knowledge on principle and design of illumination systems.
3.	To analyze the performance and different methods of electric heating and electric welding.
4.	To impart knowledge on electric traction systems and their performance.
5.	To understand electric drives for various industrial applications.

Unit I	INTRODUCTION	9	+	0

Generation of electrical power by conventional & non-conventional methods – a brief review of tidal power, wind power, geothermal power, solar energy, hydro station, steam and nuclearpower plants.
Economics of generation – definitions – load duration curve – number and size ofgenerator units – Cost of electrical energy – tariff – need for electrical energy conservation –methods.

Unit II	ILLUMINATION	9	+	0

Introduction-nature of radiation – definition – laws of illumination – luminous efficacy-photometry – lighting calculations – design of illumination systems for residential, commercial, street lightingand sports ground– types of lamps –incandescent lamp- mercury vapour –fluorescent lamp-energyefficiency lamps – types of lighting schemes – requirements of good lighting

Unit III	HEATING AND WELDING	9	+	0

Introduction- classification of methods of heating – requirements of a good heating material – design of heating element – temperature control of resistance furnace – electric arc furnace –induction heating – dielectric heating – electric welding – resistance welding – electric arcwelding-electrical properties of arc-applications of electric arc welding.

Unit IV	ELECTRIC TRACTION	9	+	0

Introduction – requirements of an ideal traction system – supply systems – train movement -mechanism of train movement – traction motors and control –speedcontrol of three phase induction motor- multiple unit control – braking – recent trends in electric traction.

Unit V	DRIVES AND THEIR INDUSTRIAL APPLICATIONS	9	+	0

Electric drive –advantages of electric drive-individual drive and group drive –factors affecting selection of motor – types of loads – steady state –transient characteristics –size of motor– load equalization – industrial applications – modern methods of speed control of D.C drives-dynamic braking using thyristors-regenerative braking using thyristors.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the concept of generation of electrical power from conventional and non-conventional energy resources.
CO2	:	Understand the economic aspects connected with power system.
CO3	:	Understand the concept behind illumination and design a suitable illumination system for a specific application.
CO4	:	Design and choose an appropriate heating method for specific application and gain knowledge about electric welding system.
CO5	:	Understand the concepts and recent trends of traction system.
CO6	:	Understand the concepts of electric drives and their characteristics.

Text Books:

1.	C.L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt.Ltd, 2015.

2.	Eric Openshaw Taylor, “Utilisation of Electric Energy”, English Universities Press Limited, 2009
3.	J.B. Gupta, “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons, 2013.
Reference Books:	
1.	G.C.Garg, S.K.Gridhar&S.M.Dhir, “A Course in Utilization of Electrical Energy”, Khanna Publishers, Delhi, 2003.
2.	H. Partab, “Art and Science of Utilization of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.
E-Reference	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	2	1	1	1
CO2	2	3	2	3	1	1	2	1	1			1
CO3	3	3	1	3	1	1	2	1				
CO4	1	2	2	3	3	1	2	1				
CO5	3	1	1	2	1	1	2	1		1		1
CO6	1	3	3	3	3	1	2	2				1

18EEP11	ELECTRICAL ENERGY CONSERVATION AND AUDITING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To get knowledge about basics of energy and energy scenario on India.
2.	To understand the energy conservation concepts.
3.	To know about energy auditing.

Unit I	**ENERGY SCENARIO**	**9**	**+**	**0**

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	**ENERGY SOURCES**	**9**	**+**	**0**

Electricity tariff - Load management and maximum demand control - Thermal Basics-fuels - Thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Unit III	**ENERGY MANAGEMENT AND AUDIT**	**9**	**+**	**0**

Definition - Energy audit – Need and 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 and energy substitution - Energy audit instruments. Material and energy balance: Facility as an energy system - Methods for preparing process flow, material and energy balance diagrams.

Unit IV	**ENERGY EFFICIENCY**	**9**	**+**	**0**

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.

Unit V	**ENERGY EFFICIENT TECHNOLOGIES**	**9**	**+**	**0**

Maximum demand controllers - Automatic power factor controllers - Energy efficient motors -Softstarters with energy saver - Variable speed drives - Energy efficient transformers - Electronic ballast - Occupancy sensors - Energy efficient lighting controls - Energy saving potential of each technology.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the present energy scenario.
CO2	:	Get fundamental knowledge about energy and its various forms.
CO3	:	Understand the process of energy management and energy auditing.
CO4	:	Understand the methods improving energy efficiency and energy efficient devices.
CO5	:	Conduct Energy Audit in industry.

Text Books:

1.	Sonal Desai, “Handbook of Energy Audit”, McGraw Hill, 2017.
2.	Tripathy, S. C, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.

Reference Books:	
1.	General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, New Delhi, 2015.
2.	Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency, New Delhi, 2015.
E-References:	
1.	www.bee-india.nic.in
2.	NPTEL Course: Non-Conventional Energy Resources – Prof. PrathapHaridoss, IIT-M.
3.	NPTEL Course: Energy Management Systems and SCADA, 2015 organised by IIT-M.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	2	2	1	3	2	2	2	2	2
CO2	1	1	2	2	1	1	3	2	1	1	2	2
CO3	2	2	2	3	1	1	3	2	2	2	1	2
CO4	2	1	2	2	1	1	3	2	1	2	2	2
CO5	2	2	3	1	2	1	3	1	2	1	2	1

18EEP12	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

1	To get an overview of system operation and control.
2	To understand and model power-frequency dynamics and to design power-frequency controller.
3	To understand and model reactive power-voltage interaction and different methods of control for maintaining voltage profile against varying system load.
4	To study the economic operation of power system
5	To teach about SCADA and its application for real time operation and control of power systems

Unit I	OVERVIEW OF POWER SYSTEM OPERATION AND CONTROL	9	+	0

System load variation: System load characteristics, load curves -daily, weekly and annual, load-duration curve, load factor, diversity factor - Reserve requirements: Installed, spinning , cold and hot reserves. Overview of system operation: Load forecasting, unit commitment, load dispatching. Overview of system control: Governor control, LFC, EDC, AVR, system voltage control, security control.

Unit II	REAL POWER - FREQUENCY CONTROL	9	+	0

Fundamentals of speed governing mechanism and modeling: Speed-load characteristics – Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single-area system: Static and dynamic analysis of uncontrolled and controlled cases; Multi-area systems: Two-area system modeling: static analysis, uncontrolled case, tie-line with frequency bias control; state variable model- integration of economic dispatch control with LFC.

Unit III	REACTIVE POWER–VOLTAGE CONTROL	9	+	0

Typical excitation system, modeling, static and dynamic analysis, stability compensation; generation and absorption of reactive power: Relation between voltage, power and reactive power at a node; method of voltage control: Injection of reactive power, Tap-changing transformer, numerical problems - System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

Unit IV	ECONOMIC DISPATCH AND UNIT COMMITMENT	9	+	0

Incremental cost curve, co-ordination equations with and without loss, solution by direct method and Lambda - iteration method (No derivation of loss coefficients.)- Base point and participation factors- Economic dispatch controller added to LFC control.

Statement of Unit Commitment problem- Constraints in Unit Commitment: spinning reserve- thermal unit constraints- hydro constraints- fuel constraints and other constraints; Unit Commitment solution methods: Priority-list methods, forward dynamic programming approach, numerical problems only in priority-list method using full-load average production cost.

Unit V	COMPUTER CONTROL OF POWER SYSTEMSIN	9	+	0

EMS functions - Energy control centre functions: Monitoring, data acquisition and control, energy control centre levels - SCADA: system hardware configuration –master station-remote terminal units- and functions; Network topology determination- state estimation, security analysis and control - Various operating states: normal, alert, emergency, extremis and restorative; State transition diagram showing various state transitions and control strategies.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the overview of power system operation and control.
CO2	:	Design power-frequency controller for single and two area system

CO3	:	Understand reactive power control methods for maintaining voltage profile against varying system load.
CO4	:	Formulate the optimal scheduling problems in power system.
CO5	:	Get the knowledge about the computer control of power systems.
Text Books:		
1.		Allen J. Wood and Bruce F.Wollenberg, “Power Generation, Operation and Control”, Wiley India Ltd, New Delhi, Second Edition, Reprint 2016.
2.		Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Ltd, New Delhi, 34th reprint 2010.
3.		P. Kundur, 'Power System Stability & Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint 2011.
Reference Books:		
1.		D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Fourth, Tata McGraw Hill Education Pvt., Limited, New Delhi, 2011.
2.		L.L. Grigsby, 'The Electric Power Engineering, Hand Book', CRC Press & IEEE Press, 2012
E-Reference		
1		NPTEL courses on Power System Operation and Control, IIT, Bombay.
2.		NPTEL courses on Power System Generation, Transmission And Distribution, IIT Delhi.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1				1	1
CO2	2	2	2	2	2	2	2				2	2
CO3	1	1	1	1	1	1	1				1	1
CO4	2	2	2	2	2	2	2				2	2
CO5	2	2	2	2	2						1	1

18EEP13	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the concept of microgrid
2.	To impart knowledge about distributed generation technologies, their interconnection in grid
3.	To understand relevance of power electronics in DG,

Unit I	**INTRODUCTION**	**9**	**+**	**0**

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources

Unit II	**DISTRIBUTED GENERATIONS (DG**	**9**	**+**	**0**

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

Unit III	**IMPACT OF GRID INTEGRATION**	**9**	**+**	**0**

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

Unit IV	**BASICS OF A MICROGRID**	**9**	**+**	**0**

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

Unit V	**CONTROL AND OPERATION OF MICROGRID**	**9**	**+**	**0**

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

Total (45+0)=45 Periods

Course Outcomes:

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

CO1	:	Explain various distributed generation systems
CO2	:	Understand various developments happening in the field of Grid integration.
CO3	:	Understand the microgrids and their control schemes.
CO4	:	Implement distributed generation in a hilly or remote place
CO5	:	Configure a microgrid for a group of energy sources

Text Books:

1.	H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2018, 1st edition.
2.	M.GodoySimoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.2007
3	Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.

Reference Books:	
1	John Twidell and Tony Weir, “Renewable Energy Resources” Tyalor and Francis Publications, 2015, 3rd edition
2	DorinNeacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.
3	AmirnaserYezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009
4	F. Katiraei, M.R. Iravani, ‘Transients of a Micro-Grid System with Multiple Distributed Energy Resources’, International Conference on Power Systems Transients (IPST’05) in Montreal, Canada on June 19-23, 2005.
5	Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, ‘Facility Microgrids’, General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005
E-Reference	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	2	1	2	1				2
CO2	1	2	2	2	2	1	2	1				2
CO3	1	2	2	2	2	1	2	1				2
CO4	1	2	2	2	2	1	2	1				2
CO5	1	2	2	2	2	1	2	1				2

18EEP14	WIND AND SOLAR ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Understand the concepts of power generation through Wind and Solar Power
2.	Learn optimal extraction of renewable power and their integration to grid

Unit I	PHYSICS OF WIND POWER	9	+	0

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	9	+	0

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	THE SOLAR RESOURCE	9	+	0

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

Unit IV	SOLAR PHOTOVOLTAIC	9	+	0

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

Unit V	GRID INTEGRATION ISSUES	9	+	0

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.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the physics behind the wind and solar power generation
CO2	:	Implementation of optimal extraction techniques in renewable power generation
CO3	:	Apply power electronics to renewable power optimization
CO4	:	Understand integration techniques used, power quality issues and their mitigation
CO5	:	Device methods to create an approximate energy conversion systems.

Text Books:

1.	Mohan, Net al. “Power Electronics: Converters, Application and Design", Wiley India (P) Ltd, New Delhi, 2008.
2.	Bimbhra, P.S, "Power Electronics ", Khanna Publishers, New Delhi, 4thEdition, 2018.

Reference Books:

1.	T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2012, 2nd edition.
2.	G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2013
3.	S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 2008.
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, 2013, 4th edition
7.	Rashid M.H., “Power Electronics: Circuits, Devices and Applications ", Pearson, 3rd Edition, 2013.
E-Reference	
1	www.onlinecourses.nptel.ac.in
	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	1	0	1	1	1
CO2	1	1	1	1	1	1	1	1	0	1	1	1
CO3	1	1	1	1	1	1	1	1	0	1	1	1
CO4	1	1	1	1	1	1	1	1	0	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1

18EEP15	ELECTRICAL AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:

To understand the operation and need of electrical vehicles, hybrid vehicles with its energy storage technologies

Unit I	ELECTRIC VEHICLES	9	+	0

Configurations of Electric Vehicles (EV), Performance of Electric Vehicles: Traction Motor Characteristics, Tractive Effort and Transmission Requirement, Vehicle Performance, Energy Consumption

Unit II	HYBRID ELECTRIC VEHICLES	9	+	0

Concept of Hybrid Electric Vehicle (HEV) Trains, Architectures of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains and Parallel Hybrid Electric Drive Trains, Torque-Coupling Parallel Hybrid Electric Drive Trains, Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Trains

Unit III	ELECTRIC PROPULSION SYSTEMS	9	+	0

Functional block diagram of a typical electric propulsion system, Classification of electric motor drives for EV and HEV applications, Multiquadrant Control of Chopper-Fed DC Motor Drives, Performance Analysis and Control of BLDC Machines, Switched Reluctance Motor Drives, SRM Drive Converter, Generating Mode of Operation, Vibration and Acoustic Noise in SRM

Unit IV	ENERGY STORAGES	9	+	0

Battery Technologies: Lead-Acid Batteries, Nickel-based Batteries, Lithium-Based Batteries – Ultracapacitors, Features, Basic Principles and its Performance, Ultracapacitor Technologies- Ultrahigh-Speed Flywheels, Operation and Power Capacity

Unit V	FUEL CELL VEHICLES	9	+	0

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell Electric Vehicle – configuration and control strategy

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the operation of Electrical Vehicles and its energy storage technologies.
CO2	:	Know Fuel cell, types and characteristics.
CO3	:	Operate the vehicle with BLDC and SRM motor drives
CO4	:	Design the EV's and HEV's.
CO5	:	Choose the energy storage technology for electric vehicle

Text Books:

1.	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals, Theory, and Design', CRC PRESS, New York, third edition, 2016

Reference Books:

1.	Iqbal Hussain ,"Electric and Hybrid Vehicles: Design Fundamentals" , CRC Press, Taylor & Francis Group, 3rd Edition (2021).
2.	Ali Emadi, Mehrdad Ehsani, John M.Miller ,"Vehicular Electric Power Systems", Special Indian Edition, Marcel dekker, Inc 2010

E-Reference	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1			2		1	1			1
CO2		2		1	3		2				1	
CO3				2	2					2		
CO4	1		3	3		2			3		2	
CO5		3					3	1				2

18EEP16	SOFT COMPUTING AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

1	To provide adequate knowledge about neural network and fuzzy systems
2	To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems
3	To expose the students to the concepts of machine learning

Unit I	BASIC CIRCUITS ANALYSIS	9	+	0

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network- Feedback networks

Unit II	NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS	9	+	0

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules – Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system- Fuzzy logic control: Home heating system – fuzzy PID control, Fuzzy based motor control.

Unit III	GENETIC ALGORITHMS	9	+	0

Introduction-Gradient Search – Non-gradient search – Genetic Algorithms: binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding – constraint handling methods – applications to economic dispatch and unit commitment problems.

Unit IV	MACHINE LEARNING MODELS	9	+	0

Generative models: Definition and characteristics, probabilistic graphical models, density estimation in learning

Unit V	MACHINE LEARNING CLASSFIERS	9	+	0

Combining classifiers: Advantages, boosting, hierarchical classifiers, and issues; Selected special topics such as manifold learning and case studies.

Total (45+0)=45 Periods

Course Outcomes:

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

CO1	:	Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
CO2	:	To understand and apply computing platform and software for engineering problems.
CO3	:	To understand machine learning concepts and apply for engineering problems.
CO4	:	Solve economic dispatch and unit commitment problem using genetic algorithm
CO5	:	Design a fuzzy controller based home heating system

Text Books:

1.	LauranceFausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks',Pearson Education, 2010
2.	S.N.Sivanandam and S.N.Deepa,' Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013
3	Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
4	S. Marsland, 'Machine Learning: An Algorithmic Perspective', Chapman & Hall/CRC, 2009.

Reference Books:

1	Simon Haykin, 'Neural Networks', Pearson Education, 2009 ,3rd edition.
2	Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
3	N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
4	I. H. Witten, Data Mining: Practical Machine Learning Tools And Techniques, 2nd Edn., Elsevier India, 2011.
5	C. . Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer, 2008.

E-References:	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2						2
CO2	1	2	3	3	3	2						2
CO3	1	2	2	2	2	2						2
CO4	1	2	2	2	2	2						2
CO5	1	2	3	3	3	2						2

18EEP17	ADVANCED ELECTRIC DRIVES	L	T	P	C
		3	0	0	3

Course objectives:

1.	To know about the overview of Electrical drives.
2.	To know about the Vector control strategies for AC motor drives.
3.	To understand the concepts of various DSP based control.

UNIT I	POWER CONVERTERS FOR AC DRIVES	9	+	0

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

UNIT II	INDUCTION MOTOR DRIVES	9	+	0

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

UNIT III	SYNCHRONOUS MOTOR DRIVES	9	+	0

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

UNIT IV	PERMANENT MAGNET MOTOR AND SWITCHED RELUCTANCE MOTOR DRIVES	9	+	0

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives. Various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

UNIT V	DSP BASED MOTION CONTROL	9	+	0

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Explain DSP based motion control.
CO2	:	Understand the basics of Permanent magnet motor and Switched reluctance motor drives.
CO3	:	Learn the concepts of Synchronous motor drives.
CO4	:	Gain knowledge of Induction motor drives.
CO5	:	Apply Power converters for AC drives.

Text Books:

1.	B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2.	P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.

Reference Books:

1.	H. A. Taliyat and S. G. Campbell, “ DSP based Electromechanical Motion Control” , CRC press, 2013.
2.	R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2010,1st edition.

E-References

1	https://nptel.ac.in/courses/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	2	2	1	1	1			1	1
CO2	3	3	3	3	3	1	1	1			1	1
CO3	1	3	3	3	3	1	1	1				
CO4	1	3	3	3	3	1	1	1				1
CO5	3	3	3	3	3	1	1	1			1	1

18EEP18	COMPUTATIONAL ELECTROMAGNETICS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study the fundamental concepts and analytical methods.
2.	To give basic knowledge on finite difference methods.
3.	To understand the concept of variable methods.
4.	To provide adequate knowledge on moment methods.
5.	To gain knowledge on finite element method.

Unit I	FUNDAMENTAL CONCEPTS AND ANALYTICAL METHODS	9	+	0

Review of EM theory – Classification of EM problems – Superposition principle – Uniqueness theorem - Separation of variables in three coordinate systems – Series expansion – Practical applications: Scattering by dielectric sphere, scattering cross sections.

Unit II	FINITE DIFFERENCE METHODS	9	+	0

Finite difference schemes – Finite differencing of Parabolic, Hyperbolic and Elliptic PDEs – Accuracy and stability of FD solutions – Practical applications: Transmission lines, Yee's finite difference algorithm – Finite differencing for non-rectangular systems – Numerical integration: Euler's rule, Trapezoidal rule, Simpson's rule.

Unit III	VARIABLE METHODS	9	+	0

Operators in linear spaces – Calculus of variations – Construction of functional from PDEs – Rayleigh-Ritz method – Weighted Residual method – Collocation method: Subdomain method, Galerkin method, Least Squares method – Eigen value problems.

Unit IV	MOMENT METHODS	9	+	0

Differential equations – Integral equations – Green's functions – Applications: Quasi-static problems, Scattering by conducting cylinder, Hallen's IE, Pocklington's IE, Expansion and weighting functions, EM absorption in the human body.

Unit V	FINITE ELEMENT METHOD	9	+	0

Solution of Laplace's equation – Solution of Poisson's equation – Solution of the wave equation – Automatic mesh generation: Rectangular domains, Arbitrary domains – Bandwidth reduction – Higher order elements – Three-dimensional elements – Infinite element method – Finite-element time-domain method.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the fundamental concepts of field theory and analytical methods.
CO2	:	Understand the finite difference methods and applications.
CO3	:	Analyze the Variable methods of electromagnetics.
CO4	:	Analyze the concepts of Moment methods.
CO5	:	Gain knowledge on the concept of finite element method.

Text Books:

1.	Matthew N.O. Sadiku, "Computational Electromagnetics with MATLAB", CRC Press, 4th Edition, 2018.
2.	Matthew N.O. Sadiku, "Elements of Electromagnetics", CRC Press, 7th Edition, 2021.

Reference Books:

1.	Thomas Rylander, Par Ingelstorm, "Computational Electromagnetics", Springer Publications, 2017.

E-Reference:

1.	www.onlinecourses.nptel.ac.in

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	1	2	1	1	2	1	1	2
CO2	3	3	3	2	1	2	1	1	2	2	1	2
CO3	3	3	1	1	2	1	2	1	1	2	1	1
CO4	3	3	2	1	1	1	2	2	1	2	2	2
CO5	3	3	2	2	1	1	2	3	1	2	2	2

18EEP19	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Course Objectives:

1	Learn the fundamental concepts of special electric machines
2	Learn proper selection of special machines based on applications

Unit I	**SYNCHRONOUS RELUCTANCE MOTORS**	**9**	**+**	**0**

Constructional features – Types – Axial and radial air gap motors – Operating principle – Reluctance – Phasor diagram - Characteristics – Vernier motor

Unit II	**PERMANENT MAGNET BRUSHLESS D.C. MOTORS**	**9**	**+**	**0**

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

Unit III	**PERMANENT MAGNET SYNCHRONOUS MOTORS**	**9**	**+**	**0**

Principle of operation – EMF and torque equations – Reactance – Phasor diagram – Power controllers - Converter - Volt-ampere requirements – Torque speed characteristics - Microprocessor based control.

Unit IV	**SWITCHED RELUCTANCE MOTORS**	**9**	**+**	**0**

Constructional features – Principle of operation – Torque prediction – Power controllers – Non-linear analysis – Microprocessor based control - Characteristics – Computer control.

Unit V	**STEPPING MOTORS**	**9**	**+**	**0**

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics – Drive circuits

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the principles behind the principle of operation of different special machines
CO2	:	Apply the electromagnetic concepts in development of EMF and Torque in machines
CO3	:	Select the control structure in terms of hardware to control the special machines
CO4	:	Select appropriate control techniques for efficient control of special machines
CO5		Develop strategy and methods to implement suitable application-based projects

Text Books:

1	T.J.E. Miller, “Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989. 2nd edition
2.	P.P. Acarnley, “Stepping Motors – A Guide to Motor Theory and Practice", Peter Perengrinus, London, 1982.
3	R. Krishnan, “Switched reluctance motor drives”, CRC Press, 2017.
4	R. Krishnan , “Permanent Magnet Synchronous and Brushless DC Motor Drives”, CRC Press, 2010

E-References:

1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	0	1	1	0	1	1	1
CO2	1	1	1	1	1	0	1	1	0	1	1	1
CO3	1	1	1	1	1	1	1	1	0	1	1	1
CO4	1	1	1	1	1	1	1	1	0	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1

18EEP20	ELECTRICAL WIRING, ESTIMATION AND COSTING	L	T	P	C
		3	0	0	3

Course Objectives

1.	Knowledge of I.E rules for different types of electrical installations.
2.	Planning and preparation of different installation projects
3.	Knowledge on the costing and estimates of different installations.
4.	Knowledge on repairs and maintenance of electrical equipment.

Unit I	ELECTRICAL WIRING AND INDIAN ELECTRICITY RULES	9	+	0

Electrical symbols, need of electrical symbols, examples of wiring and schematic diagram, Electrical tools, precautions in handling the tools, wiring system, sizes of wires, stranded wires, types of wires, wire splicing and termination, difference between neutral and earth wire, domestic and industrial panel wiring. Testing tools. Indian Electricity rules for wiring, Installation of earth electrode as per I.E rule. Indian Electricity Act-2003.

Unit II	ESTIMATION AND COSTING OF DOMESTIC AND INDUSTRIAL WIRING	9	+	0

General principles of estimation - Electrical Schedule of rates, catalogues, Survey and source selection, Recording estimates Quantity and cost of material required. Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills.
Domestic & Industrial wiring : layout, load calculation, cable selection, earthing, selection of switchgear, overall estimating and costing.

Unit III	ESTIMATION OF OVERHEAD TRANSMISSION LINES	9	+	0

Main components of overhead lines, Line supports, Factors governing height of pole, Conductor materials, size of conductor for overhead transmission line, cross arms, pole brackets and clamps, guys and stays, conductors configuration spacing and clearances, span lengths, overhead line insulators, insulator materials lightning arrestors, erection of supports, setting of stays, earthing of lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between conductors, I.E rules pertaining to LV transmission lines.

Unit IV	ESTIMATION OF OVERHEAD AND UNDERGROUND DISTRIBUTIONSYSTEM AND SUBSTATION INSTALLATIONS	9	+	0

Overhead distribution system and underground distribution system : materials and accessories required for the overhead distribution system, estimate for 440V/3-phase/ 4 wires or 3 wires overhead distribution system, types of service connections, method of installation of service connection(1-phase and 3-phase), I.E. rules pertaining to overhead lines and service connection.
Classification of substation, selection and location of site for substation, main electrical connections, graphical symbols for various types of apparatus and circuit elements on substation, main connection diagram, key diagram of typical sub stations, equipment for substation and switchgear installations, substation auxiliaries supply, substation earthing.

Unit V	ESTIMATING AND COSTING OF REPAIRS AND MAINTENANCE OF ELECTRICAL DEVICES AND EQUIPMENT	9	+	0

D.O.L. starter, small motor, automatic electric iron, table/ceiling fan, ICDP/ICTP Switch, preparation of detailed drawing work of the product, preparation of material quantity sheet for the product, materials and cost required for maintenance work, estimation of repairing cost and overall cost, tools used for repairs &maintenance work Preparation of cost schedule for repair and maintenance of
electric fan, automatic electric iron, single phase transformer, mixer grinder, D.O.L. Starter.

Total (45+0)= 45 Periods

Course Outcome:

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

CO1	:	To understand various types of materials required for wiring.
CO2	:	To comprehend the estimation of a domestic and industrial installation.
CO3	:	To know different systems of earthing.

CO4	:	To prepare detail estimate and costing of overhead transmission line, overhead and underground distribution projects following IE rules.
CO5	:	To comprehend the estimation of substations.
CO6	:	To prepare estimates for repairs and maintenance of electrical devices and equipment
Text Books:		
1.		Raina K. B. and Bhattacharya S.K. " Electrical Design, estimating & Costing", New Age International (p) Limited, New Delhi,2017 2nd edition.
2.		Gupta J.B. , "Electrical Installation Estimating & Costing", S. K. Kataria& Sons, New Delhi,2015.
3.		Uppal S.L. "Electrical Estimating & Costing", New Age International (p) Limited, New Delhi ,2018
Reference Books:		
1.		SurjithSingh,"Electrical Estimating and Costing", Danpat Rai &Co2016.
2.		CEA Regulations 2019
3.		I.E rules for wiring and supply act manuals.
E-Reference:		
1		www.onlinecourses.nptel.ac.in

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	3	1	1	1					1
CO2	3	2	2	2	1	1	1			1		
CO3	3	1	1	1	2	2	1	1				1
CO4	3	3	2	2	2	3	1	1	1	1	1	
CO5	3	3	2	2	2	1	1					
CO6	2	2	3	2	1	3	2	1	1	1	1	

18EEP21	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the statistical approach for quality control.
2.	To Learn about the TQM principle.
3.	To introduce the concept of statistical process control
4.	To provide awareness on TQM standards
5.	To create an awareness about the ISO and QS certification process and its need for the industries

Unit I	INTRODUCTION	9	+	0

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

Unit II	TQM PRINCIPLES	9	+	0

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

Unit III	STATISTICAL PROCESS CONTROL (SPC)	9	+	0

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

Unit IV	TQM TOOLS	9	+	0

FBenchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

Unit V	QUALITY SYSTEMS	9	+	0

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the importance of quality, leadership and motivation in TQM
CO2	:	Understand the problem of customers and continuous process improvement in supplier partnership, selection and rating
CO3	:	Recall the seven traditional tools, management tools and sigma concepts in TQM
CO4	:	Identify the TQM tools and know the performance measures, quality control in TQM
CO5	:	Understand the need for various quality control systems and quality auditing
CO6	:	Perform the case study on ISO 9000 and 14000.

Text Books:

1.	Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc. 2018. . ISBN 81-297-0260-6.2018

Reference Books:	
1.	James R.Evans& William M.Lidsay, “The Management and Control of Quality”, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2.	Feigenbaum.A.V. “Total Quality Management, McGraw Hill, 2004.
3.	Oakland.J.S. “Total Quality Management Butterworth “ Hcinemann Ltd., Oxford. 1989.
4.	Narayana V. and Sreenivasan, N.S. “Quality Management – Concepts and Tasks”, New Age International 1996.
5.	Zeiri. “Total Quality Management for Engineers”, Wood Head Publishers, 1991.
E-References:	
1	http://textofvideo.nptel.ac.in/video.php?courseId=110104080
2	https://nptel.ac.in/courses/110104085/

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2			2		3	3	3	3	2
CO2	1		2			2		3	3	3	3	2
CO3	1		1			1		1	1	1	1	1
CO4	1		2			2		2	2	2	2	2
CO5	1		2			2		3	3	3	3	2
CO6	1		1			1		1	1	1	1	1

18EEP22	RESTRUCTURED POWER SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

1	Know about the implementation of power Systems based on applications
2	Learn various safety equipment and their installations
3	Get a clear awareness about automation in power Systems

Unit I	POWER SYSTEM RESTRUCTURING	9	+	0

Introduction –Deregulation - Need for deregulation – Power system restructure models - Electricity Market Participants – GENCOS- DISCOS- TO- ISO- PX- SC - trading arrangements - Operational Planning Activities (OPA) of Electricity Market Participants - Causes of restructuring- types and effects of restructuring – restructure models

Unit II	ELECTRICAL UTILITY	9	+	0

Electrical utility restructuring Power System Operation in competitive environment –Electricity Market Models (PoolCo- bilateral- hybrid)- Components of restructured system - Power Sector restructuring and influence on environment - Functions and responsibilities of PX- ISO- RTO and ITP - Electric Utility Market – Market Models - wholesale electricity market characteristic – Electricity Market types (energy- ancillary services- transmission- forward- real time) – Market power evaluation and mitigation

Unit III	EVALUATION OF TRANSMISSION SYSTEM	9	+	0

Electricity pricing and Transmission pricing in a restructured market - Congestion management in a deregulated market – Available Transfer Capabilities (ATC) of transmission system – Application of Monte Carlo Simulation in ATC calculation – ATC calculation with sensitivity analysis method - Tagging Electricity Transaction – Tagging process – Implementation- Curtailment and cancellation of transaction - Availability Based Tariff

Unit IV	OPTIMUM POWER FLOW (OPF) ANALYSIS IN MARKET ENVIRONMENT	9	+	0

Introduction – Approaches to OPF – Application of OPF analysis in Electricity and Power Markets with Electricity Market Participants – Power Flow Tracing – current decomposition axioms- Mathematical model of loss allocation- usage sharing problem on transmission facilities - Methodology of graph theory - Economic issues- Mechanism and transmission issues in the new market environment.

Unit V	AGC IN RESTRUCTURED POWER SYSTEM	9	+	0

Introduction – Traditional Vs Restructured Scenario –AGC in New market environment - Block diagram and State Space representation of a two-area interconnected power system in deregulated environment – Load-Frequency Control (LFC) dynamics and Bilateral Contacts – Modelling- DISCO Participation Matrix (DPM)- Generation Participation Matrix (GPM).

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Select appropriate electrical utility based on applications
CO2	:	Design power system according to requirements
CO3	:	Design an electrical market model
CO4	:	Understand proper selection of automation in power systems
CO5	:	Design load frequency control scheme for two area interconnected systems.

Text Books:

1.	Loi Lei Lai, “Power System Restructuring and deregulation”- John Wiley & Sons,2001
2	Md.Shahidehpour, MuwaffagAlmoush, “Restructured Electric Power System – Operation- Trading and Volatility”, Marcel Dekker Inc, New York, 2001.
3.	Arthur.R.Bergen, Vijay Vittal, “Power System Analysis,” Prentice Hall, New Jersey, 2000

Reference Books:	
1	Xi Fan,Wang, Yonghua Song, Malcolm Irving, “Modern Power System Analysis”, Springer, 2008
2	Das D, “Electrical Power Systems”, New Age International (P) Ltd, New Delh,- 2008.
3	Iiic M, Galiana F, Fink L, “Power Systems Restructuring” Norwell MA Kluwer 1998
4	Philipson. L, Willis H.Le, “Understanding Electric Utilities and de-regulation”, Marcel Dekker Inc Publishers, New York, 2006
E-Reference	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3								1	2
CO2	1	2	3	2	2		2					2
CO3	1	2	3	2	2		2					2
CO4	1	2	2								1	2
CO5	1	2	3	2	2		2					2

18EEP23	INDUSTRIAL ELECTRICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1	Know about the implementation of Electrical Systems based on applications
2	Learn various safety equipment and their installations
3	Get a clear awareness about automation in Electrical Systems

Unit I	ELECTRICAL SYSTEM COMPONENTS	9	+	0

LT system wiring components, select ion of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, RCCB 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	9	+	0

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	ILLUMINATION SYSTEMS	9	+	0

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, flood lighting.

Unit IV	INDUSTRIAL ELECTRICAL SYSTEM	9	+	0

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 V	INDUSTRIAL ELECTRICAL SYSTEM AUTOMATION	9	+	0

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.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Select appropriate switchgears based on applications
CO2	:	Design electrical wiring system according to requirements
CO3	:	Design an illumination system for different types of constructions
CO4	:	Understand proper selection of automation in electrical systems
CO5	:	Develop need based projects.

Text Books:

1.	S.L. Uppal and G.C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
2.	S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 2010,2nd edition.
3.	Web site for IS Standards. 2021
4.	H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

E-References:	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	0	1	1	1	1	0	0	0	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1

18EEP24	SMART GRID	L	T	P	C
		3	0	0	3

Course Objectives:

1	To introduce communication technologies, advanced Metering infrastructure and high-performance computing for Smart Grid.

Unit I	INTRODUCTION TO SMART GRID	9	+	0

Definitions and Need for Smart Grid, Today's Electric Grid versus Smart Grid, key aspects of Smart Grid development, Smart Grid architecture, Functions of Smart Grid Components, challenges and benefits.

Unit II	COMMUNICATION TECHNOLOGIES	9	+	0

Communication infrastructure for the Smart Grid, IEEE 802 architecture and, communication technologies specified under IEEE 802, Wireless LANs, ZigBee and 6LoWPAN, ZigBee communication network for smart metering, Power line communication, Standards for smart metering, Modbus, DNP3, IEC 61850 data structure and usage.

Unit III	CONTROL AND AUTOMATION TECHNOLOGIES	9	+	0

Smart metering: Benefits, Architecture, Key components and operation, communications architecture for smart metering, Demand-side integration (DSI): Definitions and services provided by DSI, Substation automation equipment: architecture, components and functions, Intelligent electronic devices (IED), Relay IED, Bay controller.

Unit IV	TRANSMISSION AND DISTRIBUTION MANAGEMENT SYTSEMS	9	+	0

Structure of Energy management systems**-** Phasor measurement units- Wide-Area Measurement for transmission Systems- Structure and main components of Distribution Management System- Supervisory Control and Data Acquisition- Customer information system

Unit V	ENERGY STORAGE SYSTEM	9	+	0

Need of Energy Storage for the smart grid- Energy storage technologies - Flow battery - Fuel cell and hydrogen electrolyser - Superconducting magnetic energy storage systems - Supercapacitors

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Understand the concepts of Smart Grid and its present developments.
CO2	:	Get acquainted with the smart resources and devices
CO3	:	Acquire knowledge of automation and control infrastructure.
CO4	:	Select an energy storage system and its integration with Smart Grids
CO5	:	Identify suitable communication networks for smart grid applications

Text Books:

1.	James Momoh "SMART GRID Fundamentals of Design and Analysis", Wiley, 2012.
2.	Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "SmartGrid: Technology and Applications", Wiley, 2012.
3.	Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3		2	1		1			1
CO2		2	3	1				1			1	
CO3			2		2					2		
CO4	2				3	1	3				2	
CO5		3		2				1	2			2

OPEN ELECTIVES

18EEOE1	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To impart knowledge on the Awareness about renewable Energy Sources and technologies.
2.	To impart knowledge on the Recognize current and possible future role of renewable energy sources.

Unit I	**INTRODUCTION**	**9**	**+**	**0**

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil Nadu, India and around the World – Potentials – Achievements / Applications – Economics of Renewable Energy Systems.

Unit II	**SOLAR ENERGY**	**9**	**+**	**0**

Solar Radiation – Measurements of Solar Radiation – Flat Plate and Concentrating Collectors – Solar Direct Thermal Applications – Solar Thermal Power Generation – Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

Unit III	**WIND ENERGY**	**9**	**+**	**0**

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects.

Unit IV	**BIO – ENERGY**	**9**	**+**	**0**

Biomass Direct Combustion – Biomass Gasifiers – Biogas Plants – Digesters – Ethanol Production – Bio Diesel – Cogeneration – Biomass Applications.

Unit V	**OTHER RENEWABLE ENERGY SOURCES**	**9**	**+**	**0**

Tidal Energy – Wave Energy – Open and Closed Ocean Thermal Energy Conversion(OTEC) Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage – Fuel Cell Systems – Hybrid Systems.

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Create awareness about renewable Energy Sources and technologies.
CO2	:	Apply knowledge in solar energy.
CO3	:	Understand basics about biomass energy.
CO4	:	Apply adequate inputs on a variety of issues in harnessing renewable Energy.
CO5	:	Apply knowledge to recognize current and possible future role of renewable energy sources.
CO6	:	Apply knowledge in various renewable energy resources and technologies and their applications.

Text Books:

1.	Rai. G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2.	Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 2009.

Reference Books:

1.	Sukhatme. S.P., “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009,3rd edition.
2.	Godfrey Boyle, “Renewable Energy, Power for A Sustainable Future”, Oxford University Press, U.K., 2012. 3rd edition.
3.	Tiwari. G.N., Solar Energy – “Fundamentals Design, Modelling & Applications”, Narosa Publishing House, New Delhi, 2002.
4.	Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
5.	Johnson Gary, L. “Wind Energy Systems”, Prentice Hall, New York, 1985

6.	David M. Mousdale – “Introduction to Biofuels”, CRC Press, Taylor & Francis Group, USA 2010
7.	Chetan Singh Solanki, Solar Photovoltaics, “Fundamentals, Technologies and Applications”, PHI Learning Private Limited, New Delhi, 2009.
E-References:	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	2	1	1	1	1	1	1	1
CO2	3	1	1	3	1	1	1	1	1	1	1	1
CO3	1	2	2	1	1	1	1	1	1	1	1	1
CO4	3	1	1	3	2	1	1	1	1	1	1	1
CO5	2	1	1	2	1	1	2	1	1	1	1	1
CO6	2	2	1	1	1	1	1	1	1	1	1	1

18EEOE2	SMART GRID TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To introduce communication technologies, infrastructure and high performance computing for Smart Grid.

Unit I	INTRODUCTION TO SMART GRID	9	+	0

Definitions and Need for Smart Grid, key aspects of Smart Grid development, Smart Grid architecture, Functions of Smart Grid Components, challenges and benefits.

Unit II	COMMUNICATION TECHNOLOGIES	9	+	0

Communication infrastructure for the Smart Grid, IEEE 802 architecture and, communication technologies specified under IEEE 802, Wireless LANs, ZigBee and 6LoWPAN, ZigBee communication network for smart metering.

Unit III	AUTOMATION TECHNOLOGIES	9	+	0

Smart metering: Benefits, Architecture, Key components and operation, communications architecture for smart metering, Intelligent electronic devices (IED), Relay IED, Bay controller.

Unit IV	ENERGY MANAGEMENT SYTSEMS	9	+	0

Structure of Energy management systems- Phasor measurement units - Supervisory Control And Data Acquisition- Customer information system

Unit V	ENERGY STORAGE SYSTEMS	9	+	0

Need of Energy Storage for the smart grid- Energy storage technologies - Flow battery - Fuel cell - Superconducting magnetic energy storage systems - Supercapacitors

Total (45+0) = 45 Periods

Course Outcomes:

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

CO1	:	Understand the concepts of Smart Grid and its present developments.
CO2	:	Get acquainted with the smart resources and devices
CO3	:	Acquire knowledge of automation and control infrastructure.
CO4	:	Select an energy storage system and its integration with Smart Grids
CO5	:	Identify suitable communication networks for smart grid applications

Text Books:

1.	James Momoh “SMART GRID Fundamentals of Design and Analysis”, Wiley, 2015.
2.	Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “SmartGrid: Technology and Applications”, Wiley, 2012.
3.	Mini S. Thomas, John D McDonald, ‘Power System SCADA and Smart Grids’, CRC Press, 2015

CO/PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3		2	1		1			1
CO2		2	3	1				1			1	
CO3			2		2					2		
CO4	2				3	1	3				2	
CO5		3		2				1	2			2

18EEOE3	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To get knowledge about basics of energy and energy scenario on India.
2.	To understand the energy conservation concepts.
3.	To know about electrical energy management.

Unit I	**ENERGY SCENARIO**	**9**	**+**	**0**

Energy scenario of India – Present non-renewable energy scenario – Gross domestic product- Energy intensity – Current energy production and pricing – Energy security - Energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit II	**BASICS OF ENERGY**	**9**	**+**	**0**

Introduction – Work, power and energy – Electricity basics – Thermal energy basics – Energy units and conversions – Energy performance – Matching energy usage to requirement.

Unit III	**ENERGY CONSERVATION APPROACHES**	**9**	**+**	**0**

Energy saving opportunities in electric motors, Benefits of Power factor improvement and its techniques-Shunt capacitor, Synchronous Condenser etc., Energy conservation by industrial drives, Methods and techniques of energy conservation in ventilation and air conditioners, compressors pumps, fans and blowers. Energy conservation in electric furnaces, ovens and boilers., lighting techniques – Natural , CFL, LED lighting sources and fittings.

Unit IV	**ENERGY MANAGEMENT**	**9**	**+**	**0**

Demand side management (DSM)– DSM planning – DSM Techniques – Load management as a DSM satergy – energy conservation – tarrif options for DSM - Energy audit – instruments for energy audit – Energy audit for generation, distribution and utilization systems – economic analysis.

Unit V	**ENERGY EFFICIENT TECHNOLOGIES**	**9**	**+**	**0**

Maximum demand controllers - Automatic power factor controllers - Energy efficient motors -Softstarters with energy saver - Variable speed drives - Energy efficient transformers - Electronic ballast - Occupancy sensors - Energy efficient lighting controls - Energy saving potential of each technology.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the present energy scenario.
CO2	:	Get fundamental knowledge about energy and its various forms.
CO3	:	Understand the process of energy management and energy auditing.
CO4	:	Understand the methods improving energy efficiency and energy efficient devices.
CO5	:	Familiarize the role of energy efficient devices in energy conservation

Text Books:

1.	Sonal Desai, “Handbook of Energy Audit”, McGraw Hill, 2015.
2.	Tripathy, S. C, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.

Reference Books:

1.	Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-1, General Aspects (available online).
2.	Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-3, Electrical Utilities (available online)
3.	Murphy. W.R and McKay G “Energy Management” Butterworths Publications, London, 1982.
4.	Wayne C Tuner, “Energy Management Hand Book” John Wiley and Sons, 2011,7th edition..

E-References:	
1.	www.bee-india.nic.in
2.	NPTEL Course: Non-Conventional Energy Resources – Prof. PrathapHaridoss, IIT-M.
3.	NPTEL Course: Energy Management Systems and SCADA, 2015 organised by IIT-M.

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	2	2	1	3	2	2	2	2	2
CO2	1	1	2	2	1	1	3	2	1	1	2	2
CO3	2	2	2	3	1	1	3	2	2	2	1	2
CO4	2	1	2	2	1	1	3	2	1	2	2	2
CO5	2	2	3	1	2	1	3	1	2	1	2	1

18EEOE4	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives

1.	To understand the components of Electric Vehicle and its global and Indian scenario.
2.	To understand the types of Electric Vehicle and its architectural design.
3.	To analyze the performance of different types of motor and its electrical and mechanical connections.
4.	To analyse the energy storage performance and battery management systems.
5.	To understand the types of charging stations and its components.

Unit I	**INTRODUCTION TO ELECTRIC VEHICLES**	**9**	**+**	**0**

Components of Electric Vehicle, Comparison with Internal combustion Engine : Technology, Comparison with Internal combustion Engine: Benefits and Challenges, EV classification and their electrification levels, EV Terminology, Global and Indian Scenario: Technology Scenario, Market scenario, Policies and Regulations,

Unit II	**ELECTRIC VEHICLE ARCHITECTURE DESIGN**	**9**	**+**	**0**

Types of Electric Vehicle and components, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV) , Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV, Comparison of fuel Vs electric and solar power, Solar Power operated Electric vehicles.

Unit III	**ELECTRIC DRIVE AND CONTROLLER**	**9**	**+**	**0**

Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor, Motor Controllers, Component sizing.
Physical locations, Mechanical connection of motor, Electrical connection of motor.

Unit IV	**ENERGY STORAGE SOLUTIONS AND BATTERY MANAGEMENT SYSTEM**	**9**	**+**	**0**

Cell Types (Lead Acid/Li/NiMH),Battery charging and discharging calculation, Cell Selection and sizing, Battery lay outing design, Battery Pack Configuration, Battery Pack Construction, Battery selection criteria. Need of BMS, Rule based control and optimization based control, Software-based high level supervisory control, Mode of power, Behavior of motor, Advance Features.

Unit V	**ELECTRIC VEHICLES CHARGING STATION**	**9**	**+**	**0**

Type of Charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station.

Total (45+0)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the concept of Electric Vehicle technology
CO2	:	Understand the types of EV and analyse their characteristics.
CO3	:	Analyse the selection and sizing of drive and controller.
CO4	:	Analyse and interpret the battery calculations and configurations.
CO5	:	Understand the control of battery management system
CO6	:	Understand and analyse the sizing of charging station

Text Books:

1.	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi,Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals, Theory, and Design, CRC PRESS, New York, third edition, 2016

2.	Iqbal Hussain “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, Taylor &Francis Group, Second Edition (2011).
Reference Books:	
1.	Ali Emadi, Mehrdad Ehsani, John M.Miller ,“Vehicular Electric Power Systems”, Ali Emadi, Mehrdad Ehsani, John M.Miller, Special Indian Edition, Marcel dekker, Inc 2010
2.	Standards. IEC IEC 60068-2 (1,2,14,30),IEC 61683,IEC 60227,IEC 60502 IEC 60947 part I,II, III ,IEC 61215
E-References:	
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

CO/PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	3	1	1	1	1			1	1
CO2	2	3	3	2	1	1	2	1	1			1
CO3	1	3	3	3	1	1	2	2		1	1	
CO4	1	2	2	3	3	1	2	1		1	1	
CO5	1	1	3	2	3	1	2	2		1	1	1
CO6	1	3	3	3	3	1	2	2	1		1	1