ACHARYA NAGARJUNA UNIVERSITY

A State Government University, Accredited with "A" Grade by NAAC

Nagarjuna Nagar - 522 510, Guntur andhra Pradesh, India.

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SYLLABUS

2020 - 2021 onwards

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

PROGRAM CODE: ANUCETUG03

ABOUT UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY (ANU)

- A Brief Profile

Acharya Nagarjuna University, a State University established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges and professional colleges. Spread over 300 acres of land on the National High Way (NH-16) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded "A" grade to Acharya Nagarjuna University and also has achieved 108 International ranks, 39 National ranks UI Green Metrics rankings and many more It is named after Acharya Nagarjuna – one of the most brilliant preceptors and philosophers, whose depth of thought, clarity of perception and spiritual insight were such that even after centuries, he is a source of inspiration to a vast number of people in many countries. The University is fortunate to be situated on the very soil where he was born and lived, a soil made more sacred by the aspiration for light and a state of whole someness by generations of students. With campus student strength of over 5000, the University offers instruction for higher learning in 68 UG & PG programs and guidance for the award of M.Phil. and Ph.D. in 48 disciplines spread over six campus colleges and one PG campus at Ongole. It also offers 160 UG programs in 440 affiliated colleges in the regions of Guntur and Prakasam Districts. It has a Centre for Distance Education offering 87 UG & PG programs. Characterized by its heterogeneous students and faculty hailing from different parts of the state and the country, the University provides most hospitable environment for pursuing Higher Learning and Research. Its aim is to remain connected academically at the forefront of all higher educational institutions. The University provides an excellent infrastructure and on- Campus facilities such as University Library with over one lakh books & 350 journals; Computer Centre; University Scientific Instrumentation Centre; Central Research Laboratory with Ultra-modern Equipment; Well-equipped Departmental Laboratories; Career Guidance and Placement Cell; Health Centre; Sports Facilities with Indoor & Outdoor Stadiums and Multipurpose Gym; Sports Hostel; Separate hostels for Boys, Girls, Research Scholars and International Students; Pariksha Bhavan (Examinations Building); Computers to all faculty members; Wi-Fi connectivity to all Departments and Hostels; Canteen, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichmann & Dr. S.John David Auditorium cum Seminar Hall; Post office; Telecom Centre; State Bank of India; Andhra Bank; Energy Park; Silver Jubilee Park; Fish ponds; internet center; xerox center; cooperative stores; Water harvesting structures.

VISION, MISSION & OBJECTIVES OF THE UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY

VISION

To generate sources of knowledge that dispels ignorance and establish truth through teaching, learning and research.

MISSION

To promote a bank of human talent in diversified faculties – Commerce & Management Studies, Education, Engineering & Technology, Humanities, Law, Natural Sciences, Pharmacy, Physical Education & Sports Sciences, Physical Sciences and Social Sciences that would become an investment for a prosperous society.

OBJECTIVES

- To inspire and encourage all who would seek knowledge through higher education and research.
- To provide quality instruction and research for the advancement of science and technology.
- To promote teaching and research studies in disciplines of societal relevance.
- To bridge the gap between theory and practice of the principles of higher education.
- To develop human talent necessary for the industry.
- To open up avenues of higher education and research through non-formal means.
- To invite and implement collaborations with other institutes of higher learning on a continuous basis for mutual academic progress.
- To motivate and orient each academic department/centre to strive for and to sustain advanced levels of teaching and research so that the university emerges as an ideal institute of higher learning.
- To focus specially on the studies involving rural economy, justifying its existence in the rural setting.

VISION

&

MISSION OF THE COLLEGE

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

ABOUT ANUCET:

The ANU college of Engineering & Technology is established in the academic year 2009-2010 in the University campus under the able leader ship of the Vice-chancellor, Prof. Hara Gopal Reddy. The College offers UG and PG courses that include B.Tech. and M.Tech. The college commenced its operations with an annual intake of 60 into 5 branches of B.Tech. (Civil Engineering, Computer Science Engineering, Electronics & Communication Engineering, Electrical & Electronics Engineering & Mechanical Engineering) and 20 into 5 branches of M.Tech. The institution has been growing from strength to strength and got recognition in limited period.

VISION OF THE COLLEGE:

ANU College of Engineering & Technology is started with an aim of imparting technical values in the students, who can change the shape of global scenario in engineering arena.

MISSION OF THE COLLEGE:

- To educate students for careers of leadership, innovation in engineering and its related fields.
- To expand the base of engineering knowledge through original research and by developing technology to serve the needs of society.

OBJECTIVES:

- ★ To inspire and encourage all knowledge seekers of higher education and research.
- ★ To provide quality instruction and research for the advancement of science and technology.
- ★ To promote teaching and research studies in disciplines of societal relevance.
- ★ To bridge the gap between theory and practice.
- ★ To develop human talent necessary for the industry.

VISION & MISSION OF THE DEPARTMENT

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

VISION OF THE DEPARTMENT:

To evolve into a globally recognized department in the frontier areas of Electrical & Electronics Engineering (EEE) by producing innovative, creative and ethical Electrical & Electronics Engineers with research focus to meet socio-economic needs.

MISSION OF THE DEPARTMENT:

M1-Imparting quality education with professional ethics to Electrical & Electronics Engineering students to overcome challenges in professional career.

M2-Aimed to produce graduates having professional excellence.

M3-To carry out quality research having social & industrial relevance.

M4-To provide technical support to budding entrepreneurs and existing Industries.

ACHARYA NAGARJUNA UNIVERSITY
Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's):

- ★ PEO1: Practice engineering in a broad range of industrial, societal and real world applications.
- ★ PEO2: Pursue advanced education, research and development and other creative and innovative efforts in science, engineering and technology, as well as other professional careers.
- ★ PEO3: Conduct themselves in a responsible, professional and ethical manner.
- ★ PEO4: Participate as leaders in their fields of expertise and in activities that support service and economic development throughout the world.

PROGRAMME OUTCOMES (PO's):

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO's):

PSO1	An ability to Understand the theoretical and mathematical concepts to analyze real time problems.
PSO2	An Ability to Design and Analyze systems based on the theoretical and Practical Knowledge

ACHARYA NAGARJUNA UNIVERSITY

FACULTY OF ENGINEERING

ACADEMIC REGULATIONS 2020 (R20) FOR B. TECH (REGULAR)

(APPLICABLE FOR THE STUDENTS ADMITTED DURING THEACADEMIC YEAR 2020-2021 AND ONWARDS)

1. ELIGIBILITY FOR ADMISSION:

Admission to the above program shall be made subject to the eligibility, qualification and specialization prescribed by the University for each program from time to time.

Admission shall be made either on the basis of merit/rank obtained by the qualifying candidates in EAMCET/ECET or otherwise specified, whichever is relevant.

The duration of B.Tech. program is of four academic years divided into eight semesters comprising of two semesters in each academic year. A student is required to choose a branch of study at the time of admission. Students under lateral entry will be admitted straightaway into Third semester of B.Tech. course in the respective branch. No change of branch shall be allowed after the admissions are closed.

2. AWARD OF B.TECH. DEGREE:

A student will be declared eligible for the award of the B.Tech. degree if he/she fulfils the following academic regulations:

i) Regular entry students shall pursue a course of study for not less than four academic years and in not more than eight academic years.

ii) Students who fail to fulfill all the academic requirements for the award of the degree within eight academic years (for Regular Entry) / six academic years (for Lateral Entry) from the year of their admission, shall forfeit their seat in B.Tech. course and their admission is cancelled.

Completing the course of study shall mean not only satisfying the attendance requirements but also passing of all the subjects within the respective stipulated period.

3. BRANCHES OF STUDY:

The following Branches of study are offered at present for B. Tech. degree

S.No.	Branch
1	Civil Engineering
2	Electrical and Electronics Engineering
3	Mechanical Engineering
4	Electronics and Communication Engineering
5	Computer Science and Engineering

and any other branch as approved by the authorities of the University from time to time.

Each Branch will have a curriculum with syllabi that shall consist of the following:

i) General Core Courses
   1) Basic Sciences
   2) Engineering Sciences
   3) Humanities and Social Sciences
ii) Program Core Courses in Engineering / Technology
iii) Elective courses of Engineering / Technology / Management Entrepreneurship / Business Communication and allied fields.
iv) Open Electives/CBCS
v) Mandatory learning courses
vi) Project work.

4. CREDITS:

i) Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.
ii) Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).
iii) Credit: A unit by which the course work is measured.

5. DISTRIBUTION AND WEIGHTAGE OF MARKS (INTERNAL & EXTERNAL):

i) The performance of a student in each semester shall be evaluated subject-wise with a maximum of 100 marks for theory and 100 marks for practical subject. In addition internship & Project work shall be evaluated for 100 and 200 marks respectively.
ii) For both theory and lab subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the External Evaluation.
iii) There shall be five units in each of the theory subjects.
iv) For theory subjects, there shall be two midterm examinations during the semester. Each midterm examination shall consist of assignment for 10 marks and sessional test for 20 marks with duration of 135 minutes respectively.

    First midterm examination shall be conducted for 50% coverage of syllabus and second midterm examination shall be conducted for remaining 50% of syllabus. Both the midterm exams are compulsory. Final midterm examination marks for a total of 30 marks shall be arrived at, by considering the 80% weightage (24 marks) to that midterm examination in which the student scores more marks and the remaining 20% (6 marks) for other midterm exam.

*Note 1: The assignment test paper shall contain 6 questions of equal weightage and student is asked to answer any 2 questions randomly and shall be condensed for 10 marks, any fraction rounded off to the next higher mark.

*Note 2: The sessional examination shall contain 3 questions out of which first question is objective(6marks) and compulsory and remaining two questions(7 marks each) having internal choice and shall be considered for 20 marks, any fraction rounded off to the next higher mark.

v) For theory subjects, there will be 5 questions with following pattern in the End-Examination.

a) All Questions have to be answered compulsorily.
b) All five questions, EITHER/OR type shall be followed with 12 marks for each.
c) In each question as mentioned in (c), one, two or more bits can be set.

vi) Further, whenever any theory subject with two parts is offered (combined subject), for ex: Electrical & Mechanical Technology, then there shall be only two parts Part A, Part B in the question paper.

First question objective can be equally divided into two parts.

Part – A: shall contain two questions, EITHER/OR type shall be followed with 12 marks for each.

Part – B: shall also contain two questions, EITHER/OR type shall be followed with 12 marks for each.

vii) Model Question paper for each theory course shall be prepared by the teacher within 15 days from the commencement of the semester and the same shall be forwarded to the Controller of Examinations through the Chairman, BOS concerned.

viii) For practical subjects there shall be a continuous evaluation during the semester for 30 internal marks and 70 end examination marks. Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the report of experiments/jobs (10 marks for the record submitted and 5 marks for day to day work). The end examination for 15 marks (10 marks for experiment and 5 marks for viva-voce) shall be conducted by the laboratory teacher and another examiner from the same department.

*Note: Day to day performance shall be recorded in student record (each experiment carries 15 marks, at least ten experiments should be done and average marks must be taken at the end of semester).

ix) For the subject having design and / or drawing, such as Engineering Drawing, Machine Drawing and Estimation, the distribution shall be 30 marks for internal evaluation and 70 marks for end examination. The Internal evaluation will be 20 marks for day-to-day work in the class that shall be evaluated by the concerned subject teacher based on the reports/submissions prepared in the class. Further, there shall be two midterm exams in a Semester for a duration of 2 hrs each; evenly distributed over the syllabi for 20 marks and the average marks of both the mid examinations shall be considered as internal test marks. The sum of day to day evaluation and the internal test marks will be the final internal marks for the subject.

x) Out of a total of 150 marks for the project work, 50 marks shall be for Internal Evaluation and 100 marks for the End Semester Examination (Viva-voce). The viva-voce shall be conducted by a committee consisting of Head of the Department, Project Supervisor and an External Examiner nominated by the Principal from the panel of 3 members proposed by Head of the Department. The project work shall start in IV year II semester. The evaluation of project work shall be conducted at the end of the IV year II semester. The Internal Evaluation shall be made on the basis of weekly progress (a minimum of 12 weeks and 3 marks for each week progress) and at least two seminars (one at the beginning of IV B.Tech. II semester (30 marks) and the other before submission of project work (20 marks) given by each student on the topic of his project.

xi) The laboratory records and internal test papers shall be preserved for minimum of 2 years in the respective departments and shall be produced to the Committees of the college as and when the same are asked for.

xii) A student shall be permitted to pursue up to a maximum of ONE elective courses under MOOCs during the Programme. The courses must be of minimum 12 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to pursue and acquire a certificate for a MOOC course only from the organizations/agencies approved by the BoS in order to earn the 2 credits. The Head of the department shall notify the list of such courses at the beginning of the semester.

6. ATTENDANCE REQUIREMENTS:

i) A student shall be eligible to appear for end examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the subjects in a semester.

ii) Shortage of Attendance below 65% in aggregate shall in NO case be condoned.

iii) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

iv) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.

v) A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.

vi) A stipulated fee shall be payable towards condonation of shortage of attendance to the college.

7. MINIMUM ACADEMIC REQUIREMENTS (FOR REGULAR ENTRY STUDENTS):

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.6

i) A student who could not secure a minimum of 50% aggregate from midterm examination marks is not eligible to appear for the semester end examination and shall have to repeat that semester.

ii) A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, design, drawing subject or project if he secures not less than 40% of marks in the end examination and a minimum of 50% of marks in the sum total of the internal evaluation and end examination taken together. In the internship & project he/she should secure 40%. For practical examination if he secures not less than 50% of marks in the semester end examination.

iii) A student shall be promoted from I to II year only if he/she fulfils the academic requirements of attendance and internal marks as stipulated in clause 6 and 7 irrespective of back log subjects in I/IV B.Tech.

iv) A student shall be promoted from II to III year only if he/she fulfils the academic requirements of attendance and internal marks as stipulated in clause 6 and 7 and also must secure 70% of the credits of the subjects that have been studied up to I year II semester from irrespective of whether the candidate takes the end examination or not as per the normal course of study. At the time of commencement of calss work, he must attain the re quired credits

v) A student shall be promoted from third year to fourth year only if he fulfills the academic requirements of of attendance and internal marks as stipulated in clause 6 and 7 and also must secure 70% of the credits of the subjects that have been studied upto II year II semester. At the time of commencement of class work, he must attain the required credits.

And in case of getting detained for want of credits by sections ii and iii above, the student may make up the credits through supplementary exams of the above exams before the date of class work commencement of Third or Fourth year I semester respectively.

8. MINIMUM ACADEMIC REQUIREMENTS (FOR LATERAL ENTRY STUDENTS):

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.6

i) A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 40% of marks in the end examination and a minimum of 50% of marks in the sum total of the internal evaluation and end examination taken together. In the Seminar & Comprehensive viva-voce he/she should secure 40%.

ii) A student who could not secure a minimum of 50% aggregate from midterm examination marks is not eligible to appear for the semester end examination and shall have to repeat that semester.

iii) A student shall be promoted from II to III year only if he/she fulfils the academic requirements of attendance and internal marks as stipulated in clause 6 and 7 irrespective of back log subjects in II/IV B.Tech.

iv) A student shall be promoted from III to IV year only if he/she fulfils the academic requirement of of attendance and internal marks as stipulated in clause 6 and 7 and also must secure 70% of the subjects that have been studied up to III year I semester.

9. GRADING:

After each subject is evaluated for 100 marks, the marks obtained in each subject will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Table – Conversion into Grades and Grade Points assigned

Range in which the marks in the subject fall	Grade	Grade points assigned
≥ 90	O (Outstanding)	10
80-89	A+ (Excellent)	9
70-79	A (Very Good)	8
60-69	B+ (Good)	7
50-59	B (Above Average)	6
45-49	C (Average)	5
40-44	D (Pass)	4
< 40	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade F shall be considered failed and will be required to reappear for that subject when the next supplementary examination offered.

ii) For non credit courses ‘Satisfactory’ or “Unsatisfactory’ shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

9.1. SEMESTER GRADE POINT AVERAGE (SGPA) AND CUMULATIVE GRADE POINT AVERAGE (CGPA):

i) The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$SGPA = \Sigma (Ci \times Gi) / \Sigma Ci$$

Where, Ci is the number of credits of the i^{th} subject and Gi is the grade point scored by the student in the i^{th} course.

ii) The Cumulative Grade Point Average (CGPA) will be computed in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

$$CGPA = \Sigma (Ci \times Si) / \Sigma Ci$$

Where 'Si' is the SGPA of the ith semester and Ci is the TOTAL number of credits in that semester.

iii) Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv) While computing the GPA/CGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, D and F.

10. GAP - YEAR:

Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. An evaluation committee shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for having the Gap Year.

11. TRANSITORY REGULATIONS:(OLD REGULATIONS CHANGED)

i) Candidates who admitted into the four year B.Tech. degree course under R-15 regulations but who got detained in any year for want of attendance/minimum aggregate sessional marks may join the appropriate year /semester in the semester system applicable for that batch and be governed by the regulations of that batch from then onwards unless otherwise specified.

ii) A student admitted under credit based regulations(CR) detained due to lack of sessional marks/attendance at the end of the first semester of II/IV B.Tech. shall join II/IV first semester fo R-15 batch . Such students will study all the courses prescribed for that R-15 in which the student joins. However the student has to clear all the first year backlog subjects by appearing the supplementary examination. Such candidates will be governed by the regulations applicable to lateral entry candidates of R-15 batch for the award of the degree.

iii) A student admitted under CR, detained due to lack of sessional marks/attendance at the end of the second semester of II/IV B.Tech. /at the end of subsequent semesters shall follow the credit based regulations only (CR).

12. WITH–HOLDING OF RESULTS:

If the candidate has any dues not paid to the college or if any case of indiscipline or malpractice is pending against him, the result of the candidate shall be withheld and he will not be allowed / promoted into the next higher semester. The issue of awarding degree is liable to be withheld in such cases.

13. AWARD OF CLASS:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	CGPA Secured
First Class with Distinction	≥ 8.0
First Class	≥ 6.5 < 8.0
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 4.0 < 5.5

14. MINIMUM INSTRUCTION DAYS:

The minimum instruction period for a semester is 16 weeks. The minimum instruction days including exams for each semester shall be for 90 days.

15. BRANCH TRANSFER:

There shall be no branch transfers after the completion of admission process.

16. GENERAL:

i) The academic regulations should be read as a whole for purpose of any interpretation.

ii) Malpractice rules - nature and punishments is appended

iii) Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

iv) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the BOS is final.

v) The University may from time to time, revise, amend or change the Regulations, Schemes of Examinations and/or Syllabi.

17. CONDUCT AND DISCIPLINE:

a) Students shall conduct themselves within and outside the premises of the institute in a manner befitting the students of our institution.

b) As per the order of Honourable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

c) The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.

   i) Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus.
   ii) Will ful damage of college / individual property
   iii) Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.
   iv) Mutilation or unauthorized possession of library books.
   v) Noisy and unseemly behavior, disturbing studies of fellow students.
   vi) Hacking of computer systems (such as entering into other person's areas without prior permission, manipulation and / or damage of computer hardware and software or any other cyber-crime etc.)
   vii) Usage of camera / cell phone in the campus
   viii) Plagiarism of any nature
   ix) Any other acts of gross indiscipline as decided by the academic council from time to time.

d) Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute / hostel, debar from examination, disallowing the use of certain facilities of the institute, rustication for a specified period or even outright expulsion from the institute or even handing over the case to appropriate law enforcement or the judiciary, as required by the circumstances.

e) For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the chief warden, the head of the department and the principal respectively, shall have the authority to reprimand or impose fine.

f) Cases of adoption of unfair means and / or any malpractice in an examination shall be reported to the principal for taking appropriate action.

g) All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the academic council.

h) The institute level standing disciplinary action committee constituted by the academic council shall be the authority to investigate the details of the offence and recommend disciplinary action based on the nature and extent of the offence committed.

i) The principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the programmes committee in an appropriate manner and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved by the appropriate authority, shall be reported to the academic council for ratification.

j) "Grievance and Redressal Committee" (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters.

18. PUNISHMENTS FOR MALPRACTICE CASES – GUIDELINES:

The examinations committee may take the following guidelines into consideration while dealing with the suspected cases of malpractice reported by the invigilators/squad members etc; during end examinations. The punishment may be more severe or less severe depending on the merits of the individual cases.

S. No.	Nature of Malpractices/Improper conduct	Punishment
1.	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
2	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks	Cancellation of the performance in that subject.
3	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
4	Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any other student or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the p is registered against him olice and a case
5	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects including practical examinations and project work of that semester/year

6	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects including practical examinations and project work of that semester/year.
7	Smuggles in the Answer book or takes out or arranges to send out the question paper during the examination or answer book during or after the examination	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects including practical examinations and project work of that semester/year. The student is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
8	Refuses to obey the orders of the Chief Superintendent / Assistant Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer- in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

9	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects including practical examinations and project work of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
10	Possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects including practical examinations and project work of that semester/year. The student is also debarred and forfeits the seat.
11	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 7 to 9.	For Student of the college: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects including practical examinations and project work of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
12	Impersonates any other student in connection with the examination	The student who has impersonated shall be expelled from examination hall. The student is debarred from writing the remaining exams and rusticated from the college fur one academic year during which period the student will not be permitted to write any exam. If the imposter is an outsider, he will be handed over to the police and a case is registered against him. The performance of the original student who has been impersonated, shall be cancelled in all the subjects of the examination including practicals and project work of that semsester / year. The student is rusticated from the college for two consecutive years during which period the student will not be permitted to write any exam. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat

13	If any malpractice is detected which is not covered in the above clauses 1 to 12 it shall be reported to the college academic council for further action to award suitable punishment
14	Malpractice cases identified during sessional examinations will be reported to the examination committee nominated by Academic council to award suitable punishment.

CURRICULAR FRAME WORK FOR REGULAR AND HONORS B.TECH. PROGRAMMES OF ALL BRANCHES:

AWARD OF THE DEGREE: A student will be declared eligible for the award of B. Tech. degree if he/she fulfills the following:

i) Pursues a course of study in not less than four and not more than eight academic years.
ii) After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.
iii) Registers for 160 credits and must secure all the 160 credits.
iv) A student shall be eligible for the award of B.Tech. degree with Honors or Minor if he/she earns 20 credits in addition to the 160 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.

CURRICULAR FRAME WORK FOR HONORS PROGRAMME:

1) Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.
2) A student shall be permitted to register for Honors program at the beginning of 4 th semester provided that the student must have acquired a minimum of 8.0 SGPA upto the end of 2 nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.
3) Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.
4) In addition to fulfilling all the requisites of a Regular B.Tech. Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
5) Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.

6) It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
7) The concerned BoS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
8) Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall explore the possibility of introducing virtual labs for such courses with lab component. (Model pool list is enclosed in the Annexure-2)
9) MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the university/academic council.
10) The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.
11) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.
12) In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech. degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
13) Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

CURRICULAR FRAME WORK FOR MINOR PROGRAMME:

1) a) Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering

   b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech. Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.

2) The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE, CE, ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.
3) The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.
4) There shall be no limit on the number of programs offered under Minor. The University/Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.
5) The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
6) A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) upto the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA upto 3rd semester or failed in any of the courses, his registration for Minors program shall stand cancelled. An SGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active. 18
7) A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
8) Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.
9) In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the university/academic council.

10) Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.
11) A committee should be formed at the level of College/Universities/department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.
12) If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript. 19
13) In case a student fails to meet the CGPA requirement for B.Tech. degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
14) Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor's degree.

STRUCTURE

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

COURSE STRUCTURE

SEMESTER-I

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE111 (R20)**	Mathematics - I	BS	3	0	0	30	70	3
2	**EE112 (R20)**	Engineering Physics	PC	3	0	0	30	70	3
3	**EE113 (R20)**	Professional Communication Skills	PC	3	0	0	30	70	3
4	**EE114 (R20)**	Engineering Mechanics	PC	3	0	0	30	70	3
5	**EE115 (R20)**	Computer Programming With C	PC	3	0	0	30	70	3
6	**EE116 (R20)**	Environmental Science (Mandatory)	MC	2	0	0	30	70	0
7	**EE151 (R20)**	Communication Skills Lab	PC	0	0	3	30	70	1.5
8	**EE152 (R20)**	Engineering Physics Lab	PC	0	0	3	30	70	1.5
9	**EE153 (R20)**	Computer Programming Lab	PC	0	0	3	30	70	1.5
TOTAL CREDITS									**19.5**

SEMESTER-II

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE121 (R20)**	Mathematics - II	BS	3	0	0	30	70	3
2	**EE122 (R20)**	Engineering Chemistry	PC	3	0	0	30	70	3
3	**EE123 (R20)**	Basic Electrical Engineering	PC	3	0	0	30	70	3
4	**EE124 (R20)**	Python	PC	3	0	0	30	70	3
5	**EE125 (R20)**	Engineering Graphics	PC	3	0	0	30	70	3
6	**EE161 (R20)**	Engineering Chemistry Lab	PC	0	0	3	30	70	1.5
7	**EE162 (R20)**	Basic Electrical Engineering Lab	PC	0	0	3	30	70	1.5
8	**EE163 (R20)**	Python Lab	PC	0	0	3	30	70	1.5
TOTAL CREDITS									**19.5**

SEMESTER-III

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE211 (R20)**	Mathematics-III	BS	3	0	0	30	70	3
2	**EE212 (R20)**	Digital Logic Design	PC	3	0	0	30	70	3
3	**EE213 (R20)**	Electrical Circuit Analysis	PC	3	0	0	30	70	3
4	**EE214 (R20)**	Electrical Machines-I	PC	3	0	0	30	70	3
5	**EE215 (R20)**	Analog Electronic Circuits	PC	3	0	0	30	70	3
6	**EE216 (R20)**	Professional Ethics And Human Values	MC	2	0	0	30	70	0
7	**EE251 (R20)**	Electrical Circuit Analysis lab	PC	0	0	3	30	70	1.5
8	**EE252 (R20)**	Electrical Machines-I lab	PC	0	0	3	30	70	1.5
9	**EE253 (R20)**	Electronics Lab	PC	0	0	3	30	70	1.5
10	**EE254 (R20)**	MATLAB	Skill	0	0	3	30	70	2
TOTAL CREDITS									**21.5**

SEMESTER-IV

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE221 (R20)**	Electromagnetic Field Theory	PC	3	0	0	30	70	3
2	**EE222 (R20)**	Power Systems-I	PC	3	0	0	30	70	3
3	**EE223 (R20)**	Electrical Machines-II	PC	3	0	0	30	70	3
4	**EE224 (R20)**	Microprocessor & Microcontrollers	PC	3	0	0	30	70	3
5	**EE225 (R20)**	Oops through Java	ES	3	0	0	30	70	3
6	**EE261 (R20)**	Electrical Machines-II Lab	PC	0	0	3	30	70	1.5
7	**EE262 (R20)**	Microprocessor & Microcontrollers Lab	PC	0	0	3	30	70	1.5
8	**EE263 (R20)**	Communicative English Lab-II	PC	0	0	3	30	70	1.5
9	**EE264 (R20)**	Object Oriented Programming through JAVA lab	SKILL	0	0	3	30	70	2
TOTAL CREDITS									**21.5**

SEMESTER-V

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE311 (R20)**	Linear Control Systems	PC	3	0	0	30	70	3
2	**EE312 (R20)**	LICA & Pulse circuits	PC	3	0	0	30	70	3
3	**EE313 (R20)**	Power Electronics	PC	3	0	0	30	70	3
4	**EE314 (R20)**	Professional Elective Course I	PEC	3	0	0	30	70	3
5	**EE315 (R20)**	Job oriented course I / Open Elective Course I	JOC / OEC	3	0	0	30	70	3
6	**EE316 (R20)**	Constitution of India	MC	2	0	0	30	70	0
7	**EE351 (R20)**	Control Systems Lab	PC	0	0	3	30	70	1.5
8	**EE352 (R20)**	LICA & Pulse Circuits Lab	PC	0	0	3	30	70	1.5
9	**EE353 (R20)**	Power Electronics Lab	SKILL	0	0	3	30	70	2
10	**EE354 (R20)**	Summer Internship 2 Months after second year (to be evaluated during V semester)	MC	0	0	3	100	0	1.5
TOTAL CREDITS									**21.5**

Professional Elective Course I

EE314/1 (R20): Digital Signal Processing

EE314/2 (R20): Electrical machine Design

EE314/3 (R20): Electrical Energy Conservation and Auditing

Job oriented Course I

EE315/1 (R20): Wind and Solar Energy Systems

EE315/2 (R20): Demand Side Energy Management

Open Elective Course I (Note: Offered to other Branches)

EE315/A (R20): Electrical Materials

EE315/B (R20): Utilization of Electrical Energy

SEMESTER-VI

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE321 (R20)**	Power Systems - II	PC	3	0	0	30	70	3
2	**EE322 (R20)**	Power Systems Operation and Control	PC	3	0	0	30	70	3
3	**EE323 (R20)**	Electrical Measurements & Instrumentation	PC	3	0	0	30	70	3
4	**EE324 (R20)**	Professional Elective Course II	PEC	3	0	0	30	70	3
5	**EE325 (R20)**	Job oriented course II/ Open Elective Course II	JOC / OEC	3	0	0	30	70	3
6	**EE361 (R20)**	Simulation of Electrical systems Lab - I	PC	0	0	3	30	70	1.5
7	**EE362 (R20)**	Electrical Measurements & Instrumentation Lab	PC	0	0	3	30	70	1.5
8	**EE363 (R20)**	Digital Signal Processing Lab	PC	0	0	3	30	70	1.5
9	**EE364 (R20)**	Mobile App Development	SC	0	0	3	30	70	2
TOTAL CREDITS									**21.5**

Professional Elective Course II

EE324/1 (R20): HVDC Transmission

EE324/2 (R20): Digital Control Systems

EE324/3 (R20): Computer Architecture

Job oriented course II

EE325/1 (R20): AI Techniques

EE325/2 (R20): Industrial Electrical Systems

Open Elective Course (Note: Offered to other Branches)

EE325/3 (R20): Renewable Energy Sources

EE325/4 (R20): Power Plant Engineering

SEMESTER-VII

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE411 (R20)**	Electric Drives	PC	3	0	0	30	70	3
2	**EE412 (R20)**	Computer methods in Power Systems	PC	3	0	0	30	70	3
3	**EE413 (R20)**	Power System Protection	PC	3	0	0	30	70	3
4	**EE414 (R20)**	Professional Elective Course III	PEC	3	0	0	30	70	3
5	**EE415 (R20)**	Open elective Course	OEC	3	0	0	30	70	3
6	**EE416 (R20)**	Industrial Management and Entrepreneur Development	BS	0	0	3	30	70	3
7	**EE451 (R20)**	Power Systems Lab	Skill Oriented Course	0	0	3	30	70	2
8	**EE452 (R20)**	Industrial/Research Internship (2 Months) after 3rd Year	MC	0	0	3	100	0	3
TOTAL CREDITS									**23**

Professional Elective Course III

EE414/1 (R20): FACTS Controllers

EE414/2 (R20): Machine learning

EE414/3 (R20): High Voltage Engineering

Open Elective Course (Note: Offered to other Branches)

EE415/1 (R20): Electric & Hybrid vehicles

EE415/2 (R20): Renewable Energy Sources

EE415/3 (R20): Utilization of Electrical Energy

SEMESTER-VIII

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EE461 (R20)**	Project Work	Project	0	0	0	50	100	08
2	**EE462 (R20)**	Seminar	Seminar	0	0	0	50	0	02
3	**EE463 (R20)**	MOOC's	MOOC	0	0	0	100	0	02
TOTAL CREDITS									**12**

HONOURS DEGREE COURSES [R20]

POOL-I:

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EEH101 (R20)**	Energy Storage Systems	Honour	3	0	0	30	70	4
2	**EEH102 (R20)**	Advanced Power Electronics	Honour	3	0	0	30	70	4
3	**EEH103 (R20)**	Smart Grid Technology and Applications	Honour	3	0	0	30	70	4
4	**EEH204 (R20)**	Electrical and Hybrid Vehicles	Honour	3	0	0	30	70	4

POOL-II:

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EEH201 (R20)**	Extra High Voltage Transmission	Honour	3	0	0	30	70	4
2	**EEH202 (R20)**	Advanced Power System Protection	Honour	3	0	0	30	70	4
3	**EEH203 (R20)**	Power Quality	Honour	3	0	0	30	70	4
4	**EEH204 (R20)**	Power systems dynamics and control	Honour	3	0	0	30	70	4

MINORS DEGREE COURSES [R20]

S. No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Int.	Ext.	
1	**EEM11 (R20)**	Power Generation and Transmission	Minors	3	0	0	30	70	4
2	**EEM12 (R20)**	Electrical Circuit Analysis	Minors	3	0	0	30	70	4
3	**EEM13 (R20)**	AC & DC Machines	Minors	3	0	0	30	70	4
4	**EEM14 (R20)**	Principles of Power Electronics	Minors	3	0	0	30	70	4
5	**EEM15 (R20)**	Utilization of Electrical Energy	Minors	3	0	0	30	70	4
6	**EEM16 (R20)**	Electrical Vehicle	Minors	3	0	0	30	70	4

SEMESTER I

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-I

CE/ME/EE/EC/CS 111(R20): MATHEMATICS-I

(Calculus & Algebra)

(Common to all branches of Engineering)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

CO1: Solve systems of linear equations using matrix operations and determine the rank of a matrix by echelon form.

CO2: Analyze and diagonalize a matrix using eigen values and eigenvectors and apply Cayley-Hamilton theorem to find inverse and power of a matrix.

CO3: Determine the nature of quadratic forms and reduce them to canonical forms by orthogonal transformation.

CO4: Apply mean value theorems (Rolle's, Lagrange's and Cauchy's) and Taylor's and Maclaurin's theorems to analyze functions.

CO5: Calculate double integrals, change the order of integration, evaluate double integrals in polar coordinates and find areas enclosed by plane curves.

Unit I: Matrix Operations and Solving Systems of Linear Equations

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Unit II: Mean Value Theorems

Rolle’s Theorem, Lagrange’s mean value theorem, Cauchy’s mean value theorem, Taylor’s and Maclaurin theorems with remainders (without proof);

Unit III: Multivariable calculus

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit IV: Double Integrals

Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves.

Unit V: Special Functions

Beta and Gamma functions and their properties, relation between beta and gamma functions.

TEXT BOOKS:

1) Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2) B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

REFERENCE BOOKS:

1) R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2) George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3) Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 201.

CO-PO/PSO MAPPING MATRIX:

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

EE/CS 112 (R20): ENGINEERING PHYSICS

(EE / CS)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand and apply the principle of superposition and interference of light and explain the conditions for sustained interference.
- Analyze the phenomenon of diffraction and its applications, such as determining the wavelength of light.
- Comprehend the basic concepts of lasers and their characteristics and explore the applications of lasers.
- Understand the principles of optical fibers, their modes of propagation and their applications in communication systems.
- Analyze the behavior of semiconductors, including intrinsic and extrinsic semiconductors and describe their applications.

UNIT-I: **(10 hrs)**

Interference: Principle of Superposition-Interference of light-Theory of Interference fringes-Conditions for sustained Interference-Interference in thin films by reflected light-Newton's Rings-Determination of Wavelength.

Diffraction: Fraunhofer Diffraction-Single slit Diffraction -Diffraction Grating – Grating Spectrum - Determination of Wavelength.

UNIT-II **(12 hrs)**

Lasers: Laser characteristics, Spontaneous and Stimulated emissions, Basic requirements of a laser, Population inversion – Solid state laser (Ruby laser), Gas (He-Ne) laser, Semiconductor (GaAs) laser, applications of lasers.

Fiber optics: Introduction to Optical Fibers-Principle of optical fiber-Critical angle, Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile, Modes-Propagation of electromagnetic wave through optical fiber - Fiber optic Communication system-applications of Optical fibers.

Unit– III **(14 hrs)**

Dielectrics: Introduction to Dielectrics--Electric polarization-Dielectric polarizability, Susceptibility and Dielectric constant- Types of polarizations-Lorentz (internal) field - Claussius -Mossotti equation.

Magnetics: Introduction to Magnetics-Magnetic dipole moment-Magnetization-Magnetic susceptibility and permeability-Origin of permanent magnetic moment-Classification of Magnetic materials-Hysteresis-soft and hard magnetic materials- applications of magnetic materials.

Unit – IV: Semiconductors **(12 hrs)**

Origin of energy band formation in solids-Classification of materials into conductors, semi-conductors & insulators – Semiconductors-Intrinsic semiconductors-dependence of Fermi level on carrier concentration and temperature(Qualitative)- Extrinsic semiconductors - P-type & N-type-dependence of Fermi level on carrier concentration and temperature (Qualitative)- Direct and Indirect band gap semiconductors-Hall effect- applications of Semiconductors.

Unit-V : **(12 hrs)**

Principles of Quantum Mechanics: Dual nature of light, Matter waves & properties, de Broglie's concept of matter waves, Davisson and Germer experiment, Heisenberg's uncertainty principle and application (non-existence of electron in nucleus). One dimensional time independent Schrodinger's wave equation, Physical significance of the wave function, Particle in a box (one dimensional).

Superconductivity: First experiment, critical parameters (Tc, Hc, Ic), Meissner effect, BCS Theory (in brief) and Applications of superconductors.

TEXT BOOKS:

1) M.N. Avadhanulu, P.G.Kshirsagar "A Text book of Engineering Physics"-S.Chand Publications,2017
2) H.K.Malik&A.K.Singh "Engineering Physics",- McGraw Hill Publishing Company Ltd, 2018
3) Gaur R.K. and Gupta S.L., "Engineering Physics"- DhanpatRai publishers, 2012

REFERENCE BOOKS:

1) Gerd Keiser "Optical Fiber Communications"- 4/e, Tata McGrawHill ,2008
2) S.M.Sze "Semiconductor devices-Physics and Technology"-Wiley,2008
3) D.K. Bhattacharya and A. Bhaskaran, "Engineering Physics"- Oxford Publications-2015

CO-PO/PSO MAPPING MATRIX:

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

EE/EC 113 (R20): PROFESSIONAL COMMUNICATION SKILLS

(EE / EC)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

- Students will be able to demonstrate effective listening and speaking skills in professional settings.
- Students will be able to write clear, concise and professional documents, such as emails, memos and reports.
- Students will be able to analyze and adapt their communication style for different audiences and purposes.
- Students will be able to collaborate effectively in a team setting and communicate professionally with colleagues and stakeholders.
- Students will be able to identify and apply ethical communication practices in professional contexts.

UNIT-I: 8 Hrs.

1) Reading: Listening Skills – The Boy who broke the Bank (English & Soft Skills)
2) Writing: Paragraph Writing
3) Grammar: Common Errors in Nouns- Pronoun Agreement
4) Vocabulary Building: Functional word list -100

UNIT- II: 8 Hrs.

1) Reading: Assertive Skills – The Verger (English & Soft Skills)
2) Writing: Letter Writing (Formal and Informal)
3) Grammar: Correction of Errors in Subject- Verb Agreement
4) Vocabulary Building: Sign Post

UNIT - III: 8 Hrs.

1) Reading: Learning Skills – Three Questions (English & Soft Skills)
2) Writing: Note Making, Note Taking
3) Grammar: Correction of in Tense Usage
4) Vocabulary Building: One Word Substitutes

UNIT - IV: 8 Hrs.

1) Reading: Adaptability Skills – Senor Payroll (English & Soft Skills)
2) Writing: Pictorial Description
3) Grammar: Correction of Errors in Adjectives, Articles, Prepositions
4) Vocabulary Building: Synonyms and Antonyms

UNIT - V: 8 Hrs.

1) Reading: Written Communication Skills - Gateman's Gift (English & Soft Skills)
2) Writing: Information Transfer
3) Grammar: Correction of Errors in Wh- questions, Question Tags
4) Vocabulary Building: Idioms and Phrasal Words (200)

TEXT BOOKS:

1) Dhanavel S. P. *English and Soft Skills*, Orient Black Swan Pvt. Limited, 2013.
2) Barun K Mitra, *Effective Technical Communication*, Oxford University Publication, 2014.

REFERENCE BOOKS:

1) Bailey, Stephen. *Academic writing: A handbook for International Students*. Routledge, 2014.
2) Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking*. Heinley ELT; 2nd Edition, 2018.
3) Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.
4) Michael Swan. *Practical English Usage*, OUP. 1995.
5) F.T. Wood. *Remedial English Grammar*, Macmillan.2007
6) Liz Hamp-Lyons and Ben Heasly. *Study Writing*, Cambridge University Press. 2006.
7) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad.
8) Sharon J.Gerson, Steven M.Gerson, *Technical Writing*, New Delhi: Pearson education, 2007.
9) Sanjay Kumar and PushpLata, *Communication Skills*, Noida: Oxford University Press, 2012.
10) Dr. ShaliniVerma, *Word Power Made Handy*, S. Chand & Co Ltd., 2009.

CO-PO/PSO MAPPING MATRIX:

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

EE/CS 114 (R20): ENGINEERING MECHANICS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and solve problems related to forces, equilibrium and friction in mechanical systems using principles of engineering mechanics.
- Apply the concepts of centroid, moment of inertia and center of gravity in analyzing the stability and balance of mechanical systems.
- Evaluate the motion of rigid bodies under various conditions, including rectilinear and curvilinear motion, projectile motion and motion under gravity.
- Apply Newton's Laws of motion, D'Alembert's principle and principles of work and energy to analyze and solve problems related to kinetics in mechanical systems.
- Understand the concepts of conservation of energy and momentum and apply them to analyze the behavior of ideal systems.

Unit I **12hours**

Introduction to Engineering Mechanics: Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems couple, moment of a force Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.

Unit II **10hours**

Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

Properties of Surfaces and Volumes: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite sections, center of gravity of common volumes - cylinder, cone, sphere, theorem of Pappus-guidinus.

Unit III

Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes -thin plates, thin rod, cylinder, cone, sphere, rectangular prism, radius of gyration.

Unit IV **10 hours**

Kinematics: Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, motion under gravity -projectile motion, use of rectangular coordinates, tangential and normal coordinates.

Unit V **10hours**

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.

Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse.

TEXT BOOKS:

1) N H Dubey, Engineering Mechanics: Statics and Dynamics, McGraw Hill, 2014.
2) S Timoshenko, DH Young, JV Rao, SukumarPati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 20
3) S SBhavikatti, Engineering Mechanics, 4/e, New Age International, 2008.

REFERENCE BOOKS:

1) Basudeb Bhattacharya., Engineering Mechanics, 2/e, Oxford University Press (India), 2015.
2) Irving Shames, G K M Rao, Engineering Mechanics: Statics and Dynam-ics, 4/e, Pearson, 2009.
3) K L Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010

CO-PO/PSO MAPPING MATRIX:

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

CE/ME/EE/EC/CS115 (R20): PROBLEM SOLVING AND PROGRAMMING (USING C)

(COMMON TO ALL BRANCHES)

L-3	T-1	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Design and develop flowcharts using Raptor to solve simple problems related to basic programming constructs.
- Write basic programs in C using different data types, operators and control structures.
- Develop programs using functions and understand concepts like scope, storage classes and recursion.
- Implement programs using arrays, pointers and strings for solving problems related to data manipulation.
- Understand the concept of structures and files in C programming and develop programs using structures and file handling functions.

Unit – I: Flowchart design through Raptor

Flow chart symbols, Input/Output, Assignment, operators, conditional if, repetition, function and sub charts. Example problems(section 1) – Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD of 2 numbers

Example problems(section 2) - Fibonacci generation, prime number generation. Minimum, Maximum and average of n numbers, Linear search, Binary Search

Unit II: C Basics

C-Basics: C-character set, Data types, Constants, Expressions, Structure of C program, Operators and their precedence & associatively, Simple programs in C using all the operators, Type casting ,type coercion.

Unit III: Control Structures and Functions

Control Structures, Basic input and output statements, Preprocessor directives.

Functions: Concept of a function, passing the parameters, automatic variables, scope and extent of variables, storage classes, recursion, iteration vs recursion, types of recursion, Simple recursive and non recursive programs, Towers of Hanoi problem.

Unit IV: Arrays and Pointers

Arrays: Single and multidimensional Arrays, Character array as a string, string functions, Programs using arrays and string manipulation.

Pointers: Pointers declarations, Pointer expressions, Pointer parameters to functions. Pointers, Pointers and array, Pointer arithmetic.

Unit V: Structures and Files

Structures: Declaring and using structures, operations on structures, structures and arrays, user defined data types, pointers to structures. Command line arguments.

Files: Introduction, file structure, file handling functions, file types, file error handling, Programs using file functions.

TEXT BOOKS:

1) https://raptor.martincarlisle.com/
2) Programming with C-Gottfried-Schaums Outline Series-TMH
3) C Programming – AnithaGoel/Ajay Mittal/E.Sreenivasa Reddy-Pearson India

REFERRENCE BOOKS:

1) Problem Solving with C- Somasekharan-PHI.
2) C Programming- Behrouz A forouzan – CENGAGE Learning
3) Test your c skills-Yaswanthkanithker
4) Let us C- Yaswanthkanithker

CO-PO/PSO MAPPING MATRIX:

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

EE/CS 116 (R20): ENVIRONMENTAL SCIENCE

(COMMON TO EE / CS)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

CO1: Understand the multidisciplinary nature of Environmental Studies and the need for public awareness about environmental issues.

CO2: Recognize the different types of natural resources, their associated problems and the consequences of their over-exploitation.

CO3: Describe the structure and function of ecosystems, including energy flow, food chains and ecological pyramids and identify the characteristic features of different ecosystems.

CO4: Explain the concept of biodiversity, its classification and its value at global, national and local levels and identify the threats to biodiversity and the conservation measures to protect it.

CO5: Analyze the causes, effects and control measures of different types of environmental pollution, including air, water, soil, marine, noise, thermal and nuclear pollution and discuss the role of an individual in pollution prevention.

UNIT – I: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, Scope and Importance – Need for Public Awareness.

NATURAL RESOURCES : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT – II: Ecosystems, Biodiversity and its Conservation

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

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

UNIT – III: Environmental Pollution and Solid Waste Management

ENVIRONMENTAL POLLUTION: Definition, Cause, effects and control measures of Air Pollution. Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

SOLID WASTE MANAGEMENT: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides

UNIT – IV: Social Issues and the Environment

SOCIAL ISSUES AND THE ENVIRONMENT: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.\

UNIT – V: Human Population and the Environment

HUMAN POPULATION AND THE ENVIRONMENT: Population growth, variation among nations. Population explosion – Family Welfare Programmed – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

FIELD WORK: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects and birds – river, hill slopes, etc.

TEXT BOOKS:

1) Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2) Environmental Studies by Palaniswamy – Pearson education
3) Environmental Studies by Dr.S.AzeemUnnisa, Academic Publishing Company

REFERENCE BOOKS:

1) Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.
2) Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.
3) Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.

CO-PO/PSO MAPPING MATRIX:

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

EE/EC 151 (R20): COMMUNICATIVE ENGLISH LAB

(EE / EC)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Developing speaking and listening skills for effective communication in English.
- Improving reading comprehension and writing skills for academic purposes.
- Building vocabulary and grammar knowledge for better understanding and expression in English.
- Developing intercultural communication skills for better interaction with English-speaking people from different cultures.
- Preparing for standardized tests such as TOEFL or IELTS by providing test-taking strategies and practice.

LIST OF ACTIVITIES:

1) Identifying phonic sounds, listening to the sounds, practice and record the sounds from the English learning software
2) Common mispronounced words
3) Listening to the short audios and complete the tasks based on the audios
4) Listening to motivational speeches and answering the questions
5) Comprehending Spoken material in British English & American English
6) Situational Dialogues
7) Role plays
8) Reading comprehension exercises for GRE, TOEFL, GATE etc
9) Reading articles from newspaper
10) Specific reading for enhancing vocabulary
11) Vocabulary building exercises
12) Extempore
13) JAM sessions
14) Small talks
15) Oral presentations

CO-PO/PSO MAPPING MATRIX:

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

EE/CS 152 (R20): ENGINEERING PHYSICS LABORATORY

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Apply principles of optics and electromagnetic waves to understand and analyze various phenomena in optics, such as diffraction, interference and polarization.
- Apply principles of mechanics to analyze the behavior of physical systems, such as circular motion, gravitation and harmonic motion.
- Apply principles of electromagnetism to analyze electric and magnetic fields, circuits and electromagnetic waves.
- Analyze the behavior of materials under different conditions and understand their properties, such as elasticity, stress and strain and thermal properties.
- Develop skills in experimental techniques, data analysis and technical communication through laboratory experiments and technical reports.

LIST OF PHYSICS EXPERIMENTS:

1) Determination of the radius of curvature of the lens by Newton's ring method.
2) Determination of wavelength by plane diffraction grating method.
3) Dispersive power of a Prism.
4) Resolving power of a grating.
5) Photo cell – I-V Characteristic curves and determination of stopping potential.
6) Magnetic field along the axis of a circular coil carrying current.
7) B-H Curve
8) To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle.
9) Hall effect.
10) Photo voltaic cell - Determination of fill-factor.
11) To determine the energy gap of a semiconductor.
12) Determination of Acceleration due to gravity by using compound Pendulum.
13) Poisson's ratio of aluminium and rubber.
14) Rigidity modulus of material by wire-dynamic method (torsional pendulum).
15) Determination of a.c. Frequency – Sonometer.
16) Determine the wavelength of Laser source.

REFERENCE BOOKS:

1) S. Balasubramanian , M.N. Srinivasan " A Text book of Practical Physics"- S Chand Publishers, 2017
2) http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University

CO-PO/PSO MAPPING MATRIX:

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

CE/ME/EE/EC/CS 153 (R20):PROBLEM SOLVING & PROGRAMMING USING C LAB

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand and apply fundamental programming concepts such as variables, data types, operators, control structures, functions, arrays, pointers and structures in C language.
- Develop efficient algorithms and use appropriate data structures to solve programming problems in C.
- Demonstrate the ability to write and debug C programs using appropriate tools and techniques, including integrated development environments (IDEs) and debugging utilities.
- Evaluate the efficiency and complexity of C programs in terms of time and space complexity and apply appropriate techniques to optimize program performance.
- Work collaboratively in teams to develop complex C programs and effectively communicate technical information and programming solutions to others.

CYCLE 1:

1. Construct flowcharts to

a. Calculate the maximum, minimum and average of N numbers

b. Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.

2. Construct flowcharts with separate procedures to

a. Calculate simple and compound interest for various parameters specified by the user

b. Calculate the greatest common divisor using iteration and recursion for two numbers as specified by the user

3. Construct flowcharts with procedures to

a. Generate first N numbers in the Fibonacci series

b. Generate N Prime numbers

4. Design a flowchart to perform Linear search on list of N unsorted numbers(Iterative and recursive)
5. Design a flowchart to perform Binary search on list of N sorted numbers(Iterative and recursive)
6. Design a flowchart to determine the number of characters and lines in a text file specified by the user

CYCLE 2:

1. Exercises on data types and operators?

a) Practice exercises 3.1 to 3.16 and 4.1 to 4.17 and 14.1 to 14.20 Test your C Skills – yaswanth kanitkar text book.

b) Write a program which determines the largest and the smallest number that can be stored in different data types of like short, int., long, float and double. What happens when you add 1 to the largest possible integer number that can be stored?

c) Write a program to find greatest of three numbers using conditional operator?

d) Write a program to swap two numbers with and without temp variable?

e) Practice a program using multiple unary increment and decrement operators in arithmetic expressions?

2. Exercises on control structures?

a) Practice exercise 2.1 to 2.15 Test your C Skills - yaswanthkanitkar text book.

b) Write a program to find greatest of three numbers? Use nested if, if else if and switch statements?

c) Write a program to read marks of a student and print the sum and average?

d) Display the grade based on the sum of marks?

e) Write a program to count the digits of a number? Use for loop

f) Write a program to check whether a number is perfect or not? Use do-while

g) Write a program to check whether a number is strong or not? Use while

h) Write a program to check whether a number is amstrong or not? Use for

i) Write a program to check whether a number is palindrome or not? Use for

j) Write a program to find the Fibonacci series upto the given number? Use while

k) Write a program to print the pascals triangle? Used do-while

l) Write a program to print the result of the series 1+x^2/2+x^3/3+….+x^n/n

3. Exercises on functions?

a) Practice exercise 5.1 to 5.14 Test your C skills –yaswanth kanitkar text book.

b) Write program to swap two variables using functions? Write a program to perform menu driven arithmetic operations using functions?

c) Write a program to find the factorial of a number using recursive and non- recursive functions?

d) Write a program to find the Fibonacci series using recursive functions?

e) Write a program to find the solution for towers of Hanoi using recursive function?

f) Write a program to pass parameters to a functions using call by value and call by reference?

4. Exercises on Arrays?

a) Practice exercise 9.1 to 9.17 Test your C skills – yaswanth kanitkar text book.

b) Write a program to read n numbers and sort them?
c) Write a program to find the minimum and maximum numbers of the array?
d) Write a program to read two matrices and find their sum, difference and product of them?
e) Find the transpose of a matrix?
f) Write a program to print upper and lower triangle of a given matrix?

5. Exercises on strings?

a) Practice exercise 10.1 to 10.15 yaswanth kanitkar text book.
b) Write a program to demonstrate the use of string manipulation functions?
c) Write a program to compare two strings?
d) Write a program to sort the names in Alphabetical order?

6. Exercises on pointers?

a) Practice exercise 7.1 to 8.26 yaswanth kanitkar text book.
b) Write a program to read dynamic array and sort the elements?
c) Write a program to read dynamic array and find the minimum and maximum of the elements?
d) Write a program to perform pointer arithmetic?
e) Write a program on pointers for strings?
f) Write a program to use array of pointers?

7. Exercises on structures?

a) Practice exercise 11.1 to 11.30 yaswanth kanitkar text book.
b) Write a program to create student structure and read marks of three subjects and find the sum and total of the student?
c) Write a program on arrays of structures for 60 students record using the above student structure?
d) Write a program for complex structure? Perform addition, subtraction and multiplication of two complex numbers?
e) Write a program for addition and multiplication of two polinomials?

8. Write a program on Files?

a) Practice exercise 12.1 to 12.20 yaswanth kanitkar text book.
b) Write a program to append content of a file?
c) Write a program to display the content of a file?
d) Write a program to copy content of one file to other file?
e) Write a program to count the no of characters in a file?
f) Write a program to compare the contents of two files?

REFERENCE BOOKS:

1) Test your C Skills by – Yaswanth Kanithkar-BPB Publishers
2) C programming; Test your skills-A.N. Kamthane-Pearson India

CO-PO/PSO MAPPING MATRIX:

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

SEMESTER II

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-II

CE/ME/EE/EC/CS 121 (R20): MATHEMATICS-II

(ODE, PDE AND MULTIVARIABLE CALCULUS)

(COMMON TO ALL BRANCHES)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Develop a strong foundation in linear differential equations, including knowledge of operator D, rules for finding complimentary function and methods for finding particular integrals.
- Understand and be able to solve various types of partial differential equations, including first order linear and non-linear PDEs and homogenous and non-homogenous higher order linear partial differential equations.
- Develop proficiency in multivariable calculus, including vector differentiation, vector operator del, gradient, divergence and curl, as well as vector integration, including line integral, surface integral, Green's theorem, Stoke's theorem and Divergence theorem.
- Acquire skills in solving simultaneous linear equations with constant coefficients, Cauchy's and Legendre's linear equations and applying the method of variation of parameters.
- Apply the concepts and techniques learned to solve problems in a variety of applications, including physics, engineering and mathematics.

UNIT I: Linear Differential Equations of Higher Order

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

UNIT II: Equations Reducible to Linear Differential Equations and Applications

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients,

UNIT III: Partial Differential Equations – First order

First order partial differential equations, solutions of first order linear and non-linear PDEs.

Solutions to homogenous and non-homogenous higher order linear partial differential equations.

UNIT IV: Multivariable Calculus (Vector differentiation)

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V: Multivariable Calculus (Vector integration)

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).

TEXT BOOKS:

1) Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2) B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

REFERENCE BOOKS:

1) Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2) Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3) George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4) R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5) Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011

CO-PO/PSO MAPPING MATRIX:

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

EE/CS 122 (R20): ENGINEERING CHEMISTRY

(EE / CS)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Demonstrate an understanding of the various impurities present in water and the techniques used for water treatment for both drinking and industrial purposes.
- Explain the principles and mechanisms of polymerization and the properties and applications of various types of polymers, including conducting polymers and nano materials.
- Analyze the electrochemical properties of cells and batteries, including their advantages and disadvantages and apply techniques for controlling and preventing corrosion.
- Utilize instrumental methods such as UV, IR, NMR spectroscopy and gas chromatography and HPLC techniques for the analysis of various substances.
- Evaluate the chemistry of building materials such as cement and concrete and apply organic reactions involving substitution and elimination to synthesize commonly used drug molecules such as aspirin and paracetamol.

UNIT-I: WATER TECHNOLOGY

Various impurities of Water, WHO guidelines, Hardness unit sand determination by EDTA method, water treatment for drinking purpose-sedimentation, coagulation, filtration (slow sand filter), various methods of chlorination, breakpoint chlorination.

Water treatment for industrial purpose: Boiler troubles, scales, sludges, caustic embrittlement, boiler Corrosion, priming and foaming- causes and prevention, Internal conditioning - Phosphate, Calgon and Carbonate treatment, External conditioning-Lime Soda process (simple problems), softening by ion- Exchange process, Desalination of Brackish water by Electro dialysis and Reverse osmosis.

UNIT-II: POLYMER CHEMISTRY

Introduction to polymers, Functionality of monomers, chain growth and step growth polymerization, Co-polymerization (Stereo specific polymerization) with specific examples and mechanisms of polymer formation.

PLASTICS: Thermoplastics and Thermosetting, preparation, properties and applications of Bakelite, Elastomers, Preparation, properties and applications of BUNA-S and BUNA-N Rubbers.

Conducting Polymers- Introduction, examples, general applications and mechanism of Conduction on Polyacetylene.

Chemistry of Nano materials: Introduction to nano chemistry, preparation of nano materials - carbon nanotubes and fullerenes and their engineering applications.

UNIT-III: ELECTRO CHEMISTRY AND APPLICATIONS

Electrodes-concepts, types of cells, electro chemical series, Nernst equation.

BATTERIES: Primary cell (Dry cell), Secondary cell (Lead-acid), Lithium batteries and their advantages, Fuel cell (H_2-O_2 cell).

Corrosion:

Types of corrosions- chemical corrosion, dry corrosion, electro chemical corrosion and wet corrosion, galvanic series, pitting and differential aeration of corrosion, factors affecting corrosion.

Corrosion control: Cathodic protection, Corrosion Inhibitors, Electro plating (Au) & (Ni).

Learning Outcomes:

UNIT-IV: INSTRUMENTAL METHODS

Electromagnetic spectrum-Absorption of Radiation: Beer-Lambert's law-Principle and applications of Ultra-Violet, Infra-Red and Nuclear Magnetic Resonance Spectroscopy. Principle and applications of Gas Chromatography and HPLC Techniques.

UNIT-V:

i) **Cement and Concrete Chemistry**: Introduction to Building Materials, Portland Cement, Constituents, Manufacturing Process, Setting and Hardening Cement.

ii) **Organic reactions and synthesis of a drug molecule**: Introduction to reactions involving substitution (SN_1 and SN_2), elimination reactions (E_1 and E_2), Synthesis of commonly used drug molecule – Aspirin and Paracetmol.

PRESCRIBED TEXT BOOKS:

1) Engineering Chemistry, P.C. Jain and M. Jain – Dhanapathi Rai & Sons, Delhi
2) A text book of Engineering Chemistry, S.S. Dara - S. Chand & Co. New Delhi
3) Engineering Chemistry, B.K. Sharma - Krishna Prakashan, Meerut
4) Shashichawla,A text book of engineering chemistry, 3rd Edition, Dhanpatrai & co new delhi,2007.
5) Gurudeep raj & Chatwalanand, "Instrumental methods of analysis ", 7thedition, CBS publications, 1986.
6) Quantitative analysis by day & underwood.
7) A Text book of Instrumental methods by Skoog and West.
8) H.W. Wilard and demerit, "Instrumental methods of analysis ", 7thedition, CBS publications, 1986.
9) Text book of Nano Science and Nano technology, B.S. Murthy and P. Shankar, University.

CO-PO/PSO MAPPING MATRIX:

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

EC/EE 123 (R20): BASIC ELECTRICAL ENGINEERING

(EC / EE)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the fundamental concepts of DC and AC circuits, including Kirchhoff's laws, series and parallel connections and nodal and loop analysis.
- Analyze single-phase AC circuits consisting of RL, RC and RLC series circuits, including series resonance and band width.
- Demonstrate knowledge of magnetic circuits and their properties, including Faraday's laws of electromagnetic induction, dynamically and statically induced EMF and self and mutual inductance.
- Explain the principle and operation of DC machines, including DC generators and motors and understand their performance characteristics and speed control methods.
- Describe the principle, operation and construction of AC machines, including single-phase transformers and three-phase induction motors and understand their losses, efficiency and testing methods.

UNIT – I: DC & AC Circuits

Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Nodal and loop analysis.Thevenin’s and Superposition Theorems

Representation of sinusoidal waveforms - peak and rms values - phasor representation - real power - reactive power - apparent power - power factor - Analysis of single-phase ac circuits consisting of RL - RC - RLC series circuits. Series Resonance and band width.

UNIT-II: Polyphase & Magnetic circuits

Generation of 3-phase voltages - phase sequence - star & delta connections - voltage, current & power in star & delta connected systems - analysis of 3-phase balanced circuits - measurement of 3-phase power by 2 wattmeter method.

Faraday’s Laws of Electromagnetic Induction .Dynamically induced EMF –Statically induced EMF – Self Inductance – Mutual Inductance - Coefficient of coupling –Inductances in Series – Inductances in parallel – Dot convention.

UNIT-III: DC Machines

Principle and operation of DC Generator - EMF equation - OCC characteristics of DC generator – Principle and operation of DC Motor – Performance Characteristics of DC Motors - Speed control of DC Motors.

UNIT-IV: AC Machines:

Principle and operation of Single Phase Transformer - EMF equations-losses in transformers, regulation and efficiency. OC and SC test on transformer – auto transformer.

Principle, operation and construction of Three phase Induction Motor –torque equation and torque slip characteristics-power losses and efficiency.

UNIT-V: Semiconductor Devices:

Characteristics of Semiconductor junction Diode, Zener diode, transistor, JFET, UJT, SCR and their applications. Half-wave, Full-wave rectifiers and Bridge rectifier, with (L and LC) and without filters.

Bipolar Junction Transistor: Transistor operation, Common base configuration, Common emitterconfiguration, Transistor amplifying action, Common collector configuration, Operating point

TEXT BOOKS:

1) D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2) E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.

REFERENCE BOOKS:

1) L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
2) D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.

CO-PO/PSO MAPPING MATRIX:

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

EE 124 (R20): PYTHON PROGRAMMING

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

1) Understand the fundamental concepts and tools of software development, including values and variables, expressions and arithmetic and conditional execution.
2) Develop proficiency in iterative programming using while and for loops and understand concepts such as nested loops, abnormal loop termination and infinite loops.
3) Develop a deep understanding of functions and their role in software development, including standard mathematical functions, time functions and parameter passing.
4) Learn to work with lists and understand list processing techniques such as sorting, flexible sorting, search, list permutations and reversing a list.
5) Understand the concept of objects and how to use them, including working with string and list objects, creating custom types and using class inheritance. Also, develop proficiency in handling exceptions and custom exceptions.

Unit 1:

Context of software development: Software, Development tools, Learning programming with Python, Writing a python program.

Values and Variables: Variables and assignments, identifier, Control codes within Strings, User Input, The eval function, the print function.

Expressions and Arithmetic: Expressions, Operator precedence and Associativity, Comments, Errors, More arithmetic operators.

Unit 2:

Conditional Execution: Boolean Expressions, Simple if and if else,nested conditionals, multiway decision statements, conditional expressions, errors in conditional statements.

Iteration: While statements, for statement, definite loops and indefinite loops, nested loops, abnormal loop termination, infinite loops, iteration examples: computing square root, drawing a tree, printing prime numbers.

Unit 3:

Functions: Introduction, standard mathematical functions, time functions, Random numbers, main function, parameter passing, Function examples: Better organized prime number, Command Interpreter, Restricted Input, Better Die rolling simulator, Tree-Drawing Function, Floating –Point equality, Custom functions Vs Standard functions.

More on Functions: Global variables, Default Parameters, recursion, Making functions reusable, documenting functions and modules, functions as data.

Unit 4:

Lists: Using Lists, List assignment and equivalence, list bounds, Slicing, Lists and functions, Prime generation with a list

Lists processing: Sorting, flexible sorting, search, list permutations, randomly permuting a list, reversing a list.

Unit 5:

Objects: Using Objects, String Objects, List Objects.

Custom types: geometric points, Methods, Custom type examples, Class inheritance.

Handling Exceptions: Motivation, Exception examples, Using Exceptions, Custom Exceptions.

TEXT BOOKS:

1) LEARNING TO PROGRAM WITH PYTHON Richard L. Halterman
2) Core Python Programming by Dr. R.Nageswara Rao, Dreamtech, Second edition

CO-PO/PSO MAPPING MATRIX:

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

CS/EE 125(R20): ENGINEERING GRAPHICS

(CS / EE)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the principles of engineering graphics, including conventions in drawing, lettering, dimensioning principles and conventional representations.
- Be able to project points, lines, planes and solids in various positions and orientations onto different planes using orthographic and isometric projections.
- Understand sectional views and how to create them for right regular solids, including prisms, cylinders, pyramids and cones.
- Be able to develop the surfaces of right regular solids, including prisms, cylinders, pyramids and cones and their sectional parts.
- Gain proficiency in computer-aided drafting, including setting up a drawing, using various toolbars and practicing 2D drawings.

UNIT-I

Introduction to Engineering graphics: Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions. Dimensioning principles and conventional representations

a) Conic sections including the rectangular-hhyperbola- general method only,b) Cycloid, epicycloids and hypocycloid, c) Involutes

UNIT-II

Projection of points, lines and planes: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.

UNIT-III

Projections of solids: Projections of regular solids inclined to one or both planes by rotationa

Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.

UNIT-IV

Development of surfaces: Development of surfaces of right regular solids-prism,

cylinder, pyramid, cone and their sectional parts.

Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, figures, simple and compound solids.

UNIT-V

Orthographic Projections: Systems of Projections, Orthographic Projection (Simple Figures)

(DEMONESTRATION ONLY)

Computer Aided Drafting (Using any standard package): Setting up a drawing: starting ,main menu (New, Open, Save, Save As etc.), Opening screen, error correction on screen, units, co-ordinate system, limits, grid, snap, ortho.

Tool bars: Draw tool bar, object snap tool bar, modify tool bar, dimension tool Bar Practice of 2D Drawings: Exercises of Orthographic views for simple solids using allcommands in various tool bars.

TEXT BOOKS:

1) K.L.Narayana&P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
2) N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers, 2016.

REFERENCE BOOKS:

1) Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2009
2) Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009
3) Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers, 2000
4) K.C.John, Engineering Graphics, 2/e, PHI, 2013
5) Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.
6) Youtube: http-sewor,Carleton.cag,kardos/88403/drawings.html conic sections-online, red woods.edu

CO-PO/PSO MAPPING MATRIX:

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

EE/CS 161 (R20): ENGINEERING CHEMISTRY LABORATORY

(EE / CS)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

1) Determination of hardness of water by EDTA method
2) Estimation of Mohr's salt by Permanganometry
3) Determination of alkalinity of water
4) Percentage of purity of washing soda
5) Preparation of Urea-formaldehyde resin

LIST OF EXPERIMENTS:

1) Determination of hardness of water by EDTA method
2) Estimation of Mohr's salt by Permanganometry
3) Estimation of Mohr's salt by Dicrometry
4) Determination of alkalinity of water
5) Percentage of purity of washing soda
6) Determination of available chlorine in bleaching powder
7) Preparation of Urea-formaldehyde resin
8) Determination on strength of NaoH using HClconductometrically
9) Acid-Base titration by P^H meter
10) Acid-Base titration by Potentiometer
11) Determination of viscosity of lubricating oil
12) Determination of Surface tension

CO-PO/PSO MAPPING MATRIX:

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

EE/CS162 (R20): BASIC ELECTRICAL ENGINEERING LABORATORY

(EE / CS)

L-3	T-0	P-0	M-100	C-3

LABORATORY SYLLABUS

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand basic safety precautions and be able to use measuring instruments such as voltmeter, ammeter, multi-meter and oscilloscope.
- Verify Kirchhoff's laws by performing experiments on electrical circuits.
- Verify the Superposition theorem by performing experiments on electrical circuits.
- Verify Thevenin's theorem by performing experiments on electrical circuits.
- Understand the open circuit characteristics of a DC shunt generator and be able to perform experiments to determine its behavior.

LIST OF EXPERIMENTS:

1) Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2) Verification of Kirchhoff laws.
3) Verification of Superposition Theorem.
4) Verification of Thevenin's Theorems
5) Open circuit characteristics of a DC Shunt Generator.
6) Speed control of DC Shunt Motor.
7) Brake test on DC Shunt Motor.
8) OC & SC test of 1 – Phase Transformer.
9) Brake test on 3 - Phase Induction Motor.
10) Characteristics of PN junction and zener diode
11) Characteristics of transistor in common emitter configuration
12) Verification of transistor self bias circuit

CO-PO/PSO MAPPING MATRIX:

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

EE/CS163 (R20): PYTHON PROGRAMMING LAB

(EE / CS)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

- Students will be able to explain fundamental concepts and theories related to the course topic.
- Students will be able to analyze and evaluate real-world problems related to the course topic using appropriate methods and tools.
- Students will be able to apply course concepts and theories to propose solutions to real-world problems.
- Students will be able to communicate effectively in written and/or oral formats about course concepts and their applications.
- Students will be able to work collaboratively and demonstrate professional and ethical behavior in team settings.
- Design a Python script to convert a Binary number to Decimal number and verify if it is a Perfect number.
- Design a Python script to determine if a given string is a Palindrome using recursion
- Design a Python script to sort numbers specified in a text file using lists.
- Design a Python script to determine the difference in date for given two dates in YYYY:MM:DD format(0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.
- Design a Python Script to determine the Square Root of a given number without using inbuilt functions in Python.
- Design a Python Script to determine the time difference between two given times in HH:MM:SS format.(0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)
- Design a Python Script to find the value of (Sine, Cosine, Log, PI, *e*) of a given number using infinite series of the function.
- Design a Python Script to convert a given number to words
- Design a Python Script to convert a given number to roman number.
- Design a Python Script to generate the frequency count of words in a text file.
- Design a Python Script to print a spiral pattern for a 2 dimensional matrix.
- Design a Python Script to implement Gaussian Elimination method.
- Design a Python script to generate statistical reports(Minimum, Maximum, Count, Average, Sum etc) on public datasets.

- Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorising them into distinction, first class, second class, third class and failed.
- Design a Python script to search an element in the given list.
- Design a Python script on *str* methods and *list* methods.

CO-PO/PSO MAPPING MATRIX:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
O1	-	1	2	1	1	-	-	2	-	-	-	2	3	1
CO2	2	3	1	3	2	-	-	2	-	-	-	2	3	1
CO3	-	2	-	1	-	-	-	2	-	-	-	2	3	1
CO4	2	3	-	3	2	-	-	2	-	-	-	2	3	1
CO5	3	3	2	3	-	-	-	-	-	-	1	3	2	1

SEMESTER III

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-III

CE/ME/CS/EC/EE 211(R20): MATHEMATICS – III

(COMMON TO ALL BRANCHES)

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

- Students will be able to define integral transform and explain the domain of the function and kernel for Laplace transforms.
- Students will be able to apply Laplace transforms to find the solution of ordinary differential equations.
- Students will be able to derive Fourier series expansion for periodic functions and apply it to typical waveforms.
- Students will be able to explain Fourier integral theorem and Fourier transforms and apply them to find the solution of partial differential equations.
- Students will be able to use numerical methods such as Bisection method and Newton-Raphson method to solve algebraic and transcendental equations and solve linear simultaneous equations using iterative methods like Gauss-Seidel method.

UNIT – I: **Laplace transform and its applications to Ordinary differential equations:** Definition of Integral transform, Domain of the function and Kernel for the Laplace transforms. Existence of Laplace transform. Laplace transform of standard functions, first shifting Theorem, Laplace transform of functions when they are multiplied or divided by "t". Laplace transforms of derivatives and integrals of functions. – Unit step function – second shifting theorem. Dirac's delta function, Periodic function – Inverse Laplace transform by Partial fractions(Heaviside method) Inverse Laplace transforms of functions when they are multiplied or divided by "s", Inverse Laplace Transforms of derivatives and integrals of functions, Convolution theorem –- Solving ordinary differential equations by Laplace transforms.

UNIT – II: Fourier Series: Introduction and Euler's formulae, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Even and Odd functions, Half range series, Typical wave forms and Parseval's formulae, Complex form of the Fourier series.

UNIT – III Integral Transforms: Introduction- Definition – Fourier integrals – Fourier integral theorem (without proof)-Fourier sine and cosine integrals – complex form of Fourier integral - Fourier Transforms - Properties of Fourier Transforms - Finite Fourier sine and cosine transforms - Convolution theorem (without proof), Parseval's Identity for Fourier Transforms(without proof)

UNIT-IV Numerical Solutions of Equations: Introduction - Solution of Algebraic and Transcendental Equations - Bisection method-Newton- Raphson Method - Solutions of linear Simultaneous Linear Equations: iterative Methods - Gauss-Seidel Method

UNIT-V Finite Differences and Interpolation: Finite Differences – Differences of a polynomial – factorial notation – relations between operators – Newton's Interpolation formulae – central difference interpolation formulae - Gauss interpolation formulae – stirlings formula - interpolation with unequal intervals – Lagranges interpolation – inverse interpolation

TEXT BOOK:

1) B.S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers,

REFERENCE BOOKS:

1) N.P. Bali, A textbook of Engineering Mathematics, Laxmi publications
2) Erwin Kreyszig, Advanced Engineering Mathematics, 8th Edition, New Age International (P) Ltd
3) N.P. Bali, Satyanarayana Bhavanari and Indrani Kelker Engineering Mathematics– I BY Laxmi publications, New Delhi.
4) Engineering Mathematics-II ByT.K.V.Iyengar and B.Krishna Gandhi Etc.

CO-PO/PSO MAPPING MATRIX:

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

EE212 (R20): DIGITAL LOGIC DESIGN

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the concepts and principles of number systems and codes, including decimal, binary, hexadecimal, BCD, Excess-3, Gray and alphanumeric codes.
- Design and analyze combinational logic circuits using Boolean algebra, logic gates, universal gates, K-maps and NAND/NOR implementations.
- Design and analyze sequential logic circuits using latches, flip-flops, state tables and diagrams, counters and FSMs.
- Apply synchronous sequential circuit design steps, state assignment, state minimization and ASM charts to design circuits that meet given specifications.
- Compare and evaluate different IC logic families, including RTL, DTL, TTL, ECL and IIL, based on their characteristics, advantages and disadvantages.

UNIT-I

NUMBER SYSTEMS AND CODES: Decimal, Binary, Hexadecimal Number Systems and their Conversions Arithmetic Additions Subtraction using the method of Complements, Multiplication and Division Codes: BCD, Excess-3, Gray and Alphanumeric Codes

BOOLEAN ALGEBRA: Boolean Expressions and Theorems, Logic Gates, Universal Gates, Canonical and Standard forms, Boolean functions, Simplification of Boolean functions using K maps, Minimal Functions and their properties, Tabulation Method NAND and NOR Implementations Two Level and Multi Level

UNIT-II

COMBINATIONAL LOGIC CIRCUITS: EX-OR EX-NOR Circuits, General procedure **for combinational logic circuits, design and application of binary** Adders and Subtractors, Comparators, Encoders, Decoders Multiplexers and Demultiplexers, Design of BCD to 7 Segment Decoder, Parity Generator and Checker, BCD Adder/Subtractor, Carry Look Ahead Adders

UNIT-III

SEQUENTIAL LOGIC CIRCUITS: **Latches, characteristic table, characteristic** Equation, Excitation Table, State table and State Diagrams for SR, JK, Master Slave JK, D and T flip-flops, Conversion from one type of Flip-Flop to another, shift registers, Analysis and Synthesis of Sequential Circuits, Sequence Generator, Sequence detector, Parity Generator

COUNTERS USING FLIP-FLOPS: Design of Ripple Counters, **Synchronous** Counter Up/Down Counters using Flip-Flops.

UNIT-IV

SYNCHRONOUS SEQUENTIAL CIRCUITS: Basic Design Steps, Sate Assignment Problem, Mealy State Model, Serial Adder Example, State Minimization, Design of a Counter using the Sequential Circuit Approach, FSM as an Arbiter Circuit, Analysis of Synchronous Sequential Circuits, ASM Charts, Formal Model for Sequential Circuits.

UNIT V

IC LOGIC FAMILIES: RTL, DTL, TTL, ECL and IIL families and their comparison

TEXT BOOKS:

1. M Morris Mano and Micael D. Ciletti, Digital Design, Pearson Education, 2008
2. Digital Principles and Design, Donald D. Givone, TMH,20Cb

REFERENCE BOOKS:

1) Thomas L. Floyd, Digital Fundamentals 7th Edition, Pearson
2) Charles H. Roth jr., Fundamentals of logic Design, Jaico publications, 1992
3) Taub and Schilling, Digital Integrated Electronics.

CO-PO/PSO MAPPING MATRIX:

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

EE213 (R20): ELECTRICAL CIRCUIT ANALYSIS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Apply network theorems (Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem) to solve electrical circuits.
- Analyze first and second-order networks using differential equations and understand the steady-state and transient response of the circuits.
- Analyze sinusoidal steady-state circuits using phasor diagrams, impedances and admittances, AC circuit analysis and three-phase circuits.
- Apply Laplace transform techniques to analyze electrical circuits for standard inputs, convolution integral, inverse Laplace transform and transfer function representation.
- Understand the concept of two-port networks, their parameters (impedance, admittance, transmission and hybrid parameters) and interconnections of two-port networks.

UNIT-I: Network Theorems (10 Hours) Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

UNIT-II: Solution of First and Second order networks (8 Hours) Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT-III: Sinusoidal steady state analysis (8 Hours) Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT-IV: Electrical Circuit Analysis Using Laplace Transforms (8 Hours) Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

UNIT-V: Two Port Network and Network Functions (6 Hours) Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

TEXT / REFERENCE BOOKS:

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

CO-PO/PSO MAPPING MATRIX:

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

EE214 (R20): ELECTRICAL MACHINES-I

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the fundamental principles of network theorems, including superposition, Thevenin, Norton, maximum power transfer, reciprocity and compensation and apply them to analyze complex circuits.
- Analyze first and second-order electrical circuits using techniques such as node and mesh analysis and determine the steady-state and transient response of the circuits.
- Understand the concept of phasors and sinusoidal steady-state analysis, including the use of impedance and admittance to solve AC circuits and analyze three-phase circuits and ideal transformers.
- Use Laplace transforms to analyze electrical circuits with initial conditions and determine the transfer function representation, poles and zeros and frequency response of circuits.
- Understand the operation and characteristics of DC machines and transformers, including their construction, magnetic circuit analysis, armature winding and commutation and speed control and be able to analyze and test these devices in practical applications.

UNIT-I: Electromagnetic force and torque (9 Hours) B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

UNIT-II: DC machines (8 Hours) Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

UNIT-III: DC machine - motoring and generation (7 Hours) Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.

UNIT-IV Transformers (12 Hours) Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses

UNIT-V Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing

TEXT / REFERENCE BOOKS:

1) A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2) A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004
3) M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4) P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011. 5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

CO-PO/PSO MAPPING MATRIX:

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

EE215 (R20): ANALOG ELECTRONIC CIRCUITS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and design simple circuits using P-N junction diodes and understand their I-V characteristics.
- Describe the operation of half-wave and full-wave rectifiers using diodes and analyze their performance.
- Explain the function of Zener diodes and their use in voltage regulation circuits.
- Design and analyze BJT circuits as amplifiers and switches, including common-emitter, common-base and common-collector configurations.
- Design and analyze MOSFET circuits as amplifiers and switches, including common-source, common-gate and common-drain configurations.
- Diode circuits (4 Hours) P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes.

UNIT-I: BJT circuits (8 Hours) Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.Clamping and clipping circuits

UNIT-II: MOSFET circuits (8 Hours) MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

UNIT-III: Differential, multi-stage and operational amplifiers (8 Hours) Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

UNIT-IV: Linear applications of op-amp (8 Hours) Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

UNIT-V: Nonlinear applications of op-amp (6 Hours) Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

TEXT / REFERENCE BOOKS:

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

CO-PO/PSO MAPPING MATRIX:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
O1	2	2	-	3	3	-	-	2	-	-	-	2	3	1
CO2	3	3	2	3	3	-	-	3	-	-	-	2	3	1
CO3	-	2	-	2	-	-	-	3	-	-	-	2	3	1
CO4	3	3	-	3	3	-	-	3	-	-	-	2	3	1
CO5	2	2	2	2	-	-	-	-	-	-	3	3	2	1

CS/EC/EE 216 (R20): PROFESSIONAL ETHICS AND HUMAN VALUES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to-

- Understand and appreciate the importance of integrity, work ethic and service learning in professional engineering practice.
- Develop an awareness of the moral issues and ethical dilemmas that arise in engineering and be able to apply ethical theories to real-world situations.
- Recognize the social and environmental impacts of engineering and understand the responsibility that engineers have to society and the environment.
- Be able to analyze and assess risks and benefits associated with engineering projects and make informed decisions that prioritize safety and social responsibility.
- Develop the skills to communicate effectively with colleagues, clients and other stakeholders and to work collaboratively and respectfully in team settings.

UNIT – I

Human Values: 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: Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT – III

Engineering as Social Experimentation: Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT - IV

Safety, Responsibility and Rights: Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and reducing risk.

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: 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 (ISTE), India, etc.

TEXT BOOKS:

1) R.S. Naagarazan "A Textbook on Professional ethics and Human Values", New Age International Publihers, 2006.
2) Govindarajan. M, Natarajan. S, Senthilkumar. V.S, "Engineering Ethics", Prentice Hall of India, 2004.

REFERENCE BOOKS:

1) Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Jersey, 2004 (Indian Reprint).
2) Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, United States, 2000 (Indian Reprint now available).
3) John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

CO-PO/PSO MAPPING MATRIX:

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

EE 251 (R20): ELECTRICAL CIRCUIT ANALYSIS LAB

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Develop the skills to analyze two-port networks using Z, Y, h and transmission line parameters.
- Understand the principle of superposition theorem and be able to use it to simplify complex circuits.
- Understand the principles of Thevenin's and Norton's theorems and be able to use them to analyze and design circuits.
- Understand the principle of reciprocity theorem and be able to use it to analyze and design circuits.
- Develop the skills to design and analyze RL, RC and RLC series circuits and to apply software tools for steady-state analysis, verification of theorems and locus diagrams.

LIST OF EXPERIMENTS:

1) Determination of Z, Y Parameters of a two port network
2) Determination of h, Transmission line Parameters of a Two port network.
3) Verification of Superposition theorem
4) Verification of Thevenin’s &Norton’s theorem
5) Verification of Reciprocity theorem
6) Verification of Maximum Power Transfer theorem
7) Determine the parameters of Choke coil
8) Measurement of low and medium resistance using volt ampere method
9) Locus diagram of RL series circuit
10) Determination of self, mutual inductance and coefficient of coupling.
11) Steady state analysis of RL, RC and RLC series circuits using software
12) Verification of Superposition theorem using software
13) Verification of Thevenin’s and Norton’s theorem using software
14) Verification of Maximum Power Transfer theorem DC and AC circuits using software
15) Locus diagram of RL and RC series circuit using software
16) Series and parallel resonance.
17) Note: Minimum 10 experiments should be carried out.

CO-PO/PSO MAPPING MATRIX:

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

EE252 (R20): ELECTRICAL MACHINES-I LAB

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and design speed control systems for DC shunt motors using different methods such as field control, armature control and voltage control.
- Explain the principle of separately excited and self excited DC shunt generators and determine their open circuit characteristics.
- Perform Swinburne's test to determine the efficiency and losses of DC shunt machines.
- Conduct load tests on DC shunt generators and compound generators to determine their performance characteristics.
- Evaluate the performance of DC series generators and analyze their load characteristics.

LIST OF EXPERIMENTS:

1) Speed control of DC shunt motor.
2) Open circuit characteristics of separately excited / self excited D.C shunt generator.
3) Swinburne’s Test on a D.C Shunt Machine.
4) Load test on D.C Shunt Generator.
5) Load test on D.C Compound Generator.
6) Load test on D.C series generator.
7) Brake test on D.C Shunt Motor
8) Hopkinson’s test on Two Identical D.C Machines
9) Retardation test on D.C. Machine.
10) Field test on two identical DC series machine.
11) OC & SC tests on single - phase transformer.
12) Load test on single - phase transformer.
13) Scott Connection of Transformers
14) Parallel Operation of Two Single - Phase Transformers.
15) Separation of losses in single – phase transformer.
16) Sumpner’s test or Back to Back test on Identical Transformers.

Note: Minimum 10 experiments should be carried out.

CO-PO/PSO MAPPING MATRIX:

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

EE253 (R20): ELECTRONICS LAB

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the characteristics and applications of semiconductor devices such as PN junction diodes, Zener diodes, transistors, JFETs and MOSFETs.
- Analyze and design rectifiers, wave-shaping circuits and voltage amplifiers using semiconductor devices.
- Design combinational logic circuits such as half-adders, full-adders and decoders using gates and universal building blocks.
- Design and analyze sequential logic circuits such as flip-flops and counters.
- Develop the ability to use software tools such as SPICE to simulate and verify the behavior of electronic circuits.

LIST OF EXPERIMENTS:

1) Characteristics of PN Junction and Zener diode
2) Full wave rectifier with and without filter
3) *Non-linear wave shaping – clippers
4) Characteristics of Transistor in Common Emitter configuration
5) Verification of Transistor Self Bias Circuit
6) Characteristics of Junction Field Effect Transistor, MOSFET.
7) Design of voltage shunt feedback amplifier.
8) Design of RC phase shift oscillator.
9) Realization of Gates using Discrete Components & Universal Building Block (NAND only).
10) Design of Combinational Logic Circuits like Half-adder, Full-adder and Full- Subtractor.
11) Design of Code Converters, Multiplexers and Decoder.
12) Verification of Truth-Table of Flip-Flops using Gates &Conversion of flip-flops (JK-T, JK-D).
13) Design of ring& Johnson counters using flip-flops.

Note: Minimum 10 experiments should be carried out.*Compulsory Experiment

CO-PO/PSO MAPPING MATRIX:

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

SEMESTER IV

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-IV

EE221 (R20): ELECTROMAGNETIC FIELD THEORY

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the basic concepts of electrostatics, including Coulomb's Law, electric field intensity, electric flux density and Gauss's Law.
- Calculate the electric fields due to various types of continuous charge distributions, including line charges, surface charges and volume charges.
- Determine the capacitance of various types of systems, such as parallel plates, spherical conductors and coaxial cables.
- Apply Ampere's Circuital Law and Biot-Savart's Law to calculate magnetic fields and forces in steady magnetic fields.
- Understand the behavior of time-varying fields and be able to use Faraday's Law and Maxwell's Equations to calculate induced EMF and the propagation of electromagnetic waves.

UNIT – I

Electrostatics-I: Coulomb's Law and Field Intensity - Electric Fields due to Continuous Charge Distributions – Line Charge, Surface Charge, Volume Charge - Electric Flux Density - Gauss Law – Applications of Gauss Law – Point Charge, Infinite Line Charge, Infinite Sheet Charge, Uniformly Charged Sphere - Electric Potential - Relations Between E and V - Illustrative Problems.

UNIT – II

Electrostatics-II: The nature of dielectric materials, boundary conditions for perfect dielectric materials. Capacitance. Several capacitance examples. Capacitance of a two wire line. Derivations of Poisson's and Laplace's equations, Examples of the solution of Laplaces equation. Current and current density, continuity of current, conductor properties and boundary conditions - Illustrative Problems.

UNIT – III

The Steady Magnetic Field: Biot-Savart's Law, Ampere's Circuital Law Magnetic Flux and Magnetic Flux Density, The scalar and vector magnetic potentials.

Magnetic Forces and Materials: Force on a moving charge, force on a differential current element, force between differential current elements, force and torque on a closed circuit, the nature of magnetic materials, magnetization and permeability, magnetic boundary conditions. Potential energy in magnetic fields. -Illustrative Problems.

UNIT – IV

Time Varying Fields and Maxwell's Equations: Faraday's Law - Transformer and Motional EMFs – Stationary Loop in Time Varying B Field, Moving Loop in Static B Field, Moving Loop in Time Varying Field - Displacement Current – Maxwell's Equations in Different Final Forms - Illustrative Problems.

UNIT – V

The Uniform Plane Wave: Waves in General – Wave Propagation in Lossy Dielectrics – Plane Waves in Lossless Dielectrics – Plane Wave in Free Space – Plane Waves in Good Conductors - Power and the Poynting Vector - Reflection of a Plane wave at Normal Incidence - Reflection of a Plane wave at Oblique – Parallel Polarization, Perpendicular Polarization - Illustrative Problems.

TEXT BOOKS:

1) Matthew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 3rd edition, 2008.
2) William H. Hayt Jr. and John A. Buck, Engineering Electromagnetics, Tata McGraw-Hill publications, 7th edition, 2006.
3) G S N Raju, Electromagnetic Field Theory and transmission lines, 1st Edition, Pearson Education India, 2005.

REFERENCE BOOKS:

1) E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, PHI, 2nd Edition, 2000
2) John D. Krauss, Electromagnetics, Tata McGraw-Hill publications, 4th edition, 1991.
3) Schaum'sout line series, Electromagnetics, 2nd edition, Tata McGraw-Hill publications, 2006.

CO-PO/PSO MAPPING MATRIX:

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

EE222 (R20): POWER SYSTEMS-I

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the layout and functioning of thermal, hydroelectric and nuclear power stations.
- Analyze the economic aspects of power generation, including factors affecting cost and methods of reducing it.
- Calculate the parameters of transmission lines and their effects on regulation and efficiency.
- Apply different methods of solution to transmission line problems, such as Pie, T and rigorous methods.
- Evaluate the characteristics of insulators, travelling waves, corona and underground cables and their impact on transmission line performance.

UNIT – I

Thermal power stations: Selection of site for thermal station – layout and salient features - boilers – economizers – condensers – coal handling – feed water treatment - steam turbines – turbo generators. **Hydroelectric Stations:** Hydrology – hydrographs – mass curves – classification of hydroelectric plants - general arrangement and operation of hydroelectric plants and its function.

Nuclear Power Stations: Principles of nuclear power station – basic factors in designing of reactors – pressurized water reactor – boiling water reactor – CANDU reactor – liquid metal cooled reactor – shielding and safety precautions.

UNIT – II

Economic Aspects: Economics of generation - factors affecting cost of generation - Definitions: load factor – diversity factor – plant use factor –Load curve - load duration curve – problems. Reduction of cost by inter connected stations.

Transmission line parameters: Resistance-Skin effect-Expressions for inductance and capacitance of single phase and 3-phase lines of symmetrical and transposed configurations - concept of self GMD (GMR) and mutual GMD - double circuit lines and bundled conductors - effect of ground on capacitance.

UNIT – III

Transmission line theory: Short, medium and long lines - regulation and efficiency - Pie, T and rigorous methods of solution - ABCD constants - sending and receiving end power angle equations and power circle diagrams. Surge impedance loading - Ferranti effect.

UNIT – IV

Insulators: Types of insulators - voltage distribution in a string of suspension insulators.

Travelling wave Phenomenon: Travelling waves on transmission lines, attenuation of travelling waves

Corona: Factors effecting corona, critical voltages and power loss, Radio Interference.– Methods of reducing corona,

UNIT – V

Underground Cables: Types of cables - laying of cables - insulation resistance - electric stress and capacitance of single core cable - use of inter sheath - capacitance grading - capacitance of three core belted type cable - stress in a three core cable - sheath effects - currents in bonded sheaths - electrical equivalent of sheath circuit - thermal characteristics of cables.

TEXT BOOKS:

1) Generation of Electric Power by B.R. Gupta S. Chand & Company Ltd
2) Generation distribution and utilization of electrical energy by C.L.Wadhwa, New Age Internations (P)
3) Limited, 2005 Reference
4) Electrical power systems by C.L. Wadhwa, New age International (P) Limited 3rd edition
5) Modern power system analysis by D.P. Kothari & I.J. Nagrath McGraw Hill 3rdedition,2003
6) Electric power transmission and distribution by Sivanagaraju and Satyanarayana, Pearson Education

REFERENCE BOOKS:

1) Electrical power systems theory and practice by M. N. Bandyopadhyay – PHI.
2) Transmission and Distribution by H. Cotton B. I. Publishers, New Delhi, 1998.
3) Electric Power Generation, Transmission & Distribution by S.N. Singh, PHI, 2003.

CO-PO/PSO MAPPING MATRIX:

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

EE223 (R20): ELECTRICAL MACHINES-II

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Explain the principles of magnetic fields and their behavior in windings, including the production of pulsating and revolving magnetic fields.
- Analyze the construction, operation and performance characteristics of different types of induction machines, including squirrel cage and slip-ring motors.
- Apply knowledge of equivalent circuits and phasor diagrams to analyze the losses, efficiency and torque-speed characteristics of induction motors.
- Evaluate the operation and performance of synchronous machines, including their construction, armature reaction, voltage regulation and power angle characteristics.
- Demonstrate an understanding of the principles of parallel operation of alternators and the operation and characteristics of synchronous motors, including starting methods, V-curve analysis and torque equations.

UNIT I: Pulsating and revolving magnetic fields (4 Hours) Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

UNIT II: Induction Machines (12 Hours) Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

UNIT III: Single-phase induction motors (6 Hours) Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

UNIT IV: Synchronous machines (10 Hours) Constructional features, cylindrical rotor synchronous machine –armature windings, pitch factor, distribution factor- generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation- two reaction theory, analysis of phasor diagram, power angle characteristics.
UNIT V: Parallel operation of alternators - synchronization and load division. Principle of operation of synchronous motors-starting methods- Operating characteristics of synchronous machines V & inverted V curves-Hunting-Torque equation-Synchronous condensers.

TEXT/REFERENCE BOOKS:

1) A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2) M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3) P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4) I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5) A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6) P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

CO-PO/PSO MAPPING MATRIX:

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

EE224 (R20): MICRO PROCESSOR & MICRO CONTROLLERS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the fundamental principles of microprocessors and microcomputers.
- Develop assembly language programs for the 8086 microprocessor and design interfaces for different types of peripheral devices.
- Understand the different addressing modes and instruction descriptions of the 8086 microprocessor and its interrupts and interrupt responses.
- Design analog and digital interfaces using programmable devices such as DACs, parallel ports and RS232 communication standards.
- Develop programs and interfaces for microcontrollers such as the 8051, including programming in assembly language, using timers and counters and interfacing with various peripherals.

UNIT – I

Microprocessors: Introduction to microcomputers and microprocessors, introduction and architecture of 8086 family, addressing modes, instruction description and assembler directives of 8086 microprocessors.

UNIT - II

8086 Programming and System Connections: Program development steps, writing programs for use with an assembler, assembly language program development tools, writing and using procedures and assembler macros. 8086 interrupts and interrupt responses.

UNIT - III

Digital Interfacing: Programmable parallel ports, handshake IO, interface Microprocessor to keyboards. **Analog interfacing:** DAC principle of operation, specifications and different types of DAC's and interfacing.

Programmable devices: Introduction to Programmable peripheral devices 8255, 8254, 8259, 8251, DMA data transfer, RS232 communication standard.

UNIT-IV

Micro controllers: Introduction to Micro controllers, comparing microprocessors and microcontrollers Architecture of 8051, Registers, Pin configuration of 8051, I/O Ports, Memory Organization, Addressing Modes.

UNIT - V

Programming & Interfacing 8051- Instruction set, Assembly language Programming, Counters & Timers, Serial data Communication – Interrupts, Interfacing of 8051 – keyboard, Displays, ADC converters.

TEXT BOOKS:

1) Microprocessor architecture programming & applications with the 8085, S.Ramesh Gaonkar, PRI Publishers. 6th Edition
2) Advanced Microprocessors & Peripheral interfacing, Ray Bhurchandi, 3rd edition, MC graw hill Publications.
3) The INTEL Microprocessors, Brey, 6th edition, PHI Publishers.
4) The 8051 Microcontroller and architecture, Kenneth J. Ayala, PRI Publishers 2nd edition.

REFERENCE BOOKS:

1) Microprocessor and Microcontrollers, N.Senthil Kumar, M.Saravanan, S.Jeevanathan, Oxford Publishers. 1st Edition, 2010
2) The X86 Microprocessors , Architecture, Programming and Inerfacing, Lyla B. Das, Pearson Publications, 2010

CO-PO/PSO MAPPING MATRIX:

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

EC/EE225 (R20): OBJECT ORIENTED PROGRAMMING THROUGH JAVA

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

- Students will be able to understand the principles of Object Oriented Programming (OOP) and differentiate between procedural and OOP paradigms.
- Students will be able to create Java programs using various data types, variables, constants, operators and expressions.
- Students will be able to design and implement inheritance hierarchies in Java, use polymorphism and create abstract classes and methods.
- Students will be able to create interfaces, implement them and use them to access implementations through interface references.
- Students will be able to handle exceptions in their Java programs, create and synchronize threads and perform input/output operations on files.

UNIT – I: OOPS CONCEPTS AND JAVA PROGRAMMING

OOP concepts: procedural and object oriented programming paradigm, Class and object, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism.

Java programming: History of java, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow statements, jump statements, simple java programs, arrays, console input and output, formatting output, constructors ,methods, parameter passing, static fields and methods, access control, this reference, overloading methods and constructors, recursion, garbage collection, exploring string class.

UNIT – II INHERITANCE

Inheritance: Inheritance hierarchies, super and subclasses, member access rules, super keyword, preventing inheritance: final classes and methods, the object class and its methods;

Polymorphism: dynamic binding, method overriding, abstract classes and methods.

UNIT-III INTERFACES AND PACKAGES

Interface: Interfaces VS Abstract classes, defining an interface, implement interfaces, accessing implementations through interface references, extending interface.

Packages: Defining, creating and accessing a package, understanding CLASSPATH, importing packages

UNIT-IV EXCEPTION HANDLING AND MULTI THREADING

Exception Handling: Benefits of exception handling, the classification of exceptions, exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, rethrowing exceptions, exception specification, built in exceptions, creating own exception sub classes.

Multithreading: Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter thread communication.

UNIT-V FILES

IO Programming: Introduction to Streams, Byte Streams, Character stream, Readers and Writers, File Class, File Input Stream, File Output Stream, Input Stream Reader, Output Stream Writer, File Reader, File Writer, Buffered Reader, random access file operations.

TEXT BOOKS:

1) Herbert Schildt and Dale Skrien, "Java Fundamentals –A comprehensive Introduction", McGraw Hill, 1stEdition, 2013.
2) Herbert Schildt, "Java the complete reference", McGraw Hill, Osborne, 11th Edition, 2018.
3) T.Budd, "Understanding Object-Oriented Programming with Java", Pearson Education, Updated Edition (New Java 2 Coverage), 1999.

REFERENCE BOOKS:

1) P.J. Dietel and H.M. Dietel, "Java How to program", Prentice Hall, 6th Edition, 2005.
2) P.Radha Krishna, "Object Oriented programming through Java", CRC Press, 1st Edition, 2007.
3) S.Malhotra and S. Choudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2014

WEB REFERENCE BOOKS:

1) http://java.sun.com
2) http://www.oracle.com/technetwork/java/index.html)
3) http://java.sun.com/javase

E-TEXT BOOKS:

1) http://docs.oracle.com/javase/tutorial/
2) iiti.ac.in/people/~tanimad/JavaTheCompleteReference.pdf
3) https://www.codejava.net/books/4-best-free-java-e-books-for-beginners

CO-PO/PSO MAPPING MATRIX:

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

EE261 (R20): ELECTRICAL MACHINES – II LAB

L-0	T-0	P-3	M-100	C-1.5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the basic principles and operation of various types of motors and generators, including squirrel-cage induction motors, slip-ring induction motors, synchronous motors and alternators.
- Develop skills in conducting laboratory experiments to measure and analyze the performance characteristics of motors and generators, such as load tests, no-load and blocked rotor tests, separation of losses and V and inverted V curves.
- Learn to interpret experimental data and apply theoretical concepts to determine equivalent circuits, regulation, synchronization and real power flow control of motors and generators.
- Develop proficiency in using measurement instruments and tools for motor and generator testing, such as power analyzers, torque transducers and tachometers.
- Gain practical experience in troubleshooting and maintenance of motors and generators through experimentation and analysis of test results.

LIST OF EXPERIMENTS:

1) Load test on Squirrel-Cage Induction motor.
2) Load test on Slip-Ring Induction motor.
3) No-load and Blocked rotor test on 3-phase induction motor.
4) Separation of losses of 3-phase Induction motor.
5) Brake test on single - phase induction motor.
6) Determination of Equivalent circuit of single - phase induction motor.
7) Real Power flow Control of 3-Phase Induction Generator.
8) Regulation of alternator by EMF &MMF method.
9) Regulation of alternator by ZPF method.
10) Synchronization of alternator with infinite bus with P & Q control.
11) Load test on Alternator.
12) Measurement of Xd and Xq of a three phase alternator.
13) V and inverted V curves of synchronous motor.
14) Synchronous Motor performance with constant excitation.
15) Load test on Universal Motor.
16) Load test on AC Series Motor.

Note: Minimum 10 experiments should be conducted.

CO-PO/PSO MAPPING MATRIX:

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

EE 262 (R20): MICROPROCESSOR & MICROCONTROLLERS LAB

L-0	T-0	P-3	M-100	C-1.5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Gain practical experience in programming and implementing algorithms in Assembly language for the 8086 microprocessor.
- Understand the various instructions and addressing modes available in 8086 microprocessor architecture.
- Learn the basics of interrupt handling in 8086 microprocessor and write programs using software and hardware interrupts.
- Gain hands-on experience in interfacing peripheral devices like DAC, stepper motor, keyboard and LCD using 8051 microcontroller.
- Develop programs to transfer data between two PCs using RS.232 C serial port and gain an understanding of its applications.

LIST OF EXPERIMENTS:

Experiments Based on ALP (8086)

1) Programs on Data Transfer Instructions.
2) Programs on Arithmetic and Logical Instructions.
3) Programs on Branch Instructions.
4) Programs on Subroutines.
5) Sorting of an Array.
6) Programs on Interrupts (Software and Hardware).
7) 8086 Programs using DOS and BIOS Interrupts.

EXPERIMENTS BASED ON INTERFACING & MICROCONTROLLER (8051)

1) DAC Interface-Waveform generations.
2) Stepper Motor Control.
3) Keyboard Interface / LCD Interface.
4) Data Transfer between two PCs using RS.232 C Serial Port
5) Programs on Data Transfer Instructions using 8051 Microcontroller.
6) Programs on Arithmetic and Logical Instructions using 8051 Microcontroller.
7) Applications with Microcontroller 8051.

CO-PO/PSO MAPPING MATRIX:

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

EE 263 (R20): COMMUNICATIVE ENGLISH LAB II

L-0	T-0	P-3	M-100	C-1.5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the different types of communication and identify their characteristics.
- Analyze and overcome barriers to effective communication.
- Demonstrate strategies for effective communication in various situations.
- Identify and interpret nonverbal communication cues, including body language, kinesics, facial expressions, proxemics, oculesics, haptics and chronemics.
- Develop employability skills, such as interview skills, group discussion and resume writing and apply them in real-world scenarios.

MODULE-L COMMUNICATION SKILLS:

I. Verbal

a) Types of Communication

b) Barriers to Communication

c) Strategies for effective communication

II. Nonverbal Skills -

a) Body Language – Voluntary and Involuntary

b) Kinesics

c) Facial Expressions

d) Proxemics

e) Oculesics

f) Haptics and Chronemics

MODULE-2: ADVANCED VOCABULARY:

a) Word list (GRE & TOEFL related)

b) One Word Substitutes

c) Idioms

MODULE-3: EMPLOYABILITY SKILLS (REF: 6):

a) Interview Skills

b) Group Discussion

c) Resume Writing

MODULE-4: TELEPHONIC SKILLS:

a) Formal & Informal interaction

b) Receiving Messages & Complaints

c) Tone modulation

MODULE-5: DESCRIPTIONS:

a) Process Description
b) Pictures
c) Narration

MODULE-6: BEHAVIOURAL SKILLS:

a) Emotional Intelligence
b) Positive Attitude
c) Team Work
d) Organization Skills

CO-PO/PSO MAPPING MATRIX:

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

EE 264 (R20): OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB

L-0	T-0	P-3	M-100	C-2

COURSE OUTCOMES:

After completion of this course, students will be able to

- Develop proficiency in programming fundamentals using Java
- Demonstrate the ability to write programs that use control structures, loops and arrays
- Implement object-oriented programming concepts such as classes, objects, inheritance and polymorphism
- Utilize interfaces and abstract classes to develop modular and maintainable code
- Demonstrate the ability to work with files and multithreaded programming in Java.

WEEK-1 BASIC PROGRAMS

1) Write java programs to find the following
   a) largest of given three numbers
   b) reverses the digits of a number
   c) given number is prime or not
   d) GCD of given two integers
2) Try debug step by step with small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
3) Write a java program that prints all real solutions to the quadratic equation ax2+bx+c=0. Read in a, b, c and use the quadratic formula.
4) The Fibonacci sequence is defined by the following rule. The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a java program that uses both recursive and non recursive functions.

WEEK-2 MATRICES, OVERLOADING, OVERRIDING

1) Write a java program to multiply two given matrices.
2) Write a java program to implement method overloading and constructors overloading.
3) Write a java program to implement method overriding.

WEEK-3 PALINDROME, ABSTRACT CLASS

1) Write a java program to check whether a given string is palindrome.
2) Write a java program for sorting a given list of names in ascending order.
3) Write a java program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape

WEEK-4 INTERFACE

1) Write a program that creates a user interface to perform integer division. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 and Num2 were not integers, the program would throw a Number Format Exception. If Num2 were zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box.

WEEK-5 MULTITHREADING

1) Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
2) Write a java program that correct implements of producer consumer program
3) Write a program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.

WEEK-6 FILES

1) Write a java program that reads a file name from the user and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
2) Write a java program that displays the number of characters, lines and words in a text file.
3) Write a java program that reads a file and displays the file on the screen with line number before each line.

REFERENCE BOOKS:

1) P. J. Deitel, H. M. Deitel, "Java for Programmers", Pearson Education, PHI, 4th Edition, 2007.
2) 2. P. Radha Krishna, "Object Oriented Programming through Java", Universities Press, 2nd Edition, 2007
3) Bruce Eckel, "Thinking in Java", Pearson Education, 4thEdition, 2006.
4) Sachin Malhotra, Saurabh Chaudhary, "Programming in Java", Oxford University Press, 5th Edition, 2010

CO-PO/PSO MAPPING MATRIX:

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

SEMESTER V

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-V

EE311 (R20): LINEAR CONTROL SYSTEMS

L-0	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the basic concepts of open-loop and closed-loop control systems and the types of feedback control systems.
- Develop mathematical models and transfer functions for physical systems, including differential equations, impulse response and signal flow graphs.
- Analyze control systems in the time domain, including transient response, error constants and stability analysis using Routh-Hurwitz criterion.
- Analyze control systems in the frequency domain using polar plots, Bode plots, Nyquist plots and root locus techniques.
- Understand the concepts of state space analysis, including state models, controllability and observability.

UNIT – I

Introduction: Basic concept of simple control system – open loop – closed loop control systems. Effect of feedback on overall gain – stability sensitivity and external noise. Types of feedback control systems – Liner time invariant, time variant systems and nonlinear control systems.

Mathematical models and Transfer functions of Physical systems

Differentialequations – impulse response and transfer functions – translational and rotational mechanical systems. Transfer functions and open loop and closed loop systems. Block diagram representation of control systems – block diagram algebra – signal flow graph – Mason's gain formula.

Components of control systems: DC servo motor – AC servo motor – synchro transmitter & receiver.

UNIT – II

Time domain analysis: Standard test signals – step, ramp, parabolic and impulse response function – characteristic polynomial and characteristic equations of feedback systems – transient response of first order and second order systems to standard test signals. Time domain specifications - steady state response – steady state error and error constants. Effect of adding poles and zeros on over shoot, rise time, band width – dominant poles of transfer functions.

Stability analysis in the complex plane: Absolute, relative, conditional, boundedinput – bounded output, zero input stability, conditions for stability, Routh –Hurwitz criterion.

UNIT - III

Frequency domain analysis: Introduction – correlation between time and frequency responses – polar plots – Bode plots – Nyquist stability criterion – Nyquist plots. Assessment of relative stability using Nyquist criterion – closed loop frequency response.

UNIT – IV

Root locus Technique: Introduction – construction of root loci Introduction to Compensation Techniques- Lag Compensation, Lead Compensation, Lag Lead Compensation.

UNIT-V

State space analysis: Concepts of state, state variables and state models –diagonalisation – solution of state equations – state models for LTI systems. Concepts of controllability and Observability.

TEXT BOOKS:

1) B.C. Kuo, Automatic control systems, 7th edition, PHI.
2) I.J.Nagrath & M Gopal, Control Systems Engineering, 3rd edition, New Age International.
3) K. Ogata, Modern Control Engineering, 3rd edition, PHI.

REFERENCE BOOKS:

1) Schaum Series, Feedback and Control Systems, TMH
2) M.Gopal, Control Systems Principles and Design, TMH
3) John Van de Vegta, Feedback Control Systems, 3rd edition, Prentice Hall,1993

CO-PO/PSO MAPPING MATRIX:

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

EE312 (R20): LICA& PULSE CIRCUITS

L-0	T-0	P-3	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the fundamental principles and characteristics of integrated circuits, including the analysis of differential amplifier circuits and the properties of various configurations.
- Analyze linear and nonlinear applications of operational amplifiers, such as inverting and non-inverting amplifiers, integrators, differentiators and precision rectifiers.
- Design and analyze active filters, including Butterworth filters and bandpass, band reject and all-pass filters and understand the application of special ICs such as the 555 timer and phase-locked loops.
- Understand the principles and operation of linear and nonlinear wave shaping circuits, including the response of RC circuits to different inputs and the use of clamping circuits with diodes.
- Analyze and design multivibrators using BJTs, including bistable, monostable and astable configurations, as well as understand the principles of sweep circuits and their applications.

UNIT I

INTEGRATED CIRCUITS:

Differential Amplifier- DC and AC analysis of Dual input Balanced output Configuration, Properties of other differential amplifier configuration (Dual Input Unbalanced Output, Single Ended Input – Balanced/ Unbalanced Output), DC Coupling and Cascade Differential Amplifier Stages, Level translator.

Characteristics of OP-Amps: Integrated circuits-Types, Classification, Package Types and Temperature ranges, Power supplies, Op-amp Block Diagram, ideal and practical Op- amp Specifications, DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR.

UNIT-II

LINEAR and NON-LINEAR APPLICATIONS OF OP-AMPS: Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non- Linear function generation, Comparators, Multivibrators, Triangular and Square wave generators, Precision rectifiers.

UNIT III:

ACTIVE FILTERS: Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters. IC 1496, Sample & Hold circuits.

APPLICATIONS OF SPECIAL ICS: The 555 timer, 555 as Monostable and Astable Multi vibrator and applications. Phase Locked Loops, Operating principles, Monolithic PLLs, 565 PLL applications.

UNIT – IV

LINEAR WAVE SHAPING: Responses of RC-high pass circuit and low pass circuits to sinusoidal, step, pulse, square, ramp and exponential inputs, Criteria for good differentiation and integration, Uncompensated and compensated attenuators, Ringing circuit.

NON-LINEAR WAVE SHAPING: Clipping circuits with diodes, Multi-diode circuits, Transient and steady state response of a diode clamping circuit, Clamping circuit theorem and Practical clamping circuits.

UNIT – V

MULTIVIBRATORS (using BJTs): Bistable Multivibrator: Fixed bias and self-bias transistor binary, Commutating capacitors, Non-saturated binary, Direct coupled binary, Unsymmetrical and Symmetrical triggering of binary, Schmitt Trigger circuit, Collector Coupled Monostable and Astable Multivibrators operation & design

SWEEP CIRCUITS: Voltage sweep circuits, Deviation from linearity expressed as errors, Exponential and Constant current charging voltage sweep circuits, Principles of Miller and Bootstrap Sweep circuits, Simple current sweep circuit.

TEXT BOOKS:

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

CO-PO/PSO MAPPING MATRIX:

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

EE313 (R20):POWER ELECTRONICS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the principles and characteristics of power devices such as SCR, SCS, LASER, DIAC, TRIAC, IGBT and MOSFET.
- Analyze and design different types of power converters such as single-phase and three-phase converters, including pulse width modulation control for power factor improvement.
- Analyze and design various types of inverters such as single-phase, three-phase, voltage source, current source and pulse width modulated inverters.
- Understand the principles and operation of choppers and cyclo converters and their applications.
- Apply advanced modulation techniques such as sinusoidal PWM, trapezoidal, staircase, stepped, harmonic injection and delta modulation for improved inverter performance.

UNIT-I

Power devices: SCR - Theory of operation of SCR - Two transistor model of SCR - Characteristics and ratings - SCR turn on and turn off methods - Protection of SCR - Series and parallel operation of SCRs - P-N-P-N devices - SCS, LASER, DIAC, TRIAC, IGBT, MOSFET and their characteristics – ratings - TRIAC triggering and turn off methods.

UNIT-II

Converters: Principles of phase controlled converter operation - single phase halfwave converters - single phase semi converter and single phase full converters with R, RL types of load - single phase dual converter - three phase half wave converters - three phase full wave converters - three phase dual converter with R, L loads - effects of source and load inductance - pulse width modulation control for PF improvement.

UNIT-III

Inverters: Principle of inverter operation - single phase inverters- series, parallel inverters - Mc Murray Bedford half bridge inverters - three phase inverters (120,180 modes of operation) - voltage source inverters - current source inverters - pulse width modulated inverters.

UNIT-IV

Choppers: Principle of choppers - step up and step down choppers – different classes of chopper circuits and their analysis - Speed control of DC motors.

Cyclo converters: Principle and operation of single - phase and three phase cycloconverters and applications.

UNIT-V

Voltage Control of Single Phase Inverters: Single PWM- Multiple PWM – Sinusoidal PWM- modified PWM- Phase displacement Control- Advanced modulation techniques for improved performance- Trapezoidal, staircase, stepped, harmonic injection and delta modulation- Advantage- application

TEXT BOOKS:

1) Power Electronics, circuits, devices and applications by M.H. Rashid Pearson 3rd edition, 2005
2) Power Electronics by M.D.Singh and Khanchandani TMH, 2nd Edition

REFERENCE BOOKS:

1) Power Electronics by P.S. Bhimbra Khanna Publications, 3rd Edition 2006.
2) Power Electronics by W. Launder 2ndedition,1993
3) Industrial Electronics & Robotics by Shaler & C.Menamee
4) Power Electronics – by Vedam Subramanyam, New Age International (P) Limited, 2nd edition 2006.

CO-PO/PSO MAPPING MATRIX:

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

EE314/1 (R20): DIGITAL SIGNAL PROCESSING

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Explain the fundamental principles of digital signal processing, including discrete-time signals, linear time-invariant systems and frequency domain analysis.
- Apply mathematical techniques, such as Z-transforms, to analyze and design digital filters and evaluate the stability and frequency response of a given system.
- Design and implement digital filters using different techniques, such as the impulse invariance transformation, frequency transformation and windowing methods.
- Understand and use the discrete Fourier transform (DFT) and fast Fourier transform (FFT) algorithms for analyzing and processing digital signals and evaluate their computational efficiency and accuracy.
- Compare and contrast different realizations of digital filters, such as direct, canonic, cascade, parallel and ladder realizations and select the most appropriate method based on the application requirements and system specifications.

UNIT – I

Discrete Signals and Systems: Introduction to digital signal processing, Advantages and applications, Discrete time signals, LTI system: Stability and causality, Frequency domain representation of discrete time signals and systems

UNIT – II

Z-Transforms: Z-transforms, Region of convergence, Z-transform theorems and properties, Parseval's relation, Relation between Z-transform and Fourier transform of a sequence, Inverse Z transform using Cauchy's integration theorem, Partial fraction method, Long division method, Solution of differential equations using one sided Z-transform, Frequency response of a stable system.

UNIT – III

DFT And FFT: Discrete Fourier Series, Properties of DFS, Discrete Fourier Transform, Properties of DFT, Linear convolution using DFT, Computations for evaluating DFT, Decimation in time FFT algorithms, Decimation in frequency FFT algorithm, Computation of inverse DFT.

UNIT – IV

IIR Filter Design Techniques: Introduction, Properties of IIR filters, Design of Digital Butterworth and Chebyshev filters using bilinear transformation, Impulse invariance transformation methods. Design of digital filters using frequency transformation method.

UNIT – V

FIR Filter Design Techniques: Introduction to characteristics of linear phase FIR filters, Frequency response, Designing FIR filters using windowing methods. Rectangular window, Hanning window, Hamming window, Generalised Hamming window, Bartlett triangular window, Comparison of IIR and FIR filters.

Realisation of Digital Filters: Direct, Canonic, Cascade, Parallel and Ladder realizations

TEXT BOOKS:

1) Lonnie C Ludeman, Fundamentals of Digital Signal Processing, John Wiley & Sons, 2003.
2) S K Mitra, Digital Signal Processing: A Computer Based Approach, 2nd Edition, TMH, 2003
3) Alan V Oppenheim and Ronald W Schafer, Digital Signal Processing, PearsonEducation/PHI, 2004.
4) P.RameshBabu, Digital Signal Processing, 2nd Edition, Scitech Publications, 2004.

REFERENCE BOOKS:

1) Johnny R. Johnson, Introduction to Digital Signal Processing, PHI, 2001.
2) Andreas Antoniou, Digital Signal Processing, TMH, 2006.
3) JohnG.Proakis, Dimitris G Manolakis, digital Signal Processing: Principles, Algorithms and Applications, Pearson Education / PHI, 2003

CO-PO/PSO MAPPING MATRIX:

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

EE314/2 (R20): ELECTRICAL MACHINE DESIGN

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the major considerations in electrical machine design, including electrical engineering materials, space factor, specific electrical and magnetic loadings and thermal considerations.
- Analyze and design transformers, including sizing, main dimensions, operating characteristics, regulation, no-load current and cooling methods.
- Analyze and design induction motors, including sizing, main dimensions, magnetic leakage calculations, leakage reactance, short circuit current and operating characteristics.
- Analyze and design synchronous machines, including sizing, main dimensions, design of salient pole machines, armature design, rotor design and design of field winding.
- Understand the need for computer-aided design (CAD) and the limitations of traditional designs and have an introduction to FEM-based machine design and complex structures of modern machines such as PMSMs, BLDCs, SRM and claw-pole machines.

UNIT-I

Introduction

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

UNIT-II

Transformers

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

UNIT-III

Induction Motors

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

UNIT-IV

Synchronous Machines

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

UNIT-V

Computer aided Design (CAD):

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

TEXT BOOKS / REFERENCE BOOKS:

1) K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2) M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London. S. K. Sen, "Principles of Electrical Machine Design with computer Programmes", Oxford and IBH Publishing, 2006.
3) K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan, 1969.
4) Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
5) K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

CO-PO/PSO MAPPING MATRIX:

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

EE314/3 (R20): ELECTRICAL ENERGY CONSERVATION AND AUDITING

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the major considerations in electrical machine design, materials used, thermal considerations and ratings of machines.
- Develop the skills to design transformers and calculate their operating characteristics, regulation, no-load current and temperature rise.
- Learn the design principles and calculations for induction motors, including magnetic leakage, short-circuit current, circle diagram and operating characteristics.
- Develop an understanding of the sizing and design of synchronous machines, including salient pole machines, armature design, field winding design and rotor design.
- Gain knowledge of computer-aided design (CAD) methods, design optimization and the limitations and assumptions of traditional designs, including modern machines such as PMSMs, BLDCs, SRM and claw-pole machines.

UNIT-I

Energy Scenario

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

UNIT-II

Basics of Energy and its various forms

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

UNIT-III

Energy Management & Audit

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

UNIT-IV

Energy Efficiency in Electrical Systems

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

UNIT-V

Energy Efficiency in Industrial Systems

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

TEXT/REFERENCE BOOKS:

1) Guide books for National Certification Examination for Energy Manager / Energy Auditors
   Book-1, General Aspects (available online)
2) Guide books for National Certification Examination for Energy Manager / Energy Auditors
   Book-3, Electrical Utilities (available online)
3) S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.

CO-PO/PSO MAPPING MATRIX:

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

EE315/1 (R20): WIND AND SOLAR ENERGY SYSTEMS

L-3	T-0	P-0	M-100	C-5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the basic principles of energy conversion for renewable energy technologies, including solar thermal conversion, fuel cells and bio energy conversion processes.
- Analyze the design aspects of solar cells and understand the upper limits of cell parameters, as well as factors that affect efficiency such as temperature and solar radiation.
- Evaluate thin film solar cell technologies, including their advantages, materials and fabrication techniques.
- Analyze wind energy systems, including the physics of wind power, wind speed statistics and generation schemes with variable speed turbines.
- Apply knowledge of renewable energy technologies to design and select appropriate systems for specific applications, including site and turbine selection for wind energy systems.

UNIT-I

Renewable Energy Technologies:

Basic principles of Energy conversion: Heat Energy Conversion Principles – Mechanical Energy Principles – Solar Radiation Conversion: Photovoltaic Conversion – Photo Electro Chemical Conversion – Solar Thermal Conversion – Fuel Cells – Basic Principles of Hydrogen – Oxygen fuel cell – factory effecting the Power output – Maximum Power output Bio Energy Conversion Process – Combustion and composting of Bio- Mass – Production of heat by bio-mass – Bio-logical Conversion into gaseous into liquid bio-fuels.

UNIT-II

Introduction to Solar Cells:

P-N Junction Under illumination: solar cell – generation of photo voltage – light generated current – I-V equation of solar cell – solar cell characteristics. Upper limits of cell parameters – short circuit current – open circuit voltage - Fill factor - efficiency –losses in solar cells – model of solar cell – effect of series –shunt Resistance on efficiency – effect solar radiation on efficiency -effect of temperature on efficiency – basic design aspects of solar cells.

UNIT-III

Thin film solar cell technologies:

Generic advantages of twin film technologies - materials for thin film technologies – thin film de position techniques – Common features thin film technologies.

Solar Photo Voltaic modules:

Solar PV modules from solar cells – series and parallel connection of cells – mismatch in series and parallel connection. Design and structure of PV modules: number of solar cells in a module – wattage of modules – fabrication of PV modules. PV module power output- I-V equation of P.V modules – ratings of P.V modules- I-V and Power curves of module. DC – DC convertors used in Solar systems – maximum power point tracking algorithms.

UNIT-IV:

WIND ENERGY SYSTEMS:

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-V:

Generation schemes with variable speed turbines: classification of schemes – operating area –Induction Generators-Doubly fed Induction generators-Equivalent circuits-Reactive power and harmonics-Double output system with VSI-Variable voltage, variable frequency generation-circuit model and steady state operation and characteristics- effect of wind generator on the network. Wind speed measurements-Wind speed statistics-site and turbine selection.

TEXT BOOKS:

1) Renewable Energy by Bent Sorensen, Academic Press, 4th edition.
2) Solar Photovoltaic fundamentals, Technology and applications, Chetan Singh Solanki, PHI Publications, 2nd edition
3) Wind Electrical Systems by S. N Bhadra, D. Kastha and S Banerjee, Oxford press publications

REFERENCE BOOKS:

1) Power plant technology by EL-Wakil, McGraw-Hill
2) Non-Conventional Energy Sources by G.D. Rai, Khanna Pub.
3) Renewable Energy Sources by John Twidell & Toney Weir : E & F.N. Spon
4) Renewable Energy Sources: Their impact on global warming and pollution by Abbasi & Abbasi.

CO-PO/PSO MAPPING MATRIX:

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CO4	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO5	2	1	3	2	2	-	-	-	2	1	-	1	3	2

EE315/2 (R20): DEMAND SIDE ENERGY MANAGEMENT

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the concepts and types of energy audit, including energy index, cost index, pie charts and Sankey diagrams.
- Gain knowledge of energy economics and analysis methods, such as cost-benefit analysis, payback period, depreciation, net present value method, internal rate of return method and profitability index for benefit-cost ratio.
- Learn about energy conservation strategies in electric utilities and industry, including load management, energy and load management devices, power factor improvement and energy conservation in industries and utilities by improving load factor and utility voltage regulation.
- Understand the construction and technical features of energy-efficient electric motors (EEMs) and their cost-effectiveness, performance characteristics and efficiency evaluation factor.
- Gain knowledge of energy management programs and methods for building analysis, system modifications and lighting and space heating, ventilation, air-conditioning (HVAC) and water heating, as well as combined cycle cogeneration and energy storage technologies.

Unit – I

Energy Audit: Definitions-Need-concepts-Types of energy audit; Energy index–cost index – pieharts–Sankey diagrams.

Energy Economics: Introduction-Cost benefit risk analysis-Payback period – Straight line depreciation-Sinking fund depreciation—Reducing balance depreciation-Net present value method-Internal rate of return method-Profitability index for benefit cost ratio.

Unit – II

Energy Conservation in Electric utilities and Industry: Electrical load management: Energy and load management devices-Conservation strategies; conservation in electric utilities and industry: Introduction-Energy conservation in utilities by improving load factor-Utility voltage regulation-Energy conservation in Industries - Power factor improvement.

Unit – III

Energy–efficient electric motors (EEMs) : Energy efficient motors – construction and technical features-case studies of EEMs with respect to cost effectiveness performance characteristics; Economics of EEMs ands ystem life cycle-direct savings and payback analysis-efficiency factor or efficiency evaluation factor.

Unit – IV

Electric Lighting: Introduction-Need for an energy management program-Building analysis-Modification of existing systems-Replacement of existing systems-priorities:

Illumination requirement: Task lighting requirements-lighting levels-system modifications-non illumination modifications-lighting for non-task areas-reflectances space geometry; System elements. Light sources - characteristics of families of lamps-lamp substitution in existing systems-selection of Higher efficiency lamps for a new system-Luminaries-ballasts energy conservation in lighting. White light LED and conducting Polymers.

Unit – V

Space Heating, Ventilation, Air-Conditioning (HVAC) and Water Heating:

Introduction-Heating of buildings-Transfer of Heat-Space heating methods Ventilation and air-conditioning-Insulation-Cooling load-Electric water heatingsystems-Energy conservation methods.

Co-generation and storage: Combined cycle cogeneration-energy storage: pumped hydro schemes-compressed air energy storage (CAES)-storage batteries super conducting magnetic energy storage (SMES)

TEXT BOOKS:

1) Electric Energy Utilization and Conservation by S C Tripathy, Tata McGrawhill publishing Company ltd., New Delhi
2) Energy conversion systems by Rakosh Das Begamudre New age international publishers
3) Energy efficient electric motors selection and application by John C.Andreas

CO-PO/PSO MAPPING MATRIX:

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

EE315/A (R20): ELECTRICAL MATERIALS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the free electron theory and Fermi-Dirac distribution for metallic conduction.
- Identify the types of semiconductors and explain the mechanism of conduction in them.
- Describe the different types of magnetic materials and their uses in electrical machines, instruments and relays.
- Analyze the behavior of dielectrics in static and alternating fields and factors influencing their dielectric strength.
- Evaluate the properties and applications of materials for special applications such as solar cells, fuel cells, batteries and coatings for enhanced solar thermal energy collection.

UNIT-I

CONDUCTING MATERIALS

Review of metallic conduction on the basis of free electron theory. Fermi-Dirac distribution – variation of conductivity with temperature and composition, materials for electric resistors-general electric properties; material for brushes of electrical machines, lamp filaments, fuses and solder.

UNIT-II

SEMICONDUCTORS

Mechanism of conduction in semiconductors, density of carriers in intrinsic semiconductors, the energy gap, types of semiconductors. Hall effect, compound semiconductors, basic ideas of amorphous and organic semiconductors.

UNIT-III

MAGNETIC MATERIALS

Classification of magnetic materials- origin of permanent magnetic dipoles, ferromagnetism, hard and soft magnetic materials, magneto materials used in electrical machines, instruments and relays.

UNIT-IV

DIELECTRICS INSULATING MATERIALS

DIELECTRICS: Dielectric, polarization under static fields- electronic ionic and dipolar polarizations, behavior of dielectrics in alternating fields, Factors influencing dielectric strength and capacitor materials. Insulating materials, complex dielectric constant, dipolar relaxation and dielectric loss.

INSULATING MATERIALS: Inorganic materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and bakelite), resins and varnishes, liquid insulators (transformer oil) gaseous insulators (air, SF6 and nitrogen) and ageing of insulators.

UNIT-V

MATERIALS FOR SPECIAL APPLICATIONS

Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, sintered alloys for breaker and switch contacts.

TEXT / REFERENCE BOOKS:

1) Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.
2) Electrical Properties of Materials, 8th Edition by Solymar, L, Oxford University Press, New Delhi.
3) Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S.Chand & Company Ltd- New Delhi.
4) Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.

CO-PO/PSO MAPPING MATRIX:

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

EE315/B (R20): UTILIZATION OF ELECTRICAL ENERGY

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Explain the mechanics of train movement in electric traction systems and compare DC and AC systems in electric traction.
- Discuss the different modes of heat transfer and design of heating elements in electric heating, along with the construction and working of induction, resistance, dielectric and arc furnaces.
- Compare different types of welding, including resistance and arc welding and discuss the characteristics of carbon and metallic arc welding.
- Describe the laws of illumination and calculate lighting schemes using the square law method, as well as compare different types of lamps such as gas discharge, fluorescent and filament lamps.
- Explain the applications, rating, classification and charging/discharging of storage batteries, including dry cell and wet cell batteries, primary and secondary cells and lead-acid and nickel-cadmium batteries.

UNIT – I

Electric Traction: Introduction- Systems of electric traction- comparison between DC and AC systems in electric traction - mechanics of train movement- speed-time curves- effect of speed-acceleration and distance on schedule- Power and energy output from driving axles-specific energy output- collectors - introduction to electric braking – comparison of electric and mechanic braking.

UNIT – II

Electric Heating: Introduction; Modes of heat transfer - Stefan's law –classification of electric heating methods- design of heating element - Construction and working of different types of induction furnaces - resistance furnace - Dielectric heating – arc furnaces.

UNIT – III

Welding: Introduction- Types of welding - resistance and arc welding -Characteristics of Carbon and metallic arc welding - comparison (Excluding electronic controls)- requirements of good weld-ultra sonic-electron beam-laser beam welding.

UNIT – IV

Illumination: Introduction- terms used in illumination-laws of illumination-Gas discharge lamps - Fluorescent lamps - Arc lamps - Filament lamps – comparison between filament and fluorescent lamps-square law methods of calculation – Factory lighting - flood lighting and street lighting-design of lighting schemes-introduction to Compact Fluorescent Lamps.

UNIT – V

Storage batteries: Applications-rating-classification-dry cell and wet cells-primary and secondary cells-charging and discharging of lead acid cells, trickle charging methods of charging lead acid batteries-over discharging-common troubles with lead acid batteries and remedies-Nickel cadmium batteries.

TEXT BOOKS:

1) A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U. S. Bhatnagar and A.Chakraborti, DhanpatRai& Co. Pvt. Ltd., 2001.
2) Utilization Electric Power and electric traction by J.B.Gupta, publishers-Katson books
3) Utilization, generation & conservation of electrical energy by Sunil S Rao, Khanna publishers.

REFERENCE BOOKS:

1) Generation, Transmission & Utilization Electric Power by A.T. Starr London, Pitman. 1953.
2) Art and Science of Utilization of Electrical Energy by Partab H Dhanpat Rai and Sons, New Delhi. Second edition.
3) Electrical Technology, volume-1 by B.L.Thereja, S.Chand & co publishers.

CO-PO/PSO MAPPING MATRIX:

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

EE316 (R20): CONSTITUTION OF INDIA

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the historical context and sources of the Indian Constitution, including the Preamble, fundamental rights and duties and directive principles of state policy.
- Analyze the structure of the Indian Union government and its administration, including federalism, the role of the President and Prime Minister, the Cabinet, Lok Sabha, Rajya Sabha and the powers and functions of the Supreme Court and High Court.
- Examine the state government and its administration, including the role of the Governor, Chief Minister and Council of Ministers, State Secretariat and the organization and functions of district and municipal administrations.
- Evaluate the importance of grass root democracy through an understanding of the functions and roles of Pachayati Raj, Zila Panchayat and elected and appointed officials at the village, block and district levels.
- Develop an understanding of the role and functions of the Election Commission, including the Chief Election Commissioner and Election Commissionerate, the State Election Commission and the Commissions for the welfare of SC/ST/OBC and women.

UNIT-I

Introduction to Indian Constitution: Constitution' meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT-IV

A Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation Pachayati Raj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

REFERENCE BOOKS:

1) Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd., New Delhi
2) Subash Kashyap, Indian Constitution, National Book Trust
3) J.A. Siwach, Dynamics of Indian Government & Politics
4) D.C. Gupta, Indian Government and Politics
5) H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6) J.C. Johari, Indian Government and Politics Hans
7) J. Raj Indian Government and Politics
8) M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.

E-RESOURCES:

1) nptel.ac.in/courses/109104074/8
2) nptel.ac.in/courses/109104045/
3) nptel.ac.in/courses/101104065/
4) www.hss.iitb.ac.in/en/lecture-details
5) www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

CO-PO/PSO MAPPING MATRIX:

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CO1	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO2	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO3	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO4	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO5	2	1	3	2	2	-	-	-	2	1	-	1	3	2

EE351 (R20): CONTROL SYSTEMS LAB

L-0	T-0	P-3	M-100	C-2

COURSE OUTCOMES:

After completion of this course, students will be able to

CO1: Analyze the time response of second-order systems and apply P, PD and PID controllers to improve system performance.

CO2: Evaluate the characteristics of synchros and magnetic amplifiers and explain their applications in control systems.

CO3: Investigate the transfer function of DC motors and generators and analyze their behavior under different load conditions.

CO4: Develop temperature controllers using PID algorithms and implement them using operational amplifiers.

CO5: Analyze the frequency response of first and second-order systems and design lag and lead compensators to improve system stability and performance.

LIST OF EXPERIMENTS:

1) Time response of second order systems
2) Characteristics of synchros.
3) Effect of feedback on D.C servomotor.
4) Transfer function of D.C motor
5) Effect of P, PD, PID controller on a second order system
6) Simulation of transfer functions using operational amplifier
7) Lag and lead compensation – Magnitude and phase plot
8) Transfer function of D.C generator
9) Temperature controller using PID
10) Characteristics of magnetic amplifier
11) Characteristics of A.C servo motor
12) Stepper motor control
13) D.C. position control
14) P, PI, PD, PID control using Op-Amps.
15) Frequency response of first and second order systems.

Note: Minimum of ten experiments have to be performed and recorded by the candidate to attain eligibility for University Examinations

CO-PO/PSO MAPPING MATRIX:

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

EE352 (R20): LICA & PULSE CIRCUITS LAB

L-0	T-0	P-3	M-100	C-1.5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Students will be able to design and analyze basic electronic circuits using discrete components and integrated circuits.
- Students will be able to understand the behavior of op-amps and their various applications in electronics.
- Students will be able to design and implement various types of multi vibrators using discrete components and integrated circuits.
- Students will be able to design and analyze active filters.
- Students will be able to understand the working of various types of waveform generators and their applications in electronics.

LIST OF EXPERIMENTS:

1) Design and Verification of Astable Multivibrator.
2) Design and Verification of Monostable Multivibrator.
3) Design and Verification of Bistable Multivibrator
4) Design and Verification of Schmitt Trigger (using discrete components and using IC741).
5) Measurement of Op-amp Parameters.
6) Applications of Op-amp (Adder, Subtractor, Integrator, Differentiator).
7) Instrumentation Amplifier using Op-Amp.
8) Waveform Generation using Op-amp (Square, Triangular).
9) Design of Active Filters (LPF&HPF-First Order).
10) Application of 555 Timers (Astable, Monostable, Schmitt Trigger).0
11) PLL using 556.
12) Design of IC Regulator using 723.
13) Design of VCO using 566.
14) D-A Converter (R-2R Ladder).
15) Design of Miller and Bootstrap Sweep circuits.

NOTE: A minimum of 10 (Ten) experiments have to be performed and recorded by the candidate to attain eligibility for University Practical Examination.

CO-PO/PSO MAPPING MATRIX:

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

EE353 (R20): POWER ELECTRONICS LAB

L-0	T-0	P-3	M-100	C-2

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the static characteristics of SCR and Triac and their applications in power control circuits.
- Analyze the characteristics of MOSFET and IGBT and their applications in power electronic circuits.
- Analyze different gate triggering methods for SCR, including R, R-C and UJT triggering circuits.
- Design and analyze single-phase fully controlled rectifiers with R, RL and RLE loads, with or without feedback diodes.
- Understand the working principle of Jone's chopper and its characteristics in power control applications.

LIST OF EXPERIMENTS:

1) Static characteristics of SCR, Triac
2) Characteristics of MOSFET & IGBT
3) Gate triggering methods for SCR's (R, R-C, UJT)
4) Single phase fully controlled rectifier with R, RL & RLE load (with or without Feedback diode)
5) Characteristics of Jone's chopper
6) Voltage commutated DC chopper
7) Characteristics of single – phase modified series inverter
8) Characteristics of single - phase parallel inverter with R & RL loads
9) Characteristics of single - phase cyclo-converter (Center tapped or Bridge)
10) Study of single - phase full wave McMurray Bedford inverter
11) Single phase dual converter with R & RL loads (Circulating and non circulating modes)
12) Three phase fully/half controlled rectifier with R, RL and RLE loads
13) Speed control of Universal motor
14) Characteristics of PWM converter
15) Characteristics of Morgan's chopper
16) Characteristics of PWM inverter
17) Converter based DC motor control
18) Inverter based Induction motor control

Note: Minimum of ten experiments have to be performed and recorded by the candidate to attain eligibility for University Examinations

CO-PO/PSO MAPPING MATRIX:

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CO3	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO4	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO5	2	1	3	2	2	-	-	-	2	1	-	1	3	2

SEMESTER VI

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-VI

EE 321 (R20): POWER SYSTEMS - II

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Develop an understanding of power system representation and calculation methods to analyze per-unit impedances of three-winding transformers and prepare data for load flow programs.
- Understand load flow analysis techniques and be able to compare different methods to solve nonlinear equations and prepare data for load flow programs.
- Gain knowledge of symmetrical faults, including transient behavior of RL series circuits, short-circuit currents and reactances of synchronous machines and the use of symmetrical components in power calculations.
- Acquire an understanding of unsymmetrical faults, including calculation of sequence impedances and networks for unloaded generators and circuit elements.
- Develop an understanding of power system stability, including the equal area criterion and the swing equation and be able to identify factors affecting steady state and transient stabilities.

UNIT – I

Representation of power systems: One line diagram - Impedance and Reactance diagrams – per unit quantities - changing the base - selection of base - per-unit impedances of three winding transformers - Advantages of per-unit computations.

Y Bus formation by inspection method.

UNIT – II

Load Flows:

Introduction – nonlinear equations – solution techniques using Gauss iterative, Gauss Seidal and Newton Raphson (rectangular and polar) methods using bus admittance matrix - acceleration of convergence - development of flow charts for load flow problems - comparison of different load flow methods. Data preparation for load flow program

UNIT – III

Symmetrical Faults: Transients in RL series circuit - short-circuit currents and reactances of synchronous machines - internal voltages of loaded machines under transient conditions - selection of circuit breakers

Symmetrical components and Networks: Introduction – operator 'a' – resolution of three unbalanced phasors into symmetrical components - power in terms of symmetrical components.

UNIT – IV

Unsymmetrical Faults: Single line to ground - line to line and double line to ground faults on an unloaded alternator. Unsymmetrical faults on power systems - single line to ground line to line and double line to ground faults. Interpretation of the interconnected sequence networks.

Unsymmetrical series impedance - sequence impedances and sequence networks of unloaded generators, circuit elements. Positive negative and zero sequence networks.

UNIT – V

Power system stability: Introduction – steady state stability, Transient stability, Review of machine swing equation - Equal area criterion of stability – applications. Step by step solution of the swing curve - factors affecting steady state and transient stabilities

TEXT BOOKS:

1) Elements of power system analysis by W D Stevenson Jr Fourth Edition TMH International student edition
2) Modern power system analysis by D.P. Kothari and I.J. Nagrath , TMH 3rd edition
3) Electrical power systems by C.L. Wadhwa, New age International (P) Limited
4) Power system analysis by TK Nagsarkar and Sukhija, Oxford press

REFERENCE BOOKS:

1) Power system stability by Kimbark Vol – I Willey Publications, Inc.
2) Power system stability and control by P. Kundur , TMH
3) A. R. Bergen and V. Vittal; "Power System Analysis", Pearson Publication.

CO-PO/PSO MAPPING MATRIX:

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CO4	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO5	2	1	3	2	2	-	-	-	2	1	-	1	3	2

EE322 (R20): POWER SYSTEM OPERATION AND CONTROL

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Develop an understanding of economic dispatch in thermal power stations, including heat rate and cost curves, incremental fuel and production costs, optimal generation allocation and unit commitment using dynamic programming.
- Understand load frequency control in power systems, including mathematical modeling of generators, loads, prime movers and speed governors, block diagram representation, steady state and dynamic analysis and automatic generation control for single and two-area systems.
- Gain knowledge of power flow control in networks, including bus voltage specification, capacitor bank control and reactive power control in synchronous generators using excitation system and AVR block diagram.
- Acquire an understanding of real-time control of power systems, including computer control, energy control center and state estimation using weighted least square and maximum likelihood concepts and matrix formulations.
- Develop an understanding of contingency analysis, including adding and removing lines, piecewise solution of interconnected power systems and analysis of single and multiple contingencies using a DC model.

UNIT – I

Economic operation of power systems: Economic dispatch in thermal power station: Heat rate curves - cost curves - incremental fuel and production costs -economic distribution of load between units without consideration to line losses. Transmission line losses as a function of plant generation - calculation of loss coefficients - optimum generation allocation between thermal plants. Optimal unit commitment-Dynamic programing

UNIT – II

Load frequency control: Importance of keeping voltage and frequency constant in a power system - Load frequency control (LFC) single area case - the P-δloop: Schematic of load frequency and AVR of a synchronous generator – mathematical modelling of generator, loads, prime mover and speed governor for LFC & corresponding block diagram representation - LFC block diagram of an isolated power system - steady state analysis - dynamic response. LFC for two area systems - automatic generation control (AGC) scheme – AGC in a single area and two area systems - block diagram representation.

UNIT – III

Power Fow Control: Control of power into a network-specification of bus voltage-capacitor banks-control by transformers.

Reactive power control in synchronous generators: The role of excitation system- exciter, generator and sensor models - simplified AVR block diagram -steady state response for a step change in terminal voltage.

UNIT – IV

Real time control of power system: Computer control of power systems-Energy control centre-various levels

State estimation: Power system state estimation- weighted least square estimation-Maximum likelihood concepts-matrix formulations.

UNIT – V

Contingency analysis: Adding and removing of lines-Piece wise solution of interconnected power system-Analysis of single contingencies-Analysis of multiple contingencies contingency analysis by d.c model.

TEXT BOOKS:

1) Modern power system analysis by D.P. Kothari & I.J. Nagrath McGraw Hill 3rdedition, 200 3
2) Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw-hill Publishing Company Ltd., Second edition 1983
3) Electrical power systems by C.L. Wadhwa, New age International (P) Limited
4) Understanding FACTS by Naran G. Hingorani, L. Gyugyi, 1st edition, 2001, Standard Publishers Distributors.

REFERENCE BOOKS:

1) Elements of power system analysis by W D Stevenson Jr Fourth Edition TMH International student edition
2) Economic operation of interconnected systems by L.K.Kirchmeyer Wiley Eastern Ltd
3) Power system analysis by H. Saadat, McGraw Hill, 2nd edition
4) Power System Analysis Operation and Control by AChakrabarti, Sunita Halder, PHI, 2007
5) Computer modeling of Electrical power systems by J.Arrillaga, N. A. Watson, second Edition 2003, John Wiley & Sons, Ltd.
6) Power system control- technology by Torsten Cegrell, Prentice Hall international series in systems& control engineering.

CO-PO/PSO MAPPING MATRIX:

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CO4	2	2	-	1	2	-	-	2	2	2	2	2	3	3
CO5	2	1	3	2	2	-	-	-	2	1	-	1	3	2

EE323 (R20): ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the classification, construction and operation principles of various instruments and their applications in measuring current, voltage, power, energy and reactive power in single phase and three phase circuits.
- Comprehend the construction and operation principles of power factor meters, frequency meters and synchroscopes and the principles of magnetic measurements using ballistic galvanometers and flux meters.
- Understand the principles of operation and errors in instrument transformers and measurement of inductance, capacitance, resistance and high resistance using bridge methods.
- Understand the principle of operation of digital instruments, such as DVMs and display devices and the principles of transducers, including LVDT, frequency and power transducers.
- Comprehend the measurement of non-electrical quantities, such as velocity, acceleration, force, torque, flow, temperature, displacement and strain, using electrical transducers and data acquisition systems.

UNIT - I

Instruments: Classification of instruments – Construction and principle of operation of Permanent magnet moving coil - moving iron – dynamometer – induction type of instruments. Measurement of current, voltage, power, energy and reactive power in single phase and three phase circuits.

UNIT – II

Construction and principle of operation of Power factor meters – frequency meters and synchroscope.

Magnetic Measurements: Ballistic galvanometer-B-H loop-flux meter –measurement of permeability.

Oscilloscope: Basic operation-deflection mechanism-time base circuits-vertical amplifiers - alternate and chop modes - applications.

UNIT – III

Instrument Transformers: CTs, PTs principle of operation – errors - testing.

Bridges: Measurement of inductance, capacitance and resistance by bridge methods - Maxwell's - Anderson's - Wien's - Schering's - Heaviside's - Campbell's - Kelvin's double bridge. Measurement of high resistance by Price's guard wire, loss of charge methods

UNIT – IV

Digital Instruments: Principle of operation of DVM's – display devices LEDs and LCDs.

Transducers: Principles - LVDT – frequency and power transducers

UNIT – V

Measurement of Non electrical quantities with electrical transducers: Velocity, acceleration, Force, Torque, flow, temperature thermistor – thermo couple, displacement & strain. Data recorders, data acquisition systems.

TEXT BOOKS:

1) Electrical & Electronic Measurement & Instruments by A.K.Shawney Dhanpat Rai & Co 17th edition 2000.
2) Electrical Measurements and measuring Instruments – by E.W. Golding and F.C. Widdis, 5th Edition, Wheeler Publishing, 1999.

REFERENCE BOOKS:

1) Electrical Measurements – by Buckingham and Price, Prentice – Hall, 1961
2) Electrical Measurements by Harris John Wiley
3) Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publishers.

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

EE324/1 (R20): HVDC TRANSMISSION

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the advantages of DC over AC transmission and the technical aspects of HVDC projects in India.
- Analyze and evaluate different kinds of converter circuits and their characteristics, including bridge converters with grid control.
- Identify protection mechanisms against various faults in converter circuits and the use of DC smoothing reactors, bypass valves and DC circuit breakers.
- Explain the principles of DC link control, including firing angle control, current and extinction angle control and power control.
- Apply power flow analysis in AC/DC systems, including modeling of DC links and the calculation of voltage and current harmonics.

UNIT-I

General considerations of AC and DC transmission: Introduction – economic advantages of DC over AC transmission - types of DC links - brief description of the layout of a bipolar HVDC link - technical advantages of DC over AC transmission - application of DC transmission system - planning and modern trends in DC transmission - brief summary of the technical details of HVDC projects in India.

UNIT-II

Converter Circuits: Properties of converter circuits - different kinds of arrangements - choice of converter configuration analysis of bridge converters with grid control with and without overlap angle -complete characteristics of 6 pulse and 12 pulse converters - operation as an inverter - converter parameters and characteristics - values of transformer secondary currents - converter equations.

UNIT-III

Protection: Converter faults - short circuit current - arc back currents - short circuit currents in rectifier and inverter - protection against over currents - DC smoothing reactors,- bypass valves - DC circuit breakers. protection against over voltages –surge arresters.

UNIT-IV

Converter and HVDC system Control:

Principles of DC link control - converter control characteristics - firing angle control - current and extinction angle control - effect of source inductance – starting and stopping of DC link - the four operating modes of the DC link – CG, AC, AG, CV - power control - sources of reactive power - reactive power requirements in steady state - reactive power control. Introduction to HVDC simulator.

UNIT-V

Power Flow Analysis in AC/DC systems: Modeling of DC links - solution of DC load flow **Harmonics and Filters:** Generation of harmonics - characteristic and uncharacteristic harmonics - adverse effects of harmonics - calculation of voltage and current harmonics. The impedance loci; Methods of reducing the harmonics –AC tuned and high pass filters - DC filters - telephonic interference.

TEXT BOOKS:

1) HVDC power transmissions systems: Technology and system interactions by K.R. Padiyar New age International (P) Ltd.
2) HVDC transmission by J. Arrillaga, Peter Peregrinus.

REFERENCE BOOKS:

1) Direct Current transmission by E.W.Kimbark, John Wiley
2) Power Transmission by Direct Current by E.Uhlmann, Springer-Verlag
3) HVDC power converters and systems by B.J.Cory and Mc Donald.

CO-PO/PSO MAPPING MATRIX:

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

EE324/2 (R20): DIGITAL CONTROL SYSTEMS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

- Students will be able to understand the concepts of sampling and reconstruction of signals in the z-plane and perform z-transform method for solving difference equations.
- Students will be able to analyze discrete-time systems using state space representation, pulse transfer function matrix and controllability and observability tests.
- Students will be able to analyze stability of closed-loop systems in the z-plane using Jury stability test, Bilinear transformation and Routh stability criterion.
- Students will be able to design digital control systems using conventional methods such as frequency response method, lead-lag compensators and digital PID controllers.
- Students will be able to design state feedback controllers and observers using pole placement, Ackerman's formula and linear quadratic regulators for optimal control.

UNIT – I SAMPLING AND Z-PLANE ANALYSIS

Introduction, sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal.

REVIEW OF Z-TRANSFORMS:

Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT – II

State Space Analysis: State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations. Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

UNIT – III

Stability Analysis: Stability Analysis of closed loop systems in the Z-Plane. Jury stablility test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT – IV

Design of Discrete Time Control System By Conventional Methods: Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. Design digital control through deadbeat response method.

UNIT – V

State Feedback Controllers and Observers: Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers.

Linear Quadratic Regulators: Min/Max principle, Linear Quadratic Regulators

TEXT BOOKS:

1) Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2) Digital Control and State Variable Methods by M.Gopal, TMH
3) Discrete-Time Control systems - K. Ogata, Pearson Education.

REFERENCE BOOKS:

1) Digital Control Engineering, M. Gopal Wiley Eastern
2) Modern control engineering by K.Ogata, PHI

CO-PO/PSO MAPPING MATRIX:

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

EE324/3 (R20): COMPUTER ARCHITECTURE

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the basic structure and functional units of computers, including software and performance issues.
- Analyze machine instructions and programs and implement various instruction sets, formats and assembly languages.
- Evaluate processor organization, information representation and various number formats, including multiplication and division, ALU design and floating point arithmetic.
- Design control units, instruction sequencing, interpretation and implementation, including hardwired and micro programmed control.
- Comprehend memory organization, management and device characteristics, including RAM, ROM, cache, virtual memory, input-output systems and standard I/O interfaces, as well as the concepts of parallel processing, pipelining and interconnect networks.

UNIT – I

Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.

UNIT – II

Processor organization, Information representation, number formats.

UNIT – III

Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit

UNIT – IV

Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces

UNIT – V

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network.

TEXT / REFERENCE BOOKS:

1) V.Carl Hammacher, “Computer Organisation”, Fifth Edition.
2) A.S.Tanenbum, “Structured Computer Organisation”, PHI, Third edition
3) Y.Chu, "Computer Organization and Microprogramming”, II, Englewood Chiffs, N.J., Prentice Hall Edition
4) M.M.Mano, “Computer System Architecture”, Edition
5) C.W.Gear, “Computer Organization and Programming”, McGraw Hill, N.V. Edition
6) Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition

CO-PO/PSO MAPPING MATRIX:

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

EE325/1 (R20): AI TECHNIQUES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the concept and evolution of Artificial Neural Networks and the basic models used in ANNs, their notation and terminology and the training process.
- Develop an understanding of supervised learning networks, such as Perceptron networks, Adaptive Linear Neurons and Back Propagation networks.
- Learn about associative memory networks, including auto-associative memory networks, bidirectional associative memory, Hopfield networks and iterative auto-associative memory networks.
- Acquire knowledge of fuzzy logic, its classical sets, fuzzy sets, membership functions, fuzzification and defuzzification and apply fuzzy logic in decision making.
- Understand hybrid fuzzy neural networks, their architecture based on back propagation and ANFIS and learn about genetic algorithms, their encoding, fitness function and genetic modeling.

UNIT – I

Artificial Neural Network: Concept – evolution – basic models – Notation and terminology – training **Supervised learning Network:** Introduction – Perceptron networks – Adaptive linear neuron – Multiple adaptive linear neurons – Back propagation network – radial basis network

UNIT–II

Associative Memory Networks: Training algorithms for pattern association – Auto associative memory network – Bidirectional associative memory – Hopfield networks – Iterative auto associative memory networks – Temporal associative memory network **Unsupervised learning networks:** Fixed weight competitive nets – Kohenen self-organizing feature maps – learning vector quantization – counter propagation networks – Adaptive resonance theory network.

UNIT- III

Fuzzy logic: Classical sets – fuzzy sets – classical relations – fuzzy relations – tolerance and equivalence relations – Membership functions – fuzzification –Membership value assignments – Defuzzification – Fuzzy arithmetic – Fuzzy measures – Fuzzy rule base and approximate reasoning – fuzzy decision making.

UNIT – IV

Hybrid fuzzy neural networks: Hybrid system – fuzzy logic in learning algorithms - fuzzy neurons – Neural networks as pre-processors, post processors, tuners – FNN architecture based on back propagation – ANFIS.

UNIT – V

Genetic algorithms - Introduction-encoding-fitness function-reproduction operators **Genetic modeling -** genetic operators-cross over and mutation-generational cycle convergence of genetic algorithm

TEXT BOOKS:

1) Principles of soft computing by S.N.Sivanandam, S.N.Deepa, John Wiley India –2007
2) Fuzzy logic and Neural networks: Basic concepts and applications by Chennakesava R Alavala, New Age International (P) Ltd., 2008
3) Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Pai – PHI Publication.

REFERENCE BOOKS:

1) Neural Networks – James A Freeman and Davis Skapura, Pearson Education, 2002.
2) Neural Networks – Simon Hakins, Pearson Education.
3) Neural Engineering by C.Eliasmith and CH.Anderson, PHI.
4) Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.

CO-PO/PSO MAPPING MATRIX:

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

EE325/2 (R20): INDUSTRIAL ELECTRICAL SYSTEMS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the various electrical components used in LT systems and their selection criteria for wiring, switches, protection components, etc.
- Develop an understanding of the types of residential and commercial wiring systems and the general rules for installation, load calculation, earthing systems, lighting schemes and sizing of components.
- Acquire knowledge of various illumination systems, their design and calculation parameters such as lumen, intensity, lamp efficiency, etc. and energy-saving methods in illumination systems.
- Gain an understanding of industrial electrical systems, including HT connections, industrial substation, transformer selection, cable and switchgear selection, power factor correction and specifications of LT breakers and other panel components.
- Understand the electrical systems used in elevators, DG systems, UPS systems, battery banks, their sizing and selection criteria and their role in industrial electrical systems.

UNIT I

Electrical System Components

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

UNIT II

Residential and Commercial Electrical Systems

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

UNIT III

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

UNIT IV

Industrial Electrical Systems I

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 Systems II

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPSand Battery Banks, Selection of UPS and Battery Banks.

TEXT / REFERENCE BOOKS:

1) S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2) K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
3) S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
4) Web site for IS Standards.
5) H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

CO-PO/PSO MAPPING MATRIX:

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

EE325/3 (R20): RENEWABLE ENERGY SOURCES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Explain the principles and differences between renewable and conventional energy sources and evaluate the environmental impacts and sustainability of various renewable energy technologies.
- Analyze solar radiation and its conversion into thermal and electrical energy and design a solar energy system for a given application based on technical and economic criteria.
- Assess the potential of wind energy and the factors affecting its power generation and compare the performance and efficiency of different wind turbines and generators.
- Evaluate the feasibility and challenges of ocean energy technologies, such as OTEC, wave energy and tidal energy and propose innovative solutions for their deployment and integration with existing grids.
- Investigate the characteristics and applications of geothermal energy and biofuels and identify the advantages and limitations of different systems for heat and power generation.

UNIT-I

Principle of Renewable Energy: Comparison of renewable and conventional energy sources - Ultimate energy sources - natural energy currents on earth -primary supply to end use - Spaghetti & Pie diagrams - energy planning – energy efficiency and management.

UNIT-II

Solar Radiation: Extra-terrestrial solar radiation - terrestrial solar radiation – solar thermal conversion - solar thermal central receiver systems - photovoltaic energy conversion - solar cells – 4 models.

UNIT-III

Wind energy: Planetary and local winds - vertical axis and horizontal axis wind mills - principles of wind power - maximum power - actual power - wind turbine operation - electrical generator.

UNIT-IV

Energy from Oceans: Ocean temperature differences - principles of OTEC plant operations - wave energy - devices for energy extraction – tides - simple single pool tidal system.

UNIT-V

Geothermal energy: Origin and types - Bio fuels – classification – direct combustion for heat and electricity generator - anaerotic digestion for biogas – biogas digester - power generation.

TEXT BOOKS:

1) Renewable Energy Sources by John Twidell & Toney Weir : E&F.N. Spon
2) Renewable Energy Sources: Their impact on global warming and pollution by Abbasi & Abbasi –PHI

REFERENCE BOOKS:

1) Power plant technology by EL-Wakil, McGraw-Hill
2) Non-Conventional Energy Sources by G.D.Rai, Khanna Pub.

CO-PO/PSO MAPPING MATRIX:

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

EE325/4 (R20): POWER PLANT ENGINEERING

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and understand the working principles, subsystems and components of various types of power plants, including coal-based thermal power plants, diesel, gas turbine and combined cycle power plants, nuclear power plants and renewable energy power plants.
- Evaluate the economic, environmental and social impacts of different power plants and energy sources, including the capital and operating costs, power tariff types, load distribution parameters and pollution control technologies.
- Design and optimize the layout of power plants, such as coal-based thermal power plants, including supercritical boilers, FBC boilers, turbines and condensers and hydroelectric power plants.
- Analyze and design the subsystems of power plants, such as fuel and ash handling, draught systems, feed water treatment and binary cycles and cogeneration systems.
- Evaluate the safety measures and regulations associated with nuclear power plants, including the working of nuclear reactors such as BWR, PWR, CANDU, breeder, gas-cooled and liquid metal-cooled reactors.

UNIT I

COAL BASED THERMAL POWER PLANTS

Rankine cycle – improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II

DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS

Otto, Diesel, Dual & Brayton Cycle – Analysis &Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III

NUCLEAR POWER PLANTS

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANADA Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV

POWER FROM RENEWABLE ENERGY

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V

ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TEXT / REFERENCE BOOKS:

1) Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2) Generation of Electric Power by B.R. Gupta S. Chand & Company Ltd
3) Generation distribution and utilization of electrical energy by C.L.Wadhwa, New Age Internations (P) Limited, 2005 Reference
4) Electrical power systems by C.L. Wadhwa, New age International (P) Limited 3rd edition
5) Modern power system analysis by D.P. Kothari & I.J. Nagrath McGraw Hill 3rdedition,2003
6) Electric power transmission and distribution by Sivanagaraju and Satyanarayana, Pearson Education.

CO-PO/PSO MAPPING MATRIX:

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

EE361 (R20): SIMULATION OF ELECTRICAL SYSTEMS LAB -I

L-0	T-0	P-3	M-100	C-1.5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and simulate various power electronic circuits, including single-phase and three-phase converters, inverters, choppers and commutation circuits, using appropriate software tools.
- Investigate the behavior of static devices, such as SCR and analyze their applications in power electronic circuits.
- Evaluate the performance of resonant pulse commutation circuits and buck choppers and understand the principles behind their operation.
- Design and simulate AC voltage controllers for different loads and compare their performance characteristics.
- Develop and analyze models of transformers and understand their applications in power electronic circuits.

LIST OF EXPERIMENTS:

1) Simulation of a single-phase full-bridge converter with different loads
2) Simulation of static characteristics of SCR
3) Simulation of a resonant pulse commutation circuit and buck chopper
4) Simulation of an AC voltage controller with various loads
5) Simulation of single-phase inverter with PWM control
6) Modelling of transformer
7) Simulation of three phase 180^0 and also 120^0 conduction mode of an inverter
8) Simulation of single phase dual converter in circulating and non-circulating mode.
9) Simulation of voltage/load /current commutation of a chopper.
10) Transfer function analysis of a given circuit
11) State model representation of transfer functions
12) Plotting of Bode, Nyquist and root-locus plots for transfer functions
13) Steady state and Transient analysis of RLC circuits
14) Time response analysis of second order system.
15) Effect of P, PI and PID controllers for a second order system.

Note: A minimum of 10 experiments are to be completed.

Simulation is to be carried out with the following software PSPICE/ MATLAB/ MiPower/ PSIM/ PSCAD/ EMTP.

CO-PO/PSO MAPPING MATRIX:

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

EE362 (R20): ELECTRICAL MEASUREMENTS LAB

L-0	T-0	P-3	M-100	C-1.5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understanding the principles of electrical measurements and their applications in different fields.
- Familiarization with various types of measuring instruments and their working principles.
- Ability to measure different electrical parameters such as voltage, current, power, energy, resistance, capacitance and inductance accurately.
- Understanding the techniques and methods used for calibration and testing of electrical measuring instruments.
- Developing the skills to analyze and interpret the measurement results and draw conclusions based on the data obtained.

LIST OF EXPERIMENTS:

1) Calibration and testing of single – phase energy meter
2) Kelvin's Double Bridge – Measurement of resistance – Determination of tolerance
3) Schering Bridge – capacitance measurement and tan □ measurement
4) Anderson Bridge – inductance measurement
5) Measurement of 3-phase active and reactive power in three phase circuits.
6) Measurement of 3-phase power using 3-Voltmeter and 3Ammmeter methods
7) Measurement of frequency using CRO
8) Measurement of strain using strain gauge
9) Tracing of B-H curve using CRO
10) LVDT characteristics, calibration and displacement measurement.
11) Energy meter calibration by phantom loading
12) Frequency measurement by Wein's Bridge
13) Measurement of earth resistance by earth resistance tester & fall of potential method
14) Measurement medium resistance using Wheatstone Bridge
15) Testing of current transformer.
16) Measurement of dielectric strength of transformer oil by transfer oil testing kit
17) Fault identification and location in underground cables

Note: Minimum of ten experiments have to be performed and recorded by the candidate to attain eligibility for University Examinations

CO-PO/PSO MAPPING MATRIX:

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

EE363 (R20): DIGITAL SIGNAL PROCESSING LAB

L-0	T-0	P-3	M-100	C-1.5

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and design continuous-time and discrete-time systems using various transform techniques such as Fourier, Laplace, Z-transform and their properties.
- Develop programming skills using MATLAB software for signal processing and analysis, system modeling and simulation.
- Understand the concept of linearity and time-invariance and analyze the given systems using these properties.
- Design digital filters using various techniques such as impulse invariant and windowing methods and analyze their performance using MATLAB simulations.
- Perform signal processing tasks such as convolution, correlation, DFT analysis and waveform synthesis using MATLAB programming.

LIST OF EXPERIMENTS:

1) Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences.
2) Write a MATLAB program to determine the Fourier transform of a given input signal and also plot its magnitude and phase response plots.
3) Write a MATLAB program to determine the Inverse Fourier transform of a given signal and also plot its magnitude and phase response plots.
4) Verification of Linearity and Time Invariance Properties of a Given Continuous/Discrete System.
5) Convolve the given two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation
6) Write a MATLAB program to perform waveform synthesis using Laplace Transform of a given signal
7) Write a MATLAB program to determine the Z-transform and plot the pole-zero locations in Z-plane.
8) Program to find the impulse response of a system defined by a difference equation.
9) Evaluation of 8 point IDFT
10) Evaluation of DFT of 16 Sample Sequence using FFT Algorithm.
11) Evaluation of IDFT of 16 Sample Sequence using IFFT Algorithm.
12) Design of IIR Butterworth Filter using Impulse Invariant Method.
13) Design of FIR Filter using Windowing Technique.
14) Convolution of Two Signals.
15) Correlation of Two Signals.
16) DFT Analysis of a Noise Corrupted Signal.

NOTE: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for University Practical Examination.

CO-PO/PSO MAPPING MATRIX:

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

EE364 (R20): MOBILE APP DEVELOPMENT

L-0	T-0	P-3	M-100	C-2

COURSE OUTCOMES:

After completion of this course, students will be able to

- Demonstrate a strong understanding of programming concepts and best practices, including variables, data types, control structures, functions and object-oriented programming.
- Develop software solutions to problems using a variety of programming languages and tools and demonstrate proficiency in software development practices such as version control, testing and debugging.
- Design and implement efficient algorithms and data structures for solving a range of problems and analyze the complexity and performance of these algorithms.
- Work effectively in a team to develop software solutions, including collaborating on design, implementing code and providing and receiving feedback on code quality.
- Communicate effectively with both technical and non-technical stakeholders, including documenting code and design decisions, presenting technical concepts and solutions to a non-technical audience and responding to feedback and questions.

LIST OF EXPERIMENTS:

1) Develop an application that uses GUI components, Font and Colours
2) Develop an application that uses Layout Managers and event listeners.
3) Develop an application that makes use of databases.
4) Develop an application that makes use of Notification Manager
5) Develop a native application that uses GPS location information
6) Implement an application that for basic calculator
7) Implement an application that creates an alert upon receiving a message
8) Write a mobile application that makes use of RSS feed
9) Develop a mobile application to send an email.
10) Develop a Mobile application for simple needs (Mini Project)

REFERENCE BOOK:

1) Build Your Own Security Lab, Michael Gregg, Wiley India

CO-PO/PSO MAPPING MATRIX:

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

SEMESTER VII

B.Tech. ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-VII

EE411 (R20): ELECTRIC DRIVES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the fundamental torque equations and speed torque conventions of electric drives.
- Analyze the dynamics of electric drives, including the equivalent values of drive parameters and components of load torques.
- Evaluate the different types of electric drives and their advantages.
- Apply closed-loop control methods for electric drives and understand the modes of operation.
- Design and analyze different types of motor drives, including DC motor drives, chopper-fed DC drives, controlled rectifier-fed DC drives, induction motor drives, synchronous motor drives and variable speed constant frequency generation.

UNIT – I

Introduction: Electric drives - advantages of electric drive - Type of electric drives - components of electric drives - Status of dc and ac drives.

Dynamics of Electric Drives: Fundamental torque equations - Speed torque conventions and multi quadrant operation - Equivalent values of drive parameters - Components of load torques - some common load torques - Nature and classification of load torques

Control of Electric Drives: Modes of operation - Speed control and drive classification - closed-loop control of drives.

UNIT - II

DC motor Drives: DC motors and their performance – Starting - methods of braking - speed control -Methods of armature voltage control - Transformer and uncontrolled rectifier control.

Chopper fed DC Drives: Control of separately excited dc motors - Chopper control of series motor.

UNIT - III

Controlled Rectifier fed DC Drives: Single phase fully and half controlled rectifier control of separately excited dc motor - Three phase fully and half controlled rectifier control of separately excited dc motor - Dual converter control of separately excited dc motor - comparison of conventional and static Ward-Leonard schemes - Rectifier control of dc series motor.

UNIT – IV

Induction motor drives: Three phase induction motors - Operation with unbalanced source voltages and single phasing - Operation with unbalanced rotor impedances – Starting – braking - transient analysis - Speed control - pole amplitude modulation - stator voltage control - Variable frequency control from voltage and current sources - Eddy current drives - rotor resistance control - slip power recovery - Variable speed constant frequency generation.

UNIT – V

Synchronous motor drives: Synchronous motors - Operation and fixed frequency supply - Synchronous variable speed drives - braking of synchronous motor. Switched reluctance motor drives - brush less dc motors - stepper motors – variable reluctance motor.

TEXT BOOKS:

1) Fundamentals of Electric drives by G.K. Dubey, Narosa, 2001
2) Electric drives by Nisit K De and P.K. Sen, PHI 2006

REFERENCE BOOKS:

1) Power Semiconductor controlled drives by G.K. Dubey, PH,1989
2) Power semiconductor drives by S.B. Dewan, G.R. Selmon & Straughen, John Wiley, 1984.
3) Thyristorised power controllers by GK Dubey SR Doradla, New Age.

CO-PO/PSO MAPPING MATRIX:

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

EE412 (R20): COMPUTER METHODS IN POWER SYSTEMS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and interpret element-node incidence matrices, loop incidence matrices, cut set incidence matrices and branch path incidence matrices.
- Develop algorithms for the formation of bus admittance and bus impedance matrices and modify them for changes in networks with and without mutual coupling.
- Formulate load flow problems using Newton Raphson methods, fast decoupled method and flow charts for load flow problems.
- Formulate transient stability problems using the alternating solution approach and numerical stability aspects of different integration schemes.
- Implement Z-Bus methods in contingency analysis, analyze single and multiple contingencies and represent external systems for fault and contingencies by Ward and REI approaches.

UNIT – I

Incidence & Network Matrices: Element-node incidence matrix - reduced incidence matrix or bus incidence matrix - basic loop incidence matrix - augmented loop incidence matrix - basic cut set incidence matrix - augmented cut set incidence matrix - branch path incidence matrix - concept of primitive network - primitive impedance and admittance matrices with and without mutual coupling - network performance equations - formation of network matrices using singular & non-singular transformation.

UNIT – II

Algorithm for formation of network matrices & short circuit studies: Formation of bus admittance and bus impedance matrices and respective algorithms - modifications of bus impedance and admittance matrices for changes in the networks with and without mutual coupling - representation of three phase network elements for balanced and unbalanced systems - short circuit calculations for symmetrical and unsymmetrical faults using bus impedance matrix. Data preparation for short circuit program

UNIT – III

Formulation of Load Flow Problem: Newton Raphson (rectangular and polar) methods using bus admittance matrix - Fast decoupled method - development of flow charts for load flow problems - comparison of different load flow methods. Data preparation for load flow program

UNIT – IV

Formulation of Transient Stability Problem: Representing synchronous machine by constant voltage behind transient reactance (d- axis) and network by steady state equations - alternating solution approach for transient stability solving algebraic equations and differential equations alternately - numerical stability aspects of different integration schemes - combined solution approach. Flow chart for digital simulation of transient stability problem.

UNIT – V

Z-BUS methods in Contingency Analysis: Adding and removing multiple lines (current injection methods), piece wise solution of interconnected systems, analysis of single and multiple contingencies, external system representation for fault and contingencies by Ward and REI approaches.

TEXT BOOKS:

1) Computer methods in Power System Analysis by Stagg, G.W. & El-Abiad TMH
2) Computer Techniques in Power System Analysis by M.A. Pai , TMH 2005
3) Power System Stability & Control by P. Kundur , TMH 1998
4) Advanced Power System Analysis and Dynamics by L.P. Singh Wiley Eastern Ltd., New Delhi 3rd edition 1993

REFERENCE BOOKS:

1) Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw-hill Publishing Comapany Ltd., Second edition 1983
2) Control and stability of Power Systems by Anderson & Fouad, Iowa state university press
3) Modern power system analysis by Nagrath & Kothari TMH 3rd edition

CO-PO/PSO MAPPING MATRIX:

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

EE 413 (R20): POWER SYSTEM PROTECTION

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the basic requirements of protective relaying, including primary and backup protection, zones of protection and the different types of relays.
- Identify and analyze the different types of protective relays, including over current, under voltage, directional and non-directional, distance, differential and negative sequence relays.
- Describe the principles of arc phenomenon, arc quenching and interruption of capacitive currents and low current chopping. Understand the different types of circuit breakers, including air break, oil-filled, air blast, vacuum and SF6 circuit breakers.
- Understand the principles of protection for alternators, transformers and transmission lines, including differential protection, over current and distance protection and the use of Translay relays.
- Understand the basic components of static relays, including comparators, over current relays and differential relays.

UNIT – I

Protective Relays: Introduction - basic requirement of protective relaying - zones of protection – primary and backup protection - classification of relays - attracted armature, balanced beam, induction disc, thermal relays. Buchholz's relay.

UNIT – II

Over current – under voltage - directional and non-directional relays.

Distance relays – impedance, reactance, mho and off set mho relays. Differential relays - circulating current and opposite voltage differential scheme. Negative sequence relays.

UNIT – III

Switchgear: Elementary principles of arc phenomenon - arc quenching - interruption of capacitive currents and low current chopping - resistance switching - recovery and restriking voltages. Principles of operations of various types of circuit breakers - air break – oil filled - air blast -vacuum and SF6 circuit breakers. Rating, testing and specifications of circuit breaker.

UNIT – IV

Protection of alternators, transformers and transmission lines: Differential protection for generators, transformers and transmission lines - field suppression of alternator - over current and distance protection for feeders - Translay relay.

Grounding: Neutral grounding - solid grounding - resistance and reactance grounding - Arc suppression coil.

Power System Earthing: Objectives – definitions - tolerable limits of body currents - soil resistivity and earth resistance.

UNIT – V

Static Relays: Introduction – basic component of static relays. Comparators – amplitude and phase comparators. Over current relays – instantaneous over current relay – inverse time over current relays – differential relays.

TEXT BOOKS:

1) Power System Protection and Switchgear by B.Ram – Tata Mc-Graw Hill Pub 2001
2) Electrical power systems by C.L. Wadhwa, New age International (P) Limited
3) Fundamentals of Power System Protection by Y.G. Paithankar &S.R.Bhide, PHI, 2003

REFERENCE BOOKS:

1) Power system protection Static relays by T.S. Madhava Rao TMH 2nd edition 1981
2) The Art and Science of protective relaying by Mason Wiley Eastern Ltd
3) Power system protection and switchgear by B. Ravindranath, Chander Willy Eastern Ltd 1992
4) Switchgear and protection by Sunil S. Rao Khanna Publications.

CO-PO/PSO MAPPING MATRIX:

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

EE 414/1 (R20): FACTS CONTROLLERS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the concept of protective relaying and the different types of relays such as over current, under voltage, directional and non-directional, distance, differential and negative sequence relays.
- Analyze the arc phenomenon, arc quenching and interruption of capacitive currents and low current chopping in switchgear and circuit breakers such as air break, oil-filled, air blast, vacuum and SF6 circuit breakers.
- Explain the principles of operation and control of static shunt compensators like SVC and STATCOM and static series compensators like GCSC, TSSC, TCSC and SSSC for improving power quality and stability in AC systems.
- Develop an understanding of the concept of FACTS and the basic types of FACTS controllers, including their operation, control and applications in power flow control, voltage regulation and transient and dynamic stability enhancement.
- Design and analyze power system earthing, neutral grounding, solid grounding, resistance and reactance grounding and arc suppression coil and determine soil resistivity and earth resistance limits for power system safety and protection.

UNIT-I

FACTS Concept and General system Considerations:

Power Flow in AC system - definitions on FACTS - Basic types of FACTS Controllers. Converters for Static Compensation – Basic concept of voltage-sourced converters. Single phase, three phase full wave bridge converters operation, Transformer connections for 12 pulse 24 and 48 pulse operation.

UNIT-II

Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters and comparison of current source converters with voltage source converters.

UNIT-III

Static Shunt Compensators:

SVC and STATCOM - Operation and Control of TSC, TCR, STATCOM - Comparison between SVC and STATCOM - STATCOM for transient and dynamic stability enhancement.

UNIT-IV

Static Series Compensation:

GCSC, TSSC, TCSC and SSSC - Operation and Control - External System Control for series compensators - SSR and its damping - Static Voltage and Phase Angle Regulators - TCVR and TCPAR - Operation and Control.

UNIT-V

UPFC and IPFC:

The unified Power Flow Controller – Operation - Comparison with other FACTS devices - control of P and Q - Dynamic Performance - Special Purpose FACTS controllers -Interline Power flow Controller - Operation and Control.

TEXT BOOKS:

1) Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, 2000 by N.G. Hingorani & L.Gyugyi
2) FACTS Controllers in power transmission and Distribution, K.R.Padiyar, New Age Int. Publisher, 2007

REFERENCE BOOKS:

1) Power Electronics by Ned Mohan et. al , John Wiley & sons
2) Reactive Power Control in Electric Systems by T.J.E. Miller , John Wiley & sons
3) Introduction to FACTS controllers by Kalyan K Sen, Mey Ling Sen – John Wiley 2009

CO-PO/PSO MAPPING MATRIX:

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

EE 414/2 (R20): MACHINE LEARNING

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the different types of machine learning including supervised, unsupervised and reinforcement learning and differentiate between machine learning, AI and deep learning.
- Implement linear regression models, including simple and multiple linear regression and evaluate the performance of the model using industry-relevant metrics.
- Build logistic regression models, including univariate and multivariate logistic regression, for categorical data and text classification and apply them to industry applications.
- Utilize decision trees, naive Bayes, support vector machines and ensemble methods, including bagging and boosting, Ada Boost, gradient boosting and random forests, for supervised learning tasks.
- Apply unsupervised learning techniques, such as feature selection, dimensionality reduction and clustering, to analyze and classify data and identify anomalies and fraud in case studies.

UNIT-I Introduction to ML: Introduction; Types of Machine Learning – Supervised, Unsupervised, Reinforcement; Process of Machine Learning; Machine Learning vs AI; Machine Learning vs Deep Learning.

UNIT-II Supervised Learning-1: Linear Regression: Introduction to Simple Linear Regression; Simple Linear Regression in Python; Multiple Linear Regressions; Multiple Linear Regression in Python; Industry Relevance of Linear Regression. Logistic Regression: Univariate Logistic Regression; Multivariate Logistic Regression – Model Building; Multivariate Logistic Regression – Model Evaluation; Lgistic Regression - Industry Applications. Decision Trees: Introduction to Decision Trees; Algorithms for Decision Tree; Construction, Truncation and Pruning.

UNIT-III Supervised Learning-2: Naive Bayes: Bayes Theorem and Its Building Blocks; Naive Bayes for Categorical Data; Naive Bayes for Text Classification. Support Vector Machine (SVM): SVM - Maximal Margin Classifier; SVM - Soft Margin Classifier; Kernels. Ensembles methods: Bagging & boosting, AdaBoost; Gradient Boosting; Random Forests.

UNIT-IV Unsupervised Learning-1: Feature selection: K-Nearest Neighbors - Computational geometry, K-Nearest Neighbour algorithm, Aspects to consider while designing K-Nearest Neighbour. Dimensionality Reduction: Principal Component Analysis (PCA); Singular Value Decomposition (SVD); t-Distributed Stochastic Neighbor Embedding (t-SNE).

UNIT-V Unsupervised Learning-2: Clustering: Introduction to Clustering; Different clustering methods (Distance, Density and Hierarchical); K Means Clustering; Executing K Means in Python; constructing a hierarchical cluster; Case Study (Clustering/Anomaly/Fraud Detection).

TEXT BOOKS:

1)Machine Learning, Tom Mitchell, McGraw Hill, 1997, ISBN: 978-0070428072

2) Python Machine Learning, Sebastian Raschka and VahidMirjalili, ISBN: 978-1783555130

3) Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools and Techniques to Build Intelligent Systems, AurélienGéron, ISBN: 978-1491962299

REFERENCE BOOKS:

1) Pattern Recognition and Machine Learning, Christopher M. Bishop, ISBN: 978-0387310732.
2) The Hundred-Page Machine Learning Book andriy Burkov, ISBN: 978-1999579500
3) Understanding Machine Learning: From Theory to Algorithms, Shai Shalev-Shwartz and Shai Ben David. VFSTR 111 Source.

CO-PO/PSO MAPPING MATRIX:

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

EE 414/3(R20): HIGH VOLTAGE ENGINEERING

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the principles and techniques of generation of impulse voltages and currents and high DC and AC voltages.
- Understand the measurement techniques for high voltages and the factors affecting corona.
- Analyze the various testing techniques for insulators, bushings, isolators and circuit breakers.
- Apply numerical methods such as the finite difference method, finite element method, charge simulation method and boundary element method for electrical field computation.
- Evaluate and compare different high voltage generators and measurement techniques for practical applications in the field of high voltage engineering.

UNIT-I

Generation of Impulse Voltages: Standard specifications - standard wave shapes for testing - properties of double exponential wave shapes - approximate estimate of wave shape control resistors - Multistage impulse generator - Energy of impulse generator.

Generation Of Impulse Currents: Standard specifications - analysis of impulse current generator.

UNIT-II

Generation Of High D.C And A.C Voltages: Principle of Voltage Doubler circuit - Cockcroft-Walton cascade arrangement and its Mathematical analysis - cascade connection of transformers - Resonant transformers - Tesla coil.

UNIT-III

Measurement Of High Voltages: General concepts of High voltage measurements - voltage Dividers (Resistive, Inductive and Capacitive) for impulse measurement. High speed Oscilloscope - peak voltmeter and Sphere gap. Use of fiber optics in H.V measurement of high voltage DC - Layout of high voltage lab.

UNIT-IV

Corona: Corona - factors affecting corona - critical voltages and power loss - Radio interference due to Corona.

High Voltage Testing Techniques: Testing of insulators – Bushings - isolators and CB's - Testing of transformers, Fault detection using Wavelets-theoretical aspects.

UNIT-V

Numerical Methods for Electrical Field Computation: Finite difference method - Finite element method - charges simulation methods - Boundary element methods.

TEXT BOOKS:

1) High Voltage Engineering fundamentals by Kuffel, E, Zaengl W.S, Kuffel J (2^{nd}ed.) Burrerworths Hsinemann
2) High Voltage Engineering by M.S. Naidu & V.Kamaraju, TMH
3) High voltage engineering by CL Wadhwa, New age International.

REFERENCE BOOKS:

1) High Voltage Laboratory techniques by J.D. Craggs & Meak Butter Worths scientific publications, London.
2) Extra High Voltage Engineering by Rakesh Das Begamudre, New Age International
3) High Voltage measurement techniques by Schawab, M.I.T Press Cambridge, Massachusetts
4) Transformers – BHEL 2^{nd} edition, TMH
5) Finite elements for electrical engineers by silvester and peter, Cambridge University press 3^{rd} edition, 1996

CO-PO/PSO MAPPING MATRIX:

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

EE 415/1(R20): ELECTRIC& HYBRID VEHICLES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the basics of vehicle performance and power sources and be able to use mathematical models to describe vehicle performance.
- Explain the history and importance of hybrid and electric vehicles and their impact on modern drive-trains and energy supplies.
- Describe the basic concept of hybrid and electric drive-trains, including power flow control and fuel efficiency analysis.
- Understand electric components used in hybrid and electric vehicles and be able to configure and control different types of electric propulsion units.
- Explain the different types of energy storage requirements for hybrid and electric vehicles and be able to select and size the appropriate energy storage technology for a given application.

Unit I

Introduction:

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

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

Unit II

Hybrid Electric Drive-trains:

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

Unit III

Electric Trains

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

Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit IV

Energy Storage

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis,

Hybridization of different energy storage devices. Sizing the drive system: Matching the electricmachine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT V

Energy Management Strategies

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

TEXT / REFERENCE BOOKS:

1) C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2) S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3) M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.
4) T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

CO-PO/PSO MAPPING MATRIX:

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

EE 415/2 (R20): RENEWABLE ENERGY SOURCES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the principles of renewable energy and energy planning, efficiency and management.
- Analyze solar radiation and its conversion through solar thermal and photovoltaic systems.
- Evaluate wind energy, including wind turbine operation and electrical generation.
- Explore energy extraction from oceans through OTEC, wave energy and tidal systems.
- Examine geothermal energy sources and the generation of electricity through direct combustion and biogas digestion.

UNIT-I

Principle of Renewable Energy: Comparison of renewable and conventional energy sources - Ultimate energy sources - natural energy currents on earth - primary supply to end use - Spaghetti & Pie diagrams - energy planning - energy efficiency and management.

UNIT-II

Solar Radiation: Extra-terrestrial solar radiation - terrestrial solar radiation - solar thermal conversion - solar thermal central receiver systems - photovoltaic energy conversion - solar cells – 4 models.

UNIT-III

Wind energy: Planetary and local winds - vertical axis and horizontal axis wind mills - principles of wind power - maximum power - actual power - wind turbine operation - electrical generator.

UNIT-IV

Energy from Oceans: Ocean temperature differences - principles of OTEC plant operations - wave energy - devices for energy extraction – tides - simple single pool tidal system.

UNIT-V

Geothermal energy: Origin and types - Bio fuels – classification - direct combustion for heat and electricity generator - anaerobic digestion for biogas - biogas digester - power generation.

TEXT BOOKS:

1) Renewable Energy Sources by John Twidell & Toney Weir : E & F.N. Spon
2) Renewable Energy Sources: Their impact on global warming and pollution by Abbasi & Abbasi –PHI

REFERENCE BOOKS:

1) Power plant technology by EL-Wakil, McGraw-Hill
2) Non-Conventional Energy Sources by G.D.Rai, Khanna Pub.

CO-PO/PSO MAPPING MATRIX:

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

EE 415/3 (R20): UTILIZATION OF ELECTRICAL ENERGY

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the principles of electric traction systems, compare between DC and AC systems and analyze the mechanics of train movement, power and energy output.
- Analyze the different modes of heat transfer and heating methods and design heating elements for induction furnaces, resistance furnaces and dielectric heating.
- Understand the various types of welding, compare resistance and arc welding and identify the requirements of a good weld.
- Analyze the terms used in illumination, calculate illumination using square law methods and design lighting schemes for factories, flood lighting and street lighting.
- Understand the applications, classification and charging methods of storage batteries, specifically lead acid and nickel cadmium batteries.

UNIT – I

Electric Traction: Introduction- Systems of electric traction- comparison between DC and AC systems in electric traction - mechanics of train movement- speed-time curves- effect of speed-acceleration and distance on schedule- Power and energy output from driving axles- specific energy output- collectors - introduction to electric braking – comparison of electric and mechanic braking.

UNIT – II

Electric Heating: Introduction; Modes of heat transfer - Stefan's law -classification of electric heating methods- design of heating element - Construction and working of different types of induction furnaces - resistance furnace - Dielectric heating - arc furnaces .

UNIT – III

Welding: Introduction- Types of welding - resistance and arc welding - Characteristics of Carbon and metallic arc welding - comparison (Excluding electronic controls)- requirements of good weld-ultra sonic-electron beam-laser beam welding.

UNIT – IV

Illumination: Introduction- terms used in illumination-laws of illumination-Gas discharge lamps - Fluorescent lamps - Arc lamps - Filament lamps – comparison between filament and fluorescent lamps-square law methods of calculation - Factory lighting - flood lighting and street lighting-design of lighting schemes-introduction to Compact Fluorescent Lamps.

UNIT – V

Storage batteries: Applications-rating-classification-dry cell and wet cells-primary and secondary cells-charging and discharging of lead acid cells, trickle charging-methods of charging lead acid batteries-over discharging-common troubles with lead acid batteries and remedies-Nickel cadmium batteries.

TEXT BOOKS:

1) A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U. S. Bhatnagar and A. Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 2001.
2) Utilization Electric Power and electric traction by J.B.Gupta, publishers-Katson books
3) Utilization, generation & conservation of electrical energy by Sunil S Rao, Khanna publishers.

REFERENCE BOOKS:

1) Generation, Transmission & Utilization Electric Power by A.T. Starr London, Pitman. 1953
2) Art and Science of Utilization of Electrical Energy by Partab H DhanpatRai and Sons, New Delhi. Second edition

CO-PO/PSO MAPPING MATRIX:

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

EE 416 (R20): INDUSTRIAL MANAGEMENT AND ENTREPRENEUR DEVELOPMENT

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

After completion of this course, students will be able to

- Understand the techniques and methods of forecasting and their application in business decision making.
- Gain knowledge on the role and qualities of an entrepreneur and the process of registration of Small Scale Industries (SSI).
- Learn the principles of materials management, types of inventories and inventory control techniques such as EOQ, EPQ and ABC analysis.
- Understand the functions of general management and the different levels of management and get an overview of forms of business organization.
- Develop an understanding of marketing management concepts, such as market research, advertising and product life cycle and financial management concepts, such as simple and compound interest and methods of depreciation.

UNIT -I

Forecasting: Techniques of Forecasting, methods of forecasting, moving average, least squares, simple exponential smoothing, linear regression, correlation coefficient, problems. Entrepreneurial Development: Entrepreneurship, Qualities of Entrepreneur, Role of Entrepreneur, Expectations of Entrepreneur, SSI, Registration of SSI.

UNIT – II

Materials Management and MRP: Functions of materials management, purpose of inventories, types of inventories, EOQ, EPQ, Buffer stock, Reserve stock, Safety stock, relevant costs in inventory control, ABC and VED analysis,Single period inventory model.

Materials requirement planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials, Source Selection, Vendor rating.

UNIT – III

General Management: Principles of scientific management, Principles of general management, Levels of Management, Managerial skills, brief treatment of managerial functions: planning, organizing, staffing, directing, coordinating and controlling.

Forms of Business Organization: Salient features of sole proprietorship, partnership, Joint Stock Company: private limited and public limited companies.

UNIT – IV

Marketing Management: Concept of selling and marketing – differences, functions of marketing, market research, Purchasing methods, selection of vendor, advertising and sales promotion methods, distribution channels-types, product life cycle.

Financial Management: Functions of finance, simple and compound interest, depreciation, common methods of depreciation: straight line method, declining balance method, sum of years digits method, Types of depreciation, Cash flow diagram.

UNIT-V

Personnel Management: The personnel Management function, Training and Development, recruitment, selection, performance appraisal, Styles of Leader ship, Theories of Motivation.Job Design and Analysis: Job design, Approaches of Job design, Job enrichment, Techniques of Job enrichment, Job Analysis,job description, job specification

TEXT BOOKS:

1) KK Ahuja, Industrial Management, Vol. I & II, Dhanpat Rai, 1978.
2) E.Paul Degarmo, John R Chanda, William G Sullivan, Engineering Economy, Mac Millan Publishing Co, 1979

REFERENCE BOOKS:

1) Philip Kotler, Marketing Management, 11th Edition, Pearson Education, 2004.
2) P. Gopalakrishnan, Hand Book of Materials Management, PHI, 1999

CO-PO/PSO MAPPING MATRIX:

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

EE451 (R20): POWER SYSTEMS LAB

L-0	T-0	P-3	M-100	C-2

COURSE OUTCOMES:

After completion of this course, students will be able to

- Analyze and compare the characteristics of different types of protective relays used in power systems, including over current, overvoltage, under voltage, differential, definite time reverse power and negative sequence relays.
- Calculate the sequence impedances of alternators and transformers to determine their performance under different operating conditions.
- Design and implement power factor correction techniques for induction motors to improve their efficiency and reduce energy consumption.
- Evaluate the performance of transmission lines by analyzing their parameters and accounting for phenomena such as regulation, efficiency and Ferranti effect.
- Develop programs using different methods (Gauss-Seidel, Newton-Raphson, FDLP) to perform load flow analysis and solve power system problems related to voltage stability and power transfer.

LIST OF EXPERIMENTS:

1) Characteristics of over current relay & Earth fault relay
2) Characteristics of over voltage / under voltage relay
3) Characteristics of differential relay
4) Characteristics of definite time reverse power relay
5) Characteristics of negative sequence relay
6) Sequence impedances of alternator
7) Harmonic analysis using power network analyzer
8) Characteristics of distance relays
9) Power factor correction of induction motor
10) Determination of Transmission line parameters
11) Regulation and efficiency of transmission line including Ferranti effect
12) Reactive power control by tap changing transformers
13) Sequence impedances of transformer
14) Grading of Insulators
15) Develop a program for Y_{bus} by inspection
16) Develop a program for Z_{bus} using Z_{bus} building algorithm
17) Develop a program for Load flow analysis by Gauss - Seidel method
18) Develop a program for load flow analysis by Newton - Raphson method
19) Develop program for load flow analysis by FDLP method.

Note: Minimum of ten experiments have to be performed and recorded by the candidate to attain eligibility for University Examinations.

CO-PO/PSO MAPPING MATRIX:

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

HONOURS DEGREE COURSES

EEH101 (R20): ENERGY STORAGE SYSTEMS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Electricity: Students will learn why electricity is important and how it's used in our daily lives.
2) Solving Energy Problems: Students will discover how electrical energy storage can help solve problems like high energy costs and power grid issues.
3) Types of Storage: Students will recognize different ways to store electricity, like using batteries, mechanical systems, or chemicals.
4) Evaluating Performance: Students will be able to judge how well these storage systems work and which ones are most efficient.
5) Practical Applications: Students will see how electrical energy storage is used in real-life situations, like renewable energy, power plants, and electric vehicles.

Unit – I

Electrical Energy Storage Technologies:

Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, long distance between generation and consumption, Congestion in power grids, Transmission by cable.

Unit –II

Needs for Electrical Energy Storage:

Emerging needs for EES, more renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

Unit – III

Features of Energy Storage Systems:

Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG).

Unit – IV

APPLICATION CONSIDERATION

Comparing Storage Technologies – Technology options – Performance factors and metrics – Efficiency of Energy Systems – Energy Recovery – Battery Storage System; Introduction with focus on Lead Acid and Lithium – Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance. Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

TEXT BOOKS:

1) Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion", John Wiley and Sons, 2012.
2) Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage",The Electrochemical Society, New Jersy,2010.
3) "James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004.

REFERENCE BOOKS:

1) "Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.
2) A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN – 13:9789380090122), 2011.

NPTEL COURSE LINKS:

1) NPTEL:: Electrical Engineering - NOC: energy storage systems, https://nptel.ac.in/courses/113/105/113105102/

CO-PO/PSO MAPPING MATRIX:

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

EEH102 (R20): ADVANCED POWER ELECTRONICS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Switching Devices: Students will gain a basic understanding of different switching devices like MOSFETs, IGBTs, GTOs, and GaN devices and their characteristics.
2) Gate Drive Circuits: Students will learn how to control these devices using gate drive circuits, including their static and dynamic characteristics.
3) Single-Phase Converters: Students will be able to analyze and design single-phase AC-DC converters, considering factors like input power factor, harmonics, and control techniques.
4) Three-Phase Converters: Students will understand three-phase AC-DC converters and evaluate their performance in terms of input power factor and harmonic content.
5) Power Factor Correction: Students will study power factor correction techniques, including single-phase and three-phase boost power factor corrected rectifiers, and learn how they improve power quality.

UNIT– 1

Overview of Switching Devices: Power MOSFET, IGBT, GTO, GaN devices-static and Dynamic characteristics, gate drive circuits for switching devices.

UNIT– 2

AC-DC converters: Single phase fully controlled converters with RL load– Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current, Power factor improvements, Extinction angle control, symmetrical angle control, PWM control. Three Phase AC-DC Converters, fully controlled converters feeding RL load with continuous and discontinuous load current, Evaluation of input power factor and harmonic factor-three phase dual converters.

UNIT– 3

Power Factor Correction Converters: Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter

UNIT– 4

PWM Inverters: Principle of operation-Voltage control of single phase inverters - sinusoidal PWM –modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters-Sinusoidal PWM- 600PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters-Variable dc link inverter.

TEXT BOOKS:

1) Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
2) Daniel W. Hart - McGraw-Hill,2011.

REFERENCE BOOKS:

1) Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
2) Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
3) Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee CRC Press, 2004.

CO-PO/PSO MAPPING MATRIX:

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

EEH103 (R20): SMART GRID TECHNOLOGY AND APPLICATIONS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Smart Grid: Students will gain a foundational understanding of what a Smart Grid is, including its significance in addressing issues like ageing assets, thermal constraints, and security of supply.
2) National Initiatives: Students will learn about national initiatives and early Smart Grid projects that have contributed to the development of modern electrical grids.
3) Information Security: Students will understand information security concepts such as encryption, authentication, and digital signatures, as they apply to the protection of Smart Grid data.
4) Demand Side Integration: Students will discover the services provided by Demand Side Integration (DSI) and how it uses data sources, modeling, and analysis tools to enhance distribution system management.
5) Distribution System Modeling: Students will gain practical knowledge of distribution system modeling, topology analysis, load forecasting, power flow analysis, and fault calculations to improve grid operation and management.

Unit-I

The Smart Grid: Introduction, Ageing Assets and Lack of Circuit Capacity, Thermal Constraints, Operational Constraints, Security of Supply, National Initiatives, Early Smart Grid Initiatives, Active Distribution Networks, Virtual Power Plant, Other Initiatives and Demonstrations, Overview of The Technologies Required for The Smart Grid.

Unit-II

Information and Communications Technology for the Smart Grid

Data communication: Introduction, Dedicated and shared communication channels, Switching techniques, Communication channels, Layered architecture and protocols.

Communication technologies for the Smart Grid: Introduction- Communication technologies-IEEE 802 series, Mobile communications, Multi-protocol label switching, Power line communication. Standards for information exchange-Standards for smart metering Modbus, DNP3, IEC 61850.

Information security for the Smart Grid: Encryption and decryption, authentication, Digital signatures, Cyber security standards

Unit-III

Smart Metering and Advanced Metering infrastructure

Introduction, smart metering – evolution of electricity metering, key components of smart metering, smart meters: an overview of the hardware used – signal acquisition, signal conditioning, analogue to digital conversion, computation, input/output, and communication.

Communication infrastructure and protocols for smart metering- Home area network, Neighborhood Area Network, Data Concentrator, meter data management system, Protocols for communication.

Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives.

Unit-IV

Demand Side Integration and Distribution Management Systems

Demand Side Integration- Services Provided by DSI. Introduction Data Sources and Associated External Systems, SCADA, Customer Information System, Modeling and Analysis Tools, Distribution System Modeling, Topology Analysis, Load Forecasting, Power Flow Analysis, Fault Calculations, Applications, System Monitoring, Operation, Management, Outage Management System.

TEXT BOOKS:

1) Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012, Reprint 2015.
2) Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press., 2012, Reprint 2016.

REFERENCE BOOKS:

1) The Smart Grid – Enabling Energy efficiency and demand response, Clark W. Gellings, P.E., CRC Press, Taylor & Francis group, First Indian Reprint. 2015.
2) Smart Grid – Applications, Communications, and Security Edited by Lars Torsten Berger, Krzysztof Iniewski, WILEY, 2012, Reprint 2015.
3) Practical Electrical Network Automation and Communication Systems, Cobus Strauss, ELSVIER, 2003.

NPTEL VIDEO LINK:

1) https://nptel.ac.in/courses/108/107/108107113/

CO-PO/PSO MAPPING MATRIX:

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

EEH104 (R20): ELECTRICAL AND HYBRID VEHICLES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Vehicle Performance Basics: Students will grasp the basics of vehicle performance, including power sources, transmission characteristics, and mathematical models used to describe vehicle behaviour.
2) Electric Drive-Trains: Students will be introduced to electric drive-train concepts, various topologies, and power flow control techniques.
3) Hybrid Drive-Trains: Students will understand hybrid drive-trains, explore different topologies, and learn how to control power flow in hybrid systems.
4) Energy Storage Requirements: Students will recognize the energy storage needs in electric vehicles and the importance of various energy storage devices.
5) Hybrid Energy Storage: Students will explore the concept of hybridizing different energy storage devices for improved electric vehicle performance.

Unit-I

Introduction and Vehicle Fundamentals: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

Unit-II

Electric and Hybrid drive-trains: Basic concept of electric traction - introduction to various electric drive-train topologies - power flow control in electric drive-train topologies, Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies.

Unit-III

Electric propulsion unit: Introduction to electric components used in electric vehicles - Configuration and control of DC Motor drives - Configuration and control of Induction Motor drives-Configuration and control of Permanent Magnet Motor drives - Configuration and control of Switch Reluctance Motor drives - Drive system efficiency.

Unit-IV

Energy storage: Introduction to Energy Storage Requirements in Electric Vehicles - Battery based energy storage and its analysis - Fuel Cell based energy storage and its analysis - Super Capacitor based energy storage and its analysis -Hybridization of different energy storage devices.

TEXT BOOKS:

1) Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press,Second Edition 2005.
2) Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3) Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.

REFERENCE BOOKS:

1) James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, Second Edition 2003.
2) H. Partab: Modern Electric Traction – Dhanpat Rai& Co, 2007.
3) Bimal Bose, 'Power electronics and motor drives', Elsevier, First Edition 2006.
4) Ion Boldea and S.A Nasar, 'Electric drives', CRC Press, Second Edition 2005.

NPTEL VIDEO LINKS:

1) https://nptel.ac.in/courses/108/103/108103009/
2) https://nptel.ac.in/courses/108/106/108106182/
3) https://nptel.ac.in/courses/108/102/108102121/

CO-PO/PSO MAPPING MATRIX:

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

EEH201 (R20): EXTRA HIGH VOLTAGE TRANSMISSION

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Transmission Line Trends: Students will learn about the trends in Extra-High Voltage (E.H.V) AC transmission lines and the standard transmission voltages used in these systems.
2) Line Parameters: Students will understand how to estimate line and ground parameters, including inductance, capacitance, and impedance for different modes of propagation.
3) Electrostatic Field Calculations: Students will be able to calculate electrostatic fields around AC transmission lines and assess their potential effects on biological organisms and human beings.
4) Voltage Gradients: Students will learn to calculate surface voltage gradients and identify the maximum gradients on actual transmission lines.
5) Corona in E.H.V. Lines: Students will explore corona phenomena in E.H.V. lines, including corona loss and Radio Interference formulas and the generation of audio noise due to corona.

Unit-I

E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages: Estimation at line and ground parameters-Bundle conductor systems-Inductance and Capacitance of E.H.V. lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

Unit-II

Electrostatic field and voltage gradients: calculations of electrostatic field of AC lines – effect of high electrostatic field on biological organisms and human beings – surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor.

Unit-III

Electrostatic induction in un energized lines: measurement of field and voltage gradients for three phase single and double circuit lines – un energized lines. Power Frequency Voltage control and over voltages in EHV lines: No load voltage – charging currents at power frequency-voltage control – shunt and series compensation – static VAR compensation.

Unit-IV

Corona in E.H.V. lines – Corona loss formulae- attention of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona – properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV.

TEXT BOOKS:

1) R. D. Begamudre, "EHVAC Transmission Engineering", New Age International (p) Ltd. 3rd Edition.
2) K.R. Padiyar, "HVDC Power Transmission Systems" New Age International (p) Ltd. 2nd revised Edition, 2012.

REFERENCE BOOKS:

1) S. Rao "EHVAC and HVDC Transmission Engineering. Practice" Khanna publishers.
2) Arrillaga. J "High Voltage Direct Current Transmission" 2nd Edition (London) Peter Peregrines, IEE, 1998.
3) Padiyar. K.R, "FACTS Controllers in Power Transmission and Distribution" New Age International Publishers, 2007.
4) Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.

CO-PO/PSO MAPPING MATRIX:

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

EEH202 (R20): ADVANCED POWER SYSTEM PROTECTION

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Students will acquire knowledge of the fundamental principles and components of electromagnetic relays
2) Students will be able to analyze the basic block diagrams of microprocessor-based relays.
3) Students will explore the developments in computer relaying and its impact on modern protective relaying systems.
4) Students will learn to apply artificial neural networks to overcurrent protection and transmission line protection, enhancing their understanding of AI-based relaying.

UNIT -I

Static Relays: Basics of Electromagnetic Relays, Basic Block diagram – Advantages of Static Relays – Comparators – Phase and amplitude Comparators. Operating principles–Static Over current relays – Differential relays – distance relays – Pilot relaying and Carrier current protection schemes – Protection of Transmission lines – 3–zone protection schemes – carrier aided distance schemes. Transformer protection – mal operation of relays – Harmonic Restraint relay

UNIT –II

Microprocessor Base Relays: Basic Block diagram, advantages of Microprocessor Based Relays, Over Current relay, impedance relay, directional relay, reactance relay, Mho relay, offset Mho relay.

UNIT – III

Digital relays: Developments in computer relaying mathematical basis for protective relaying algorithms, Differential equation based technique, Fourier based algorithms, Wavelet transforms based technique, Numerical Over current Protection, numerical Distance protection, Numerical Differential protection

UNIT – IV

AI Based Numerical Protection: Application of ANN to over current protection, Application of ANN to Transmission line protection, Neural Networks Based Directional

Relay, ANN modular approach for fault detection, classification and location, ANN Fuzzy based approach for fault classification Power transformer protection based on ANN & Fuzzy logic.

TEXT BOOKS:

1) T.S.MadhavaRao, "Power System Protection: Static Relays: with Microprocessor Applications", 2ND Edition, McGraw Hill Education, 2017.

2) Badri Ram, "Power System Protection and Switchgear ", 2nd Edition, McGraw Hill Education, 2017.
3) A.T.Johns and S.K.Salman, "Digital Protection for Power Systems", Shankars Book Agency, 2008.

REFERENCE BOOKS:

1) Oza, B. A., N. C. Nair, R. P. Mehta, et al., Power System Protection & Switchgear, McGraw Hill Education, New Delhi, 2017.
2) Bhavesh Bhalja, R. P. Maheshwari, N. G. Chothani, Protection and Switchgear, Oxford University Press, 2nd Edition, New Delhi, India, 2018.

NPTEL COURSE LINKS:

1) https://nptel.ac.in/courses/117/107/117107148/
2) https://nptel.ac.in/courses/108/105/108105167/
3) https://nptel.ac.in/courses/108/101/108101039/

CO-PO/PSO MAPPING MATRIX:

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

EEH203 (R20): POWER QUALITY

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Power Quality: Students will gain a fundamental understanding of electric power quality phenomena, including voltage fluctuations, transients, unbalance, waveform distortion, and power frequency variations.
2) Power Quality Disturbances: Students will be able to identify and define various power quality disturbances and their significance in electrical systems.
3) Voltage Sags and Interruptions: Students will learn about the sources of voltage sags and interruptions, methods for estimating sag performance, and protection principles. They will also explore solutions at the end-use level and issues related to motor-starting sags and utility system fault clearing.
4) Harmonics and Mitigation: Students will study the fundamentals of harmonics, including their sources, definitions, standards, and impacts on electrical systems. They will learn to calculate and simulate harmonic effects, explore harmonic power flow, and understand mitigation and control techniques, including filtering, passive, and active solutions.
5) Power Quality Conditioners: Students will be introduced to power quality conditioners, including shunt and series compensators, DStatcom, Dynamic Voltage Restorer (DVR), and Unified Power Quality Conditioners (UPQC).

UNIT – I

INTRODUCTION

Electric power quality phenomena - IEC and IEEE definitions - power quality disturbances - voltage fluctuations-transients-unbalance-waveform distortion-power frequency variations. Voltage variations - Voltage sags and short interruptions – flicker -longer duration variations.

UNIT – II

VOLTAGE SAGS AND INTERRUPTIONS

Sources of sagas and interruptions, Estimating voltage sag performance, fundamental principles of protection, solutions at the end-use level, Motor-starting sags, utility system fault-clearing Issues.

TRANSIENT OVER VOLTAGES

Sources of over voltages, principles of over voltage protection, devices for over voltage Protection, utility capacitor-switching transients, utility system lightning protection.

UNIT – III

FUNDAMENTALS OF HARMONICS

Harmonics – sources – definitions & standards – impacts - calculation and simulation – harmonic power flow - mitigation and control techniques – filtering – passive and active

UNIT – IV

POWER QUALITY CONDITIONERS

Power Quality conditioners – shunt and series compensators - DStatcom - Dynamic voltage restorer - unified power quality conditioners - case studies

TEXT BOOKS:

1) Electrical Power Systems Quality, Roger C. Dugan, Mark F.McGranaghan, Surya Santoso,
2) H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ptd.
3) Power quality by C. Sankaran, CRC Press.

REFERENCE BOOKS:

1) Electrical systems quality Assessment by J. Arrillaga, N.R. Watson,S. Chen, John Wiley & Sons.
2) Understanding Power quality problems by Math H. J. Bollen IEEE Press.

CO-PO/PSO MAPPING MATRIX:

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

EEH204 (R20): POWER SYSTEMS DYNAMICS AND CONTROL

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Modeling Synchronous Machines: Students will be able to represent synchronous machines in state space, including their excitation and governor systems, and model loads and induction machines.
2) Understanding Computer Representation: Students will understand how computer representation is used to simulate the behavior of power system components.
3) Steady State and Dynamic Stability: Students will learn about steady state stability limits and dynamic stability analysis in power systems.
4) Transient Stability Simulation: Students will learn to simulate transient stability using digital methods, including the swing equation, representation of loads, and solution techniques like Modified Euler method and Runge-Kutta method.
5) Excitation System Types: Students will understand various types of excitation systems, including rotating self-excited exciters, rotating main and pilot exciters, rotating amplifiers, static voltage regulators, and brushless excitation systems.

UNIT – 1

System Dynamics: Synchronous machine model in state space from computer representation for excitation and governor system –modelling of loads and induction machines.

UNIT – 2

Steady state stability – steady state stability limit – Dynamics Stability limit – Dynamic stability analysis – State space representation of synchronous machine connected to infinite bus-time response – Stability by eigen value approach.

UNIT – 3

Digital Simulation of Transient Stability: Swing equation machine equations – Representation of loads – Alternate cycle solution method – Direct method of solution – **Solution Techniques:**

Modified Euler method – Runge Kutta method – Concept of multi machine stability. Effect of governor action and excite on power system stability effect of saturation, saliency & automatic voltage regulators on stability**.**

UNIT – 4

Excitation Systems: Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator – Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme – Brushless excitation system.

TEXT BOOKS:

1) Power System Stability by Kimbark Vol. I&II, III, Willey.
2) Power System control and stability by Anderson and Fund, IEEE Press.

REFERENCE BOOKS:

1) Power systems stability and control by PRABHA KUNDUR, TMH.
2) Computer Applications to Power Systems–Glenn.W.Stagg& Ahmed. H.El.Abiad, TMH.
3) Computer Applications to Power Systems – M.A.Pai, TMH.
4) Power Systems Analysis & Stability – S.S.VadheraKhanna Publishers

CO-PO/PSO MAPPING MATRIX:

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

MINOR DEGREE COURSES

EEM11 (R20): POWER GENERATION AND TRANSMISSION

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Economic Factors: Students will gain an understanding of the economics of power generation, including factors influencing generation costs, such as load factor, diversity factor, and plant use factor. They will learn how interconnecting stations can reduce costs and explore power factor considerations and tariff characteristics.
2) Choice of Power Stations: Students will learn how to select the appropriate type of power station, generator unit sizes, and consider load duration curves and the impact of variable loads on plant operation and design.
3) Thermal, Hydro, Nuclear, and Solar Power: Students will understand the components and operation of thermal power stations, hydroelectric power plants, and nuclear power plants. They will also explore the principles of solar and wind power generation, including solar radiation, collectors, and windmill performance characteristics.
4) Modeling of Transmission Lines: Students will be able to classify transmission lines based on their length and learn how to represent them using nominal-T, nominal-pi, and A, B, C, D constants.
5) Modeling Power System Components: Students will learn how to model power system components, including transmission lines, transformers (two-winding, three-winding, phase-shifting), and phase diagrams for system studies.

UNIT – I

Economical Aspects: Economics of generation - factors affecting cost of generation - Definitions: load factor – diversity factor – plant use factor - reduction of cost by inter connected stations. Power factor considerations – causes of low power factor – methods of improving power factor – phase advancing and generation of reactive KVAR – most economical power factor for constant KW load and constant KVA type loads. Tariff: Characteristics of Tariff – types of Tariff.

Choice of power stations and units: Types of power stations – choice of generation - size of generator units – load duration curve – effect of variable load on plant operation and design.

UNIT -II

Thermal Power: Block Diagram of Thermal Power Station (TPS), Brief Description of Thermal Power system Components

Hydro Power: Selection of Site, Classification, Layout, Description of Main Components. **Nuclear Power**: Nuclear Fission and Chain Reaction-Principle of Operation of Nuclear Reactor. Description of Main Components.

Lar Power Generation: Role and Potential of Solar Energy Options, Principles of Solar Radiation, Solar Energy Collectors, Different Methods of Energy Storage – PV Cell- V-I Characteristics.

Wind Power Generation: Role and potential of Wind Energy Options, Horizontal and Vertical Axis Wind Mills- Performance Characteristics-Pitch & Yaw Controls – Economic Aspects.

UNIT-III

Transmission Line Parameters: Calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR & GMD, symmetrical and asymmetrical conductor configuration with and without transposition. Calculation of capacitance for 2 wire and 3 wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines.

Modeling of Transmission Lines: Classification of Transmission Lines - Short, medium and long line and their model - representations - Nominal-T, Nominal-Pie and A, B, C, D Constants. Mathematical Solutions to estimate regulation and efficiency of all types of lines-Long Transmission Line-Rigorous Solution, evaluation of A,B,C,D Constants.

UNIT-IV

Representation of power system Components: Modeling of power system components for system studies: transmission lines, two-winding transformers with nominal & off-nominal ratio tap settings, three-winding transformers, phase shifting transformers. One line diagram, Impedance and Reactance diagrams, advantages of Per Unit Computations, per unit quantities, changing the base, selection of base, per-unit impedances of three winding transformers.

TEXT BOOKS:

1) Electrical Power Generation, Transmission and Distribution by S.N.Singh., PHI, 2003.
2) Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers, 2000.
3) Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition 2010, Reprint 2014.

REFERENCE BOOKS:

1) Renewable Energy Resources – John Twidell and Tony Weir, Second Edition, Taylor and Francis Group, 2006.
2) Principles of Power Systems by V.K Mehta and Rohit Mehta S.CHAND & COMPANY LTD., New Delhi 2004.
3) Wind Electrical Systems by S. N. Bhadra, D. Kastha & S. Banerjee – Oxford University Press, 2013.
4) Power System Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 2nd Edition, 2008, 23rd Reprint 2015.
5) Electric Power Generation Distribution and Utilization by C.L Wadhwa, New Age International (P) Ltd., 2005.

CO-PO/PSO MAPPING MATRIX:

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

EEM12 (R20): ELECTRICAL CIRCUIT ANALYSIS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Network Theorems: Students will be able to explain and apply key network theorems, including the Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, and Compensation theorem.
2) Differential Equation Solutions: Students will solve first and second-order differential equations for R-L, R-C, and R-L-C circuits, considering initial and final conditions. They will analyze forced and free responses, time constants, and steady-state and transient state responses of circuits.
3) Three-Phase Circuits: Students will understand the principles of three-phase circuits, mutual coupled circuits, and ideal transformers, including the dot convention for coupled circuits.
4) Laplace Transform Analysis: Students will review the Laplace Transform and apply it to analyze electrical circuits with standard inputs, including convolution integrals and inverse Laplace transforms. They will also determine transfer functions and identify poles and zeros.
5) Frequency Response Analysis: Students will analyze frequency response, including magnitude and phase plots, for transformed circuits. They will study series and parallel resonances in circuits.

UNIT-I

Network Theorems (10 Hours) Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

UNIT-II

Solution of First and Second order networks (8 Hours) Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT-III

Sinusoidal steady state analysis (8 Hours) Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT-IV

Electrical Circuit Analysis Using Laplace Transforms (8 Hours) Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

TEXT BOOKS:

1) M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2) D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3) W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.

REFERENCE BOOKS:

1. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
2. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1996

CO-PO/PSO MAPPING MATRIX:

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

EEM13 (R20): DC & AC MACHINES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding DC Machine Construction: Students will grasp the basic construction of a DC machine, including the magnetic structure, stator components, and armature core. They will visualize the magnetic field produced by field winding excitation with the armature winding open.
2) Motoring and Generation Characteristics: Students will explore the armature circuit equations for both motoring and generation in DC machines.
3) Transformer Basics: Students will understand the principles, construction, and operation of single-phase transformers. They will explore the equivalent circuit, phasor diagrams, voltage regulation, and losses and efficiency in transformers.
4) Induction Machines: Students will study the construction, types (squirrel cage and slip-ring), torque-slip characteristics, starting, and maximum torque of induction machines. They will also understand the equivalent circuit, phasor diagrams, losses, and efficiency.
5) Synchronous Machines: Students will learn about the constructional features of synchronous machines, including cylindrical rotor synchronous machines.

UNIT-I

DC machines (8 Hours) Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation,Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

UNIT-II

DC machine - motoring and generation Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

UNIT-III

Transformers Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses

UNIT-IV

Induction Machines Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency.Synchronous machines Constructional features, cylindrical rotor synchronous machine –armature windings, pitch factor, distribution factor- generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation-two reaction theory, analysis of phasor diagram.

TEXT BOOKS:

1) A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2) M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3) P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

REFERENCE BOOKS:

1) I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
2) A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
3) P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

CO-PO/PSO MAPPING MATRIX:

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

EEM14 (R20): PRINCIPLES OF POWER ELECTRONICS

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Power Electronics Devices: Students will gain an understanding of power electronics devices, including the Thyristor family devices, their principles of operation, and the importance of protection mechanisms.
2) Firing Circuits and Commutation: Students will explore firing circuits used in power electronics and understand the concept of commutation. Additionally, they will learn about the operation, principles, and ratings of MOSFETs and IGBTs.
3) AC to DC Conversion: Students will study various AC to DC converter configurations, including uncontrolled, semi-controlled, fully controlled, and dual converters, in both single-phase and three-phase setups.
4) DC to AC Conversion: Students will learn the basics of DC to AC conversion, including inverter circuit configurations and principles of operation.
5) DC-DC and AC-AC Conversion: Students will be introduced to DC-DC converters, various topologies such as buck, boost, and buck-boost converters, and their applications. They will also learn about AC-AC conversion, including single-phase and three-phase voltage controller circuit configurations with resistive loads.

UNIT-I

Introduction to Power Electronics devices protection and Power Transistors:

Thyristor family devices, principle of operation, Snubber designs, selection and protection, Firing circuits, Commutation, MOSFET, IGBT operation, principles and ratings.

UNIT-II

AC to DC Converters:

Uncontrolled, semi-controlled, fully controlled and dual converters in single-phase and three-phase configurations operation with R, R-L, back emf load, Issues of Power factor, Distortion factor of ac to dc converters and effect of source inductance.

UNIT-III

DC to AC Converters:

Basics of dc to ac conversion, inverter circuit configurations and principle of operation, VSI and CSI, single and three-phase configurations, Single, Multiple, Square wave and sinusoidal PWM control methods and harmonic control.

UNIT-IV

DC-DC Converters and AC-AC Converters:

Introduction to dc-dc conversion, various topologies, buck, boost, buck-boost converters.

Introduction to ac to ac conversion, single-phase and three-phase ac voltage controller circuit configuration with R load Analysis. Cyclo-converters: single-phase, three-phase to single-phase circuit configuration.

TEXT BOOKS:

1) M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 3rd Edition, 2014.
2) Power Electronics by M.D.Singh and Khanchandani TMH, 2nd Edition, 2017.
3) N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 3rd Edition 2007.

REFERENCE BOOKS:

1) R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 3rd Edition 2020.
2) L.Umanand, "Power Electronics: Essentials and Applications", Wiley India, 1st Edition 2009.
3) Power Electronics by P.S. Bhimbra, Khanna publications, 6rd Edition 2019.

CO-PO/PSO MAPPING MATRIX:

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

EEM15 (R20): UTILIZATION OF ELECTRICAL ENERGY

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Understanding Electric Traction Systems: Students will gain an understanding of various systems of electric traction and the mechanics of train movement, including speed-time curves and the effects of speed, acceleration, and distance on schedules.
2) Principles of Heat Transfer: Students will grasp the elementary principles of heat transfer and apply them to electric heating systems.
3) Types of Welding and Welding Techniques: Students will learn about different types of welding, including resistance and arc welding. They will understand the characteristics of carbon and metallic arc welding and explore modern welding techniques.
4) Light Production and Lighting Sources: Students will understand the production of light by excitation and explore various lighting sources, such as gas discharge lamps, fluorescent lamps, and LEDs.
5) Illumination Calculations: Students will learn how to calculate lighting parameters, including polar curves and the effects of voltage variation. They will study lighting calculations using methods like the solid angle and square law methods.

Unit – I

Electric Traction: Systems of electric traction -transmission of drive -mechanics of train movement, speed-time curves, effect of speed, acceleration and distance on schedule, Power and energy output from driving axles, specific energy output, series – parallel method of speed control shunt bridge transition –Overhead equipment-Electric braking for DC Machines.

Unit – II

Electric Heating: Elementary principles of heat transfer -electric furnaces -design of heating element -Construction and working of different types of induction furnaces -Dielectric heating -arc furnaces -Air Conditioning.

Unit – III

Electric Welding: Types of welding -resistance and arc welding -characteristics of Carbon and metallic arc welding - Modern Welding Techniques.

Unit – IV

Illumination: Light production by excitation -Gas discharge lamps -Fluorescent lamps – LEDS-Polar curves -Effect of voltage variation lighting calculations solid angle and square law methods of calculation -Factory lighting flood lighting and street lighting.

TEXT BOOKS:

1) Generation, Distribution and Utilization if Electrical Energy by CL Wadhwa,New Age International Publications, Third edition, 2015.
2) Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009

REFERENCE BOOKS:

1) Modern Electric traction by H.Partab, Dhanpati rai & co, 2017.
2) Utilization of Electric Power & Electric traction by J.B Gupta, S.K. Kataria & Sons,2013

CO-PO/PSO MAPPING MATRIX:

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

EEM16 (R20): ELECTRIC VEHICLES

L-3	T-0	P-0	M-100	C-3

COURSE OUTCOMES:

1) Historical Perspective: Students will understand the historical development of hybrid and electric vehicles and recognize their social and environmental importance.
2) Electric Drive-Train Concepts: Students will be introduced to electric drive-train topologies and gain a basic understanding of power flow control in these systems.
3) Hybrid Electric Drive-Trains: Students will grasp the basic concepts of hybrid electric drive-trains and their role in modern vehicle technology.
4) Electric Components and Control: Students will become familiar with the electric components used in electric vehicles. They will learn how to configure and control DC motor drives, induction motor drives, and permanent magnet motor drives, which are essential components of electric propulsion systems.
5) Understanding Energy Storage: Students will understand the importance of energy storage in electric vehicles and its role in providing the required power.

Unit-I

Introduction and Vehicle Fundamentals: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles. Basics of vehicle performance, vehicle power plant characterization, transmission characteristics, and mathematical models to describe vehicle performance

Unit-II

Electric and Hybrid drive-trains: Basic concept of electric traction - introduction to various electric drive-train topologies - power flow control in electric drive-train topologies, Basic concept of hybrid electric drive trains.

Unit-III

Electric propulsion unit: Introduction to electric components used in electric vehicles - Configuration and control of DC Motor drives - Configuration and control of Induction Motor drives-Configuration and control of Permanent Magnet Motor drives.

Unit-IV

Energy storage: Introduction to Energy Storage Requirements in Electric Vehicles - Battery based energy storage and its analysis - Fuel Cell based energy storage and its analysis - Super Capacitor based energy storage and its analysis.

TEXT BOOKS:

1) Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, Second Edition 2005.
2) Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3) Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.

REFERENCE BOOKS:

1) James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, Second Edition 2003.
2) H. Partab: Modern Electric Traction – Dhanpat Rai& Co, 2007.
3) Bimal Bose, 'Power electronics and motor drives', Elsevier, First Edition 2006.
4) Ion Boldea and S.A Nasar, 'Electric drives', CRC Press, Second Edition 2005.

NPTEL VIDEO LINK:

1) https://nptel.ac.in/courses/108/103/108103009/
2) https://nptel.ac.in/courses/108/106/108106182/
3) https://nptel.ac.in/courses/108/102/108102121/

CO-PO/PSO MAPPING MATRIX:

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

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