Miracle Educational Society Group of Institutions(A)

Bhoghapuram-535216

DEPARTMENT OF BASIC SCIENCE & HUMANITIES

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Course Structure & Syllabus for

BS&H- ELECTRICAL & ELECTRONICS ENGINEERING

(Regular-Full time)

(Effective for the students admitted into I year from the Academic Year 2024-25 onwards)

Academic Regulations (R23)

Academic Regulations (R23) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from
the Academic Year **2023-24** onwards)

1. **Award of the Degree**
   (a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:
      (i) Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Eight years).
      (ii) Registers for 160 credits and secures all 160 credits.

   (b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:
      (i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 160 credits.
      (ii) Registering for Honors is optional.
      (iii) Honors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled. This clause shall be read along with clause 1 a) i).

3. **Admissions**
   Admission to the B. Tech Program shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/University from time to time. Admissions shall be made either based on the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

4. **Program related terms**
   Credit: A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

   Credit Definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit
2 Hrs. Practical (Lab) per week	1 credit

a) Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.

b) Choice Based Credit System (CBCS): The CBCS provides a choice for students to select from the prescribed courses.

5. Semester/Credits:

i) A semester comprises 90 working days and an academic year is divided into two semesters.

ii) The summer term is for eight weeks during summer vacation. Internship/ apprenticeship / work-based vocational education and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study.

iii) Regular courses may also be completed well in advance through MOOCs satisfying prerequisites.

6. Structure of the Undergraduate Programme

All courses offered for the undergraduate program (B. Tech.) are broadly classified as follows:

S.No.	Category	Breakup of Credits (Total 160)	Percentage of total credits	AICTE Recommendation (%)
1.	Humanities and Social Science including Management (HM)	13	8 %	8 – 9%
2.	Basic Sciences (BS)	20	13 %	12 - 16%
3.	Engineering Sciences (ES)	23.5	14%	10 – 18%
4.	Professional Core (PC)	54.5	34 %	30 – 36%
5.	Electives – Professional (PE) & Open (OE); Domain Specific Skill Enhancement Courses (SEC)	33	21 %	19 - 23%
6.	Internships & Project work (PR)	16	10 %	8 – 11%
7.	Mandatory Courses (MC)	Non-credit	Non-credit	-

7. Course Classification:

All subjects/ courses offered for the undergraduate programme in Engineering & Technology (B.Tech. degree programmes) are broadly classified as follows:

S.No.	Broad Course Classification	Course Category	Description
1.	Foundation Courses	Foundation courses	Includes Mathematics, Physics and Chemistry; fundamental engineering courses; humanities, social sciences and management courses
2.	Core Courses	Professional Core Courses (PC)	Includes subjects related to the parent discipline/department/branch of Engineering
3.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include interdisciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering
		Domain specific skill enhancement courses (SEC)	interdisciplinary/job-oriented/domain courses which are relevant to the industry
4.	Project & Internships	Project	B.Tech. Project or Major Project
		Internships	Summer Internships – Community based and Industry Internships; Industry oriented Full Semester Internship
5.	Audit Courses	Mandatory non-credit courses	Covering subjects of developing desired attitude among the learners

8. Programme Pattern

i. Total duration of the of B. Tech (Regular) Programme is four academic years.
ii. Each academic year of study is divided into two semesters.
iii. Minimum number of instruction days in each semester is 90 days.
iv. There shall be mandatory student induction program for freshers, with a three-week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.
v. Health/wellness/yoga/sports and NSS /NSS /Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduate students.
vi. Courses like Environmental Sciences, Indian Constitution, Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.
vii. Design Thinking for Innovation & Tinkering Labs are made mandatory as credit courses for all the undergraduate students.
viii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.

ix. Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses can lead to students specializing in emerging areas within the chosen field of study.

x. A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for B.Tech. Degree with a Minor within the 160 credits by opting for the courses offered through various verticals/tracks under Open Electives.

xi. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.

xii. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain/interdisciplinary courses and the other shall be a soft skills course.

xiii. Students shall undergo mandatory summer internships, for a minimum of eight weeks duration at the end of second and third year of the programme. The internship at the end of second year shall be community oriented and industry internship at the end of third year.

xiv. There shall also be mandatory full internship in the final semester of the programme along with the project work.

xv. Undergraduate degree with Honors is introduced by the University for the students having good academic record.

xvi. Each college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

xvii. Each college shall assign a faculty advisor/mentor after admission to a group of students from same department to provide guidance in courses registration/career growth/placements/opportunities for higher studies/GATE/other competitive exams etc.

xviii. Preferably 25% of course work for the theory courses in every semester shall be conducted in the blended mode of learning.

9. Evaluation Process

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. Summer Internships shall be evaluated for 50 marks, Full Internship &Project work in final semester shall be evaluated for 200 marks, mandatory courses with no credits shall be evaluated for 30 mid semester marks.

A student has to secure not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester and end examination marks taken together for the theory, practical, design, drawing subject or project etc. In case of a mandatory course, he/she should secure 40% of the total marks.

Theory Courses

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

i) For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.
ii) For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.
iii) If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B) and external examination question paper shall be set with two parts each for 35 marks.
iv) If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of 'T' for theory subject and 'P' for practical subject.

a) Continuous Internal Evaluation

i) For theory subjects, during the semester, there shall be two midterm examinations. Each midterm examination shall be evaluated for 30 marks of which 10 marks for objective paper (20 minutes duration), 15 marks for subjective paper (90 minutes duration) and 5 marks for assignment.
ii) Objective paper shall contain for 05 short answer questions with 2 marks each or maximum of 20 bits for 10 marks. Subjective paper shall contain 3 either or type questions (totally six questions from 1 to 6) of which student has to answer one from each either-or type of questions. Each question carries 10 marks. The marks obtained in the subjective paper are condensed to 15 marks.

Note:

- The objective paper shall be prepared in line with the quality of competitive examinations questions.
- The subjective paper shall contain 3 either or type questions of equal weightage of 10 marks. Any fraction shall be rounded off to the next higher mark.
- The objective paper shall be conducted by the respective institution on the day of subjective paper test.
- Assignments shall be in the form of problems, mini projects, design problems, slip tests, quizzes etc., depending on the course content. It should be continuous assessment throughout the semester and the average marks shall be considered.

iii) If the student is absent for the mid semester examination, no re-exam shall be conducted and mid semester marks for that examination shall be considered as zero.

iv) First midterm examination shall be conducted for I, II units of syllabus with one either or type question from each unit and third either or type question from both the

units. The second midterm examination shall be conducted for III, IV and V units with one either or type question from each unit.

v) Final mid semester marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage given to the better mid exam and 20% to the other.

For Example:

Marks obtained in first mid: 25
Marks obtained in second mid: 20
Final mid semester Marks: (25x0.8) + (20x0.2) = 24

If the student is absent for any one midterm examination, the final mid semester marks shall be arrived at by considering 80% weightage to the marks secured by the student in the appeared examination and zero to the other. For Example:

Marks obtained in first mid: Absent
Marks obtained in second mid: 25
Final mid semester Marks: (25x0.8) + (0x0.2) =20

b) End Examination Evaluation:

End examination of theory subjects shall have the following pattern:

i) There shall be 6 questions and all questions are compulsory.
ii) Question I shall contain 10 compulsory short answer questions for a total of 20marks such that each question carries 2 marks.
iii) There shall be 2 short answer questions from each unit.
a) In each of the questions from 2 to 6, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
iv) The questions from 2 to 6 shall be set by covering one unit of the syllabus for each question.

End examination of theory subjects consisting of two parts of different subjects, for Example: Basic Electrical &Electronics Engineering shall have the following pattern:

i) Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35 marks each.
ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1mark.
iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

Practical Courses

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

b) For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks.

c) Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the record/viva and 15 marks for the internal test.

d) The end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the subject from the same department.
- Procedure: 20 marks
- Experimental work & Results: 30 marks
- Viva voce: 20 marks.

In a practical subject consisting of two parts (Eg: Basic Electrical &Electronics Engineering Lab), the end examination shall be conducted for 70 marks as a single laboratory in 3 hours. Mid semester examination shall be evaluated as above for 30 marks in each part and final mid semester marks shall be arrived by considering the average of marks obtained in two parts.

e) For the subject having design and/or drawing, such as Engineering Drawing, the distribution of marks shall be 30 for mid semester evaluation and 70 for end examination.

Assessment Method	**Marks**
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

Day-to-day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm examinations in a semester for duration of 2 hours each for 15 marks with weightage of 80% to better mid marks and 20% for the other. The subjective paper shall contain 3 either or type questions of equal weightage of 5 marks. There shall be no objective paper in mid semester examination. The sum of day-to-day evaluation and the mid semester marks will be the final sessional marks for the subject.

The end examination pattern for Engineering Graphics, shall consists of 5 questions, either/or type, of 14 marks each. There shall be no objective type questions in the end examination. However, the end examination pattern for other subjects related to design/drawing , multiple branches, etc is mentioned along with the syllabus.

f) There shall be no external examination for mandatory courses with zero credits. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examinations. In case, the student fails, a re-

examination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in item 1 & 2 of the regulations.

g) The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

10. Skill oriented Courses

i) There shall be five skill-oriented courses offered during III to VII semesters.

ii) Out of the five skill courses two shall be skill-oriented courses from the same domain. Of the remaining three skill courses, one shall be a soft skill course and the remaining two shall be skill-advanced courses from the same domain/Interdisciplinary/Job oriented.

iii) The course shall carry 100 marks and shall be evaluated through continuous assessments during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-day work in the class / laboratory shall be evaluated for 30 marks by the concerned teacher based on the regularity/assignments/viva/mid semester test. The end examination similar to practical examination pattern shall be conducted by the concerned teacher and an expert in the subject nominated by the principal.

iv) The Head of the Department shall identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process. The marks/grades shall be assigned to the students by the above committee based on their performance.

v) The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies or any other accredited bodies. If a student chooses to take a Certificate Course offered by external agencies, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency. A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades.

vi) The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the University at the beginning of the semester. The principal of the respective college shall forward such proposals to the University for approval.

vii) If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the University.

11. Massive Open Online Courses (MOOCs):

A Student has to pursue and complete one course compulsorily through MOOCs approved by the University. A student can pursue courses other than core through MOOCs and it is mandatory to complete one course successfully through MOOCs for awarding the degree. A student is not permitted to register and pursue core courses through MOOCs.

A student shall register for the course (Minimum of either 8 weeks or 12 weeks) offered through MOOCs with the approval of Head of the Department. The Head of the Department shall appoint one mentor to monitor the student's progression. The student needs to earn a certificate by passing the exam. The student shall be awarded the credits assigned in the curriculum only by submission of the certificate. Examination fee, if any, will be borne by the student.

Students who have qualified in the proctored examinations conducted through MOOCs platform can apply for credit transfer as specified and are exempted from appearing internal as well as external examination (for the specified equivalent credit course only) conducted by the university.

Necessary amendments in rules and regulations regarding adoption of MOOC courses would be proposed from time to time.

12. Credit Transfer Policy

Adoption of MOOCs is mandatory, to enable Blended model of teaching-learning as also envisaged in the NEP 2020. As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the University shall allow up to a maximum of 20% of the total courses being offered in a particular programme i.e., maximum of 32 credits through MOOCs platform.

i) The University shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses.
ii) Student registration for the MOOCs shall be only through the respective department of the institution, it is mandatory for the student to share necessary information with the department.
iii) Credit transfer policy will be applicable to the Professional & Open Elective courses only.
iv) The concerned department shall identify the courses permitted for credit transfer.
v) The University/institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.
vi) The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.
vii) The university shall ensure no overlap of MOOC exams with that of the university examination schedule. In case of delay in results, the university will re-issue the marks sheet for such students.
viii) Student pursuing courses under MOOCs shall acquire the required credits only

after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

ix) The institution shall submit the following to the examination section of the university:
   a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
   b) Undertaking form filled by the students for credit transfer.

x) The universities shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall be permitted to register for MOOCs offered through online platforms approved by the University from time to time.

13. Academic Bank of Credits (ABC)

The University has implemented Academic Bank of Credits (ABC) to promote flexibility in curriculum as per NEP 2020 to

i. provide option of mobility for learners across the universities of their choice
ii. provide option to gain the credits through MOOCs from approved digital platforms.
iii. facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC
iv. execute Multiple Entry and Exit system with credit count, credit transfer and credit acceptance from students' account.

14. Mandatory Internships

Summer Internships : Two summer internships either onsite or virtual each with a minimum of 08 weeks duration, done at the end of second and third years, respectively are mandatory. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the Undergraduate program. One of the two summer internships at the end of second year (Community Service Project) shall be society oriented and shall be completed in collaboration with government organizations/NGOs & others. The other internship at the end of third year is Industry Internship and shall be completed in collaboration with Industries. The student shall register for the internship as per course structure after commencement of academic year. The guidelines issued by the APSCHE / University shall be followed for carrying out and evaluation of Community Service Project and Industry Internship.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. The report and the oral presentation shall carry 50% weightage

each. It shall be evaluated for 50 external marks. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the University.

Full Semester Internship and Project work: In the final semester, the student should mandatorily register and undergo internship (onsite/virtual) and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship.

The project report shall be evaluated with an external examiner. The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the University and is evaluated for 140 marks.

The college shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

15. Guidelines for offering a Minor

To promote interdisciplinary knowledge among the students, the students admitted into B.Tech. in a major stream/branch are eligible to obtain degree in Minor in another stream.

i) The Minor program requires the completion of 12 credits in Minor stream chosen.
ii) Two courses for 06 credits related to a Minor are to be pursued compulsorily for the minor degree, but maybe waived for students who have done similar/equivalent courses. If waived for a student, then the student must take an extra elective course in its place. It is recommended that students should complete the compulsory courses (or equivalents) before registering for the electives.
iii) Electives (minimum of 2 courses) to complete a total of 12 credits.

Note: A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for Minor by opting for the courses offered through various verticals/tracks under Open Electives.

16. Guidelines for offering Honors

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a

specialized area in the UG level. The programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.
ii) A student shall earn additional 15 credits for award of B.Tech.(Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 160 credits).
iii) A student is permitted to register for Honors in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honors from V Semester onwards.
iv) The concerned Principal of the college shall arrange separate class work and timetable of the courses offered under Honors program.
v) Courses that are used to fulfil the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.
vi) Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Honors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.
vii) The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.
viii) A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.
ix) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree programme.
x) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
xi) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering

Enrolment into Honors:

i) Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline
ii) The enrolment of student into Honors is based on the CGPA obtained in the major degree program. CGPA shall be taken up to III semester in case of regular entry students and only III semester in case of lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.
iii) If a student is detained due to lack of attendance either in Major or in Honors, registration shall be cancelled.

iv) Transfer of credits from Honors to regular B. Tech degree and vice-versa shall not be permitted.
v) Honors is to be completed simultaneously with a Major degree program.

Registration for Honors:

i) The eligible and interested students shall apply through the HOD of his/her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to register the courses under Honors.
ii) The selected students shall submit their willingness to the principal through his/her parent department offering Honors. The parent department shall maintain the record of student pursuing the Honors.
iii) The students enrolled in the Honors courses will be monitored continuously. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.
iv) There is no fee for registration of subjects for Honors program offered in offline at the respective institutions.

17. Attendance Requirements:

i) A student shall be eligible to appear for the University external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% of attendance in aggregate of all the subjects. b) 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.
ii) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.
iii) A stipulated fee shall be payable towards condonation of shortage of attendance to the University.
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. They may seek readmission for that semester from the date of commencement of class work.
vi) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
vii) If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

18. For induction programme attendance shall be maintained as per AICTE norms. Promotion Rules:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in section 16.

i) A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per university norms.

ii) A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) up to in the subjects that have been studied up to III semester.

iii) A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) in the subjects that have been studied up to V semester.

And in case a student is detained for want of credits for a particular academic year by ii) & iii) above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester or VII semester respectively as the case may be.

iv) When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

19. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

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

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	**Grade**	**Grade points Assigned**
90 & above	Superior	10
80 - 89	A (Excellent)	9
70 - 79	B (Very Good)	8
60 - 69	C (Good)	7
50 - 59	D (Average)	6
40 - 49	E (Pass)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.

ii) For non-credit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative GradePoint Average (CGPA):

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.,

$$SGPA = \Sigma (C_i \times G_i)/\Sigma C_i$$

where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

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

$$CGPA = \Sigma (C_i \times S_i)/ \Sigma C_i$$

where "S_i" is the SGPA of the i^{th} semester and C_i is the total number of credits up to that semester.

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

While computing the SGPA 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 the letters S, A, B, C, D and F.

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/she shall be placed in one of the following four classes:

Class Awarded	CGPA Secured
First Class with Distinction	≥ 7.5
First Class	$\geq 6.5 < 7.5$
Second Class	$\geq 5.5 < 6.5$
Pass Class	$\geq 5.0 < 5.5$

CGPA to Percentage conversion Formula – (CGPA – 0.5) x 10

20. With–holding of Results

If the candidate has any dues not paid to the university or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld in such cases.

21. Multiple Entry / Exit Option

(a) Exit Policy:

The students can choose to exit the four-year programme at the end of first/second/third year.

i) **UG Certificate in (Field of study/discipline)** - Programme duration: First year (first two semesters) of the undergraduate programme, 40 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

ii) **UG Diploma (in Field of study/discipline)** - Programme duration: First two years (first four semesters) of the undergraduate programme, 80 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

iii) **Bachelor of Science (in Field of study/discipline)** i.e., **B.Sc. Engineering in (Field of study/discipline)**- Programme duration: First three years (first six semesters) of the undergraduate programme, 120 credits.

(b) Entry Policy:

Modalities on multiple entry by the student into the B.Tech. programme will be provided in due course of time.

Note: The Universities shall resolve any issues that may arise in the implementation of Multiple Entry and Exit policies from time to time and shall review the policies in the light of periodic changes brought by UGC, AICTE and State government.

22. Gap Year Concept:

Gap year concept for Student Entrepreneur in Residence is introduced and outstanding students who wish to pursue entrepreneurship / become entrepreneur are allowed to take a break of one year at any time after II year to pursue full-time entrepreneurship programme/to establish startups. 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. The principal of the respective college shall forward such proposals submitted by the students to the University. An evaluation committee constituted by the University shall evaluate the proposal submitted by the student and the committee shall decide whether to permit the student(s) to avail the Gap Year or not

23. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

Candidates who are permitted to avail Gap Year shall be eligible for re-joining into the succeeding year of their B. Tech from the date of commencement of class work, subject to Section **2** and they will follow the academic regulations into which they are readmitted.

24. Minimum Instruction Days for a Semester:

The minimum instruction days including exams for each semester shall be 90 days.

25. Medium of Instruction:

The medium of instruction of the entire B. Tech undergraduate programme in Engineering &Technology (including examinations and project reports) will be in English only.

26. Student Transfers:

Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh and the Universities from time to time.

27. General Instructions:

i. The academic regulations should be read as a whole for purpose of any interpretation.
ii. Malpractices rules-nature and punishments are appended.
iii. Where the words "he", "him", "his", occur in the regulations, they also include "she", "her", "hers", respectively.
iv. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
v. The Universities may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Universities.
vi. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Vice-Chancellor / Head of the institution is final.

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ACADEMIC REGULATIONS (R23)

FOR B. TECH. (LATERAL ENTRY SCHEME)

*(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year **2024-25** onwards)*

1. Award of the Degree

(a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:

(i) Pursues a course of study for not less than three academic years and not more than six academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Six years).

(ii) Registers for 120 credits and secures all 120 credits.

(b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:

(i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 120 credits.

(ii) Registering for Honors is optional.

(iii) Honors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil the requirement for the award of the degree within six consecutive academic years from the year of admission, shall forfeit their seat.

3. Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.**2**

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 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.

ii. A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any decimal fraction should be rounded off to lower digit) in the subjects that have been studied up to V semester.

And in case if student is already detained for want of credits for particular academic year, the student may make up the credits through supplementary exams of the above exams before the commencement of IV year I semester class work of next year.

4. Course Pattern

i) The entire course of study is three academic years on semester pattern.

ii) A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

iii) When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfilment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

5. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

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B. Tech (Regular-Full time)

Electrical and Electronics Engineering

(Effective for the students admitted into I year from the Academic Year **2023-24** onwards)

B.TECH. - COURSE STRUCTURE – R23
(Applicable from the academic year 2023-24 onwards)

INDUCTION PROGRAMME

S.No.	Course Name	Category	L-T-P-C
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

I Year I Semester						
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BS01	Linear Algebra & Calculus	3	0	0	3
2.	R23BS04	Chemistry	3	0	0	3
3.	R23ES07	Introduction to Programming	3	0	0	3
4.	R23ES03	Engineering Graphics	1	0	4	3
5.	R23ES04	Basic Electrical & Electronics Engineering	3	0	0	3
6.	R23BS04	Chemistry Lab	0	0	2	1
7.	R23ES07	Computer Programming Lab	0	0	3	1.5
8.	R23ES05	Electrical &Electronics Engineering Workshop	0	0	3	1.5
9.	R23MC02	NSS/NCC/Scouts &Guides/Community Service	0	0	1	0.5
		Total				**19.5**

I Year II Semester						
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BS02	Differential Equations and Vector Calculus	3	0	0	3
2.	R23BS03	Engineering Physics	3	0	0	3
3.	R23HS01	Communicative English	2	0	0	2
4.	R23ES01	Basic Civil & Mechanical Engineering	3	0	0	3
5.	R23PC01	Electrical Circuit Analysis-I	3	0	0	3
6.	R23HS01	Communicative English Lab	0	0	2	1
7.	R23BS03	Engineering Physics Lab	0	0	2	1
8.	R23ES06	IT workshop	0	0	2	1
9.	R23ES02	Engineering Workshop	0	0	3	1.5
10.	R23PC01	Electrical Circuits Lab	0	0	3	1.5
11.	R23MC01	Health and Wellness, Yoga and Sports	0	0	1	0.5
		Total				**20.5**

I Year-I Semester

L	T	P	C
3	0	0	3

LINEAR ALGEBRA & CALCULUS

(Common to All Branches of Engineering)

Course Objectives:

To equip the students with standard concepts and tools of mathematics to handle various real-world problems and their applications.

Course Outcomes:

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

- develop matrix algebra techniques that is needed by engineers for practical applications.
- to find the eigen values and eigen vectors and solve the problems by using linear transformation
- learn important tools of calculus in higher dimensions.
- familiarize with functions of several variables which is useful in optimization.
- familiarize with double and triple integrals of functions of several variables in two and three dimensions.

UNIT - I: Matrices

Rank of a matrix by echelon form, normal form. Cauchy –Binet formulae (without proof). Inverse of Non- singular matrices by Gauss-Jordan method

System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

UNIT- II: Linear Transformation and Orthogonal Transformation:

Eigen values, Eigen vectors and their properties(without Proof), Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation

UNIT- III : Calculus

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

UNIT- IV : Partial differentiation and Applications (Multi variable calculus)

Partial derivatives, total derivatives, chain rule, change of variables, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

UNIT – V : Multiple Integrals (Multi variable Calculus)

Duble integrals - change of variables (Cartesian and Polar coordinates), Change of order of integration, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text books:

1. B.S.Grewal,HigherEngineeringMathematics,44/e,KhannaPublishers,2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e,John Wiley & Sons, 2018.

Reference Books:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd.,2021 (9th reprint).
2. George B. Thomas, Maurice D.Weir and Joel Hass, Thomas Calculus,14/e, Pearson Publishers, 2018.
3. Glyn James, Advanced Modern Engineering Mathematics, 5/e, Pearson publishers, 2018.
4. Michael Greenberg, Advanced Engineering Mathematics, 9thedition, Pearson edn
5. H. K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand,2021

I Year-I Semester

L	T	P	C
3	0	0	3

CHEMISTRY

C**ourse Objectives:**

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- To introduce instrumental methods, molecular machines and switches.

Course Outcomes: At the end of the course, the students will be able to:
CO1: Compare the materials of construction for battery and electrochemical sensors.
CO2: Explain the preparation, properties, and applications of thermoplastics & thermosetting & elastomers conducting polymers.
CO3: Explain the principles of spectrometry, slc in separation of solid and liquid mixtures.
CO4: Apply the principle of Band diagrams in the application of conductors and semiconductors.
CO5: Summarize the concepts of Instrumental methods.

UNIT I Structure and Bonding Models:

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of Ψ and Ψ^2, particle in one dimensional box, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O2 and CO, etc. π-molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT II Modern Engineering materials

Semiconductors – Introduction, basic concept, application

Super conductors-Introduction basic concept, applications.

Supercapacitors: Introduction, Basic Concept-Classification – Applications.

Nano materials: Introduction, classification, properties and applications of Fullerenes, carbon nano tubes and Graphines nanoparticles.

UNIT III Electrochemistry and Applications

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).

Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.

Primary cells – Zinc-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygenfuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

UNIT IV Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and mechanisms of polymer formation.

Plastics –Thermo and Thermosetting plastics, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibres.

Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline, – mechanism of conduction and applications. Bio-Degradable polymers - Poly Glycolic Acid (PGA), Polyl Lactic Acid (PLA).

UNIT V Instrumental Methods and Applications

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopies, fundamental modes and selection rules, Instrumentation. Chromatography-Basic Principle, Classification-HPLC: Principle, Instrumentation and Applications.

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
2. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb.2008
3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

L	T	P	C
3	0	0	3

I Year-I Semester

INTRODUCTION TO PROGRAMMING
(Common to All branches of Engineering)

Course Objectives:

The objectives of this course is to acquire knowledge on the
i. To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.
ii. To enable effective usage of Control Structures and Implement different operations on arrays.
iii. To demonstrate the use of Strings and Functions.
iv. To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
v. To understand structures and unions and illustrate the file concepts and its operations.
vi. To impart the Knowledge Searching and Sorting Techniques

UNIT-I Introduction to Computer Problem Solving:
Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem. Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II Introduction to C Programming:
Introduction, Structure of a C Program. Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements. Operators, Type Conversion. Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else—if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement**.**

UNIT-III Arrays:
Introduction, Operations on Arrays, Arrays as Function Arguments, Two Dimensional Arrays, Multidimensional Arrays. Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments.

UNIT-IV Functions:
Introduction Function : Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes. Recursion. Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.

UNIT-V
Structures, Unions, Bit Fields:Introduction, Nested Structures, Arrays of Structures, Structures

and Functions, Self-Referential Structures, Unions, Enumerated Data Type —Enum variables, Using Typedef keyword, Bit Fields. Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Note: The syllabus is designed with C Language as the fundamental language of implementation.

Course Outcomes:

At the end of the Course, Student should be able to:

i . Illustrate the Fundamental concepts of Computers and basics of computer programming and problem-solving approach

ii. Understand the Control Structures, branching and looping statements

iii. Use of Arrays and Pointers in solving complex problems.

iv. Develop Modular program aspects and Strings fundamentals.

v. Demonstrate the ideas of User Defined Data types, files. Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:

1. A Structured Programming Approach Using C, Forouzan, Gilberg, Cengage.
2. How to solve it by Computer, R. G. Dromey, and Pearson Education.
3. Programming In C A-Practia1 Approach. Ajay Mittal, Pearson

References:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
2. Computer Programming. Reema Thareja, Oxford University Press
3. The C Programming Language, Dennis Richie And Brian Kernighan, Pearson Education.
4. Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.
5. Let us C ,YaswanthKanetkar, 16th Edition,BPB Publication.
6.Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008

Web References:

1. http://www.c4learn.com/
2. http://www.geeksforgeeks.org/c/
3. http://nptel.ac.in/courses/122104019/
4. http://www.learn-c.org/
5. https://www.tutorialspoint.com/cprogramming/

I Year-I Semester

L	T	P	C
1	0	4	3

ENGINEERING GRAPHICS

(Common to All branches of Engineering)

Course Objectives:

- To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

Course Outcomes:

CO1: Understand the principles of engineering drawing, including engineering curves, scales, orthographic and isometric projections.
CO2: Draw and interpret orthographic projections of points, lines, planes and solids in front, top and side views.
CO3: Understand and draw projection of solids in various positions in first quadrant.
CO4: Explain principles behind development of surfaces.
CO5: Prepare isometric and perspective sections of simple solids.

UNIT I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

UNIT II

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT III

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

UNIT IV

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNIT V

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer graphics: Creating 2D&3D drawings ofobjects including PCB and Transformations using Auto CAD (*Not for end examination*).

Textbook:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

I Year-I Semester

L	T	P	C
3	0	0	3

BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common to All branches of Engineering)

Course Objectives

To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.

Course Outcomes: After the completion of the course students will be able to

Course Outcomes:
CO1: Remember the fundamental laws, operating principles of motors, generators, MC and MI instruments.
CO2: Understand the problem solving concepts associated to AC and DC circuits, construction and operation of AC and DC machines, measuring instruments; different power generation mechanisms, Electricity billing concept and important safety measures related to electrical operations.
CO3: Apply mathematical tools and fundamental concepts to derive various equations related to machines, circuits and measuring instruments; electricity bill calculations and layout representation of electrical power systems.
CO4: Analyze different electrical circuits, performance of machines and measuring instruments.
CO5: Evaluate different circuit configurations, Machine performance and Power systems operation.

PART A: BASIC ELECTRICAL ENGINEERING

UNIT I DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT II Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications

of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

UNIT III Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Textbooks:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives:

- To teach the fundamentals of semiconductor devices and its applications, principles of digital electronics.

UNIT I SEMICONDUCTOR DEVICES

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT III DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Textbooks:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009

L	T	P	C
0	0	2	1

I Year-I Semester

CHEMISTRY LAB

Course Objectives:

- Verify the fundamental concepts with experiments.

Course Outcomes: At the end of the course, the students will be able to

CO1: Determine the cell constant and conductance of solutions.
CO2: Prepare advanced polymer Bakelite materials.
CO3: Measure the strength of an acid present in secondary batteries.
CO4: Analyse the IR spectra of some organic compounds.
CO5: Calculate strength of acid in Pb-Acid battery.

List of Experiments:

1. Measurement of 10Dq by spectrophotometric method
2. Conductometric titration of strong acid vs. strong base
3. Conductometric titration of weak acid vs. strong base
4. Determination of cell constant and conductance of solutions
5. Potentiometry - determination of redox potentials and emfs
6. Determination of Strength of an acid in Pb-Acid battery
7. Preparation of a Bakelite
8. Verify Lambert-Beer's law
9. Wavelength measurement of sample through UV-Visible Spectroscopy
10. Identification of simple organic compounds by IR
11. Preparation of nanomaterials by precipitation method
12. Estimation of Ferrous Iron by Dichrometry

Reference:

- "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar

I Year-I Semester

L	T	P	C
0	0	3	1.5

COMPUTER PROGRAMMING LAB
(Common to All branches of Engineering)

Course Objectives:

The course aims to give students hands – on experience and train them on the concepts of the C- programming language.

Course Outcomes:
CO1: Read, understand, and trace the execution of programs written in C language.
CO2: Select the right control structure for solving the problem.
CO3: Develop C programs which utilize memory efficiently using programming constructs like pointers.
CO4: Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.

UNIT I

WEEK 1
Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:
Tutorial 1: Problem-solving using Computers.
Lab1: Familiarization with programming environment
i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

WEEK 2
Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:
Tutorial 2: Problem-solving using Algorithms and Flow charts.
Lab 1: Converting algorithms/flow charts into C Source code.
Developing the algorithms/flowcharts for the following sample programs
i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

WEEK 3
Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:
Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.
i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

UNIT II

WEEK 4
Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:
Lab4: Simple computational problems using the operator' precedence and associativity
i) Evaluate the following expressions.
    a. A+B*C+(D*E) + F*G
    b. A/B*C-B+A*D/3
    c. A+++B---A
    d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5
Objective: Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments/Activities:
Tutorial 5: Branching and logical expressions:
Lab 5: Problems involving if-then-else structures.
i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.

WEEK 6
Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and

For loop in addition to structured jump constructs like break and continue including when eachof these statements is more appropriate to use.

Suggested Experiments/Activities:
Tutorial 6: Loops, while and for loops
Lab 6: Iterative problems e.g., the sum of series

i) Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

UNIT III

WEEK 7:
Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:
Tutorial 7: 1 D Arrays: searching.
Lab 7:1D Array manipulation, linear search

i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.
iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

WEEK 8:
Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:
Tutorial 8: 2 D arrays, sorting and Strings.
Lab 8: Matrix problems, String operations, Bubble sort

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

UNIT IV

WEEK 9:
Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array

and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

Suggested Experiments/Activities:
Tutorial 9: Pointers, structures and dynamic memory allocation
Lab 9: Pointers and structures, memory dereference.

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc()

WEEK 10:
Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:
Tutorial 10: Bitfields, Self-Referential Structures, Linked lists
Lab10 : Bitfields, linked lists
Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V

WEEK 11:
Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:
Tutorial 11: Functions, call by value, scope and extent,
Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

WEEK 12:
Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls
Lab 12: Recursive functions

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

WEEK 13:
Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

Suggested Experiments/Activities:
Tutorial 13: Call by reference, dangling pointers
Lab 13: Simple functions using Call by reference, Dangling pointers.

i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK14:
Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:
Tutorial 14: File handling
Lab 14: File operations

i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-line arguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

Textbooks:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

I Year-I Semester

L	T	P	C
0	0	3	1.5

ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP
(Common to All branches of Engineering)

Course Objectives:

To impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

Course Outcomes:

CO1: Understand the Electrical circuit design concept; measurement of resistance, power, power factor; concept of wiring and operation of Electrical Machines and Transformer.
CO2: Apply the theoretical concepts and operating principles to derive mathematical models for circuits, Electrical machines and measuring instruments; calculations for the measurement of resistance, power and power factor.
CO3: Apply the theoretical concepts to obtain calculations for the measurement of resistance, power and power factor.
CO4: Analyse various characteristics of electrical circuits, electrical machines and measuring instruments.
CO5: Design suitable circuits and methodologies for the measurement of various electrical parameters; Household and commercial wiring.

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
   - Provide some exercises so that hardware tools and instruments are learned to be used by the students.

2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
   - Provide some exercises so that measuring instruments are learned to be used by the students.

3. Components:
   - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.

- Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LAB

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Note: Minimum Six Experiments to be performed.

PART B: ELECTRONICS ENGINEERING LAB

Course Objectives:

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

Course Outcomes: At the end of the course, the student will be able to
CO1: Identify & testing of various electronic components.
CO2: Understand the usage of electronic measuring instruments.
CO3: Plot and discuss the characteristics of various electron devices.
CO4: Explain the operation of a digital circuit.

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers

4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

References:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software.

I Year-I Semester

L	T	P	C
0	0	1	0.5

NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE

(Common to All branches of Engineering)

Course Objectives:

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes: After completion of the course the students will be able to

CO1: Understand the importance of discipline, character and service motto.
CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3: Explore human relationships by analyzing social problems.
CO4: Determine to extend their help for the fellow beings and downtrodden people.
CO5: Develop leadership skills and civic responsibilities.

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care

Activities:

i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.

ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

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I Year-II Semester

L	T	P	C
3	0	0	3

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to All Branches of Engineering)

Course Objectives:

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them in to advanced level by handling various real-world applications.

Course Outcomes:

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

- solve the differential equations related to various engineering fields.
- model engineering problems as higher order differential equations and solve analytically.
- identify solution methods for partial differential equations that model physical processes.
- interpret the physical meaning of different operators such as gradient, curl and divergence.
- estimate the work done against a field, circulation and flux using vector calculus.

UNIT- I : Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits

UNIT – II : Linear differential equations of higher order (Constant Coefficients)

Definitions, homogenous and non-homogenous, complimentary function, general particular integral, Wronskean, method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT – III : Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT - IV : 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 : 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) and applications of these theorems.

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e,John Wiley & Sons, 2018.
2. B.S.Grewal,HigherEngineeringMathematics,44/e,Khanna publishers,2017.

Reference Books:

1. Dennis G.Zill and Warren S.Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2018.
2. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, Pearson Publishers, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).
5. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2017

L	T	P	C
3	0	0	3

I Year-II Semester

ENGINEERING PHYSICS

(Common for all branches of Engineering)

Course Objectives:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

Course Outcomes:

CO1: Analyze the intensity variation of light due to polarization, interference and diffraction.
CO2: Familiarize with the basics of crystals and their structures.
CO3: Explain fundamentals of quantum mechanics and apply it to one dimensional motion of particles.
CO4: Summarize various types of polarization of dielectrics and classify the magnetic materials.
CO5: Explain the basic concepts of Quantum Mechanics and the band theory of solids.
CO6: Identify the type of semiconductor using Hall effect.

UNIT I Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.
Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT III Dielectric and Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation

polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT IV Quantum Mechanics and Free electron Theory

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

UNIT V Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

Textbooks:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: https://www.loc.gov/rr/scitech/selected-internet/physics.html

L	T	P	C
2	0	0	2

I Year-II Semester

COMMUNICATIVE ENGLISH

(Common to All Branches of Engineering)

Course Objectives:

The main objective of introducing this course, *Communicative English*, is to facilitate using Listening, Reading, Speaking and Writing skills effectively by the students. It should result in their better comprehending abilities, oral presentations, reporting useful information and with enhanced knowledge of grammatical structures and vocabulary. This course helps the students in using speaking and writing (productive) skills more efficiently and to make them industry-ready

Course Outcomes

- **By the end of the course the students will have** Learned how to understand the context, topic, and specific information from social or transactional dialogues.
- Remedially learn applying grammatical structures to formulate sentence sand use appropriate words and correct word forms.
- Using discourse markers to speak clearly on a specific topic in formal as well as informal discussions.(not required)
- Improved communicative competence in formal and informal contexts and for social and academic purposes.
- Critically comprehending and appreciatingading /listening texts and to write summaries based on global comprehension of these texts.
- Writing coherent paragraphs essays, letters/e-mails and resume.

Instructions:

1. The reading texts can be given as podcasts to the students so that their listening skills can be enhanced
2. While listening and reading to the text can be given as homework, the classwork for the students can be to discuss and critically evaluate the texts based on the context, purpose or writing the text and understanding it from the author's as well as reader's point of view.
3. Reading as habit for both academic and non-academic (pleasure) purposes has to be inculcated in the students. So training has to be given in intensive and extensive reading strategies.
4. Writing for both academic (assignments, examinations, reports, e-mails/letters etc)
5. The writing tasks given in the class are to be self and peer evaluated by the students before they are finally graded by the faculty.

   Note: Please note that the texts given here are just contexts for teaching various language skills and sub skills. The students' ability to use language cannot be confined to comprehending or using the language related to the given texts (textbooks). The given texts can be used only for practice.
6. All the activities to develop language skills have to be integrated and interconnected, within each unit and across the units.

7. Use as many supplementary materials as possible in various modes (Audio, visual and printed versions) in the classroom so that the students get multimode input and will how to use language skills in the absence of the teacher.

UNIT I
Lesson: HUMAN VALUES: A Power of a Plate of Rice by Ifeoma Okoye (Short Story)

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.(That has to be part of the bridge course- 2 weeks before the actual academic programme starts)
Grammar: Parts of Speech, Basic Sentence Structures-forming questions
Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNITII
Lesson: NATURE: Night of the Scorpion by Nissim Ezekiel (Indian and contemporary)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
Writing: Structure of a paragraph - Paragraph writing (specific topics)
Grammar: Cohesive devices -linkers,use of articles and zero article prepositions.
Vocabulary: Homonyms, Homophones, Homographs.

UNITIII
Lesson: BIOGRAPHY Steve Jobs

Listening: Listening for global comprehension and summarizing what is listened.
Speaking: Discussing specific topics in pairs or small groups and reporting whatis discussed
Reading: Readingatextindetailbymakingbasicinferences-recognizingandinterpretingspecific contextclues;strategies touse textclues for comprehension.
Writing: Summarizing, Note-making, paraphrasing
Grammar: Verbs - tenses;subject-verbagreement; Compound words, Collocations
Vocabulary: Compound words, Collocations

UNIT IV
Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.
Writing: Letter Writing :Official Letters, Resumes
Grammar: Reporting verbs, Direct & Indirect speech, Active& Passive Voice
Vocabulary: Words often confused, Jargons

UNIT V

Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic on texts
Reading: Reading comprehension.
Writing: Writings structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject-verb agreement)
Vocabulary: Technical Jargons

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition,Orient BlackSwan, 2023 (Units 1,2 & 3)
2. Empowering English by Cengage Publications, 2023 (Units 4 & 5)

Suggestion: Instead of giving the syllabus in the form of textbooks it would be better toprocurethe soft copies of individual texts (stories or poems or biographies and non-fiction texts)by the university and make them available on the university website for registered students to access and download

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources:

GRAMMAR:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/

5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

L	T	P	C
3	0	0	3

I Year-II Semester

BASIC CIVIL & MECHANICAL ENGINEERING

(Common to All branches of Engineering)

Course Objectives:

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- Introduction to basic civil engineering materials and construction techniques.

Course Outcomes: On completion of the course, the student should be able to:

CO1: Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.

CO2: Know the concepts of surveying and to understand the measurement of distances, angles and levels through surveying.

CO3: Realize the importance of Transportation in nation's economy and the engineering measures related to Transportation.

CO4: Understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated.

CO5: Understand the basic characteristics of Civil Engineering Materials and attain knowledge on prefabricated technology.

UNIT I

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III

Transportation Engineering Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality

of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Textbooks:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

PART B: BASIC MECHANICAL ENGINEERING

Course Objectives: The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

Course Outcomes: On completion of the course, the student should be able to

CO1: Understand the different manufacturing processes.
CO2: Explain the basics of thermal engineering and its applications.
CO3: Describe the working of different mechanical power transmission systems and power plants.
CO4: Describe the basics of robotics and its applications.

UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.
Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II

Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.
Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants.
Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.
Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

Textbooks:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.

I Year-II Semester

L	T	P	C
3	0	0	3

ELECTRICAL CIRCUIT ANALYSIS -I

Course Objectives:

To develop an understanding of the fundamental laws, elements of electrical circuits and to apply circuit analysis to DC and AC circuits.

Course Outcomes:

CO1: Remembering the basic electrical elements and different fundamental laws.
CO2: Understand the network reduction techniques, transformations, concept of self-inductance and mutual inductance, phasor diagrams, resonance and network theorems.
CO3: Apply the concepts to obtain various mathematical and graphical representations.
CO4: Analyse nodal and mesh networks, series and parallel circuits, steady state response, different circuit topologies (with R, L and C components).
CO5: Evaluation of Network theorems, electrical, magnetic and single-phase circuits.

UNIT I INTRODUCTION TO ELECTRICAL CIRCUITS

Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent), Kirchoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources, node and mesh analysis.

UNIT II MAGNETIC CIRCUITS

Basic definition of MMF, flux and reluctance, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, analysis of series and parallel magnetic circuits.

UNIT III SINGLE PHASE CIRCUITS

Characteristics of periodic functions, Average value, R.M.S. value, form factor, representation of a sine function, concept of phasor, phasor diagrams, node and mesh analysis. Steady state analysis of R, L and C circuits to sinusoidal excitations-response of pure resistance, inductance, capacitance, series RL circuit, series RC circuit, series RLC circuit, parallel RL circuit, parallel RC circuit.

UNIT IV RESONANCE AND LOCUS DIAGRAMS

Series Resonance: Characteristics of a series resonant circuit, Q-factor, selectivity and bandwidth, expression for half power frequencies; Parallel resonance: Q-factor, selectivity and bandwidth; Locus diagram: RL, RC, RLC with R, L and C variables.

UNIT V NETWORK THEOREMS (DC & AC EXCITATIONS)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem

Textbooks:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, Tata Mc Graw Hill Education, 2005, sixth edition.
2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised Third Edition

Reference Books:

1. Fundamentals of Electrical Circuits, Charles K. Alexander and Mathew N.O. Sadiku, Mc Graw Hill Education (India), 2013, Fifth Edition
2. Electric Circuits (Schaum's outline Series), Mahmood Nahvi, Joseph Edminister, and K. Rao, Mc Graw Hill Education, 2017, Fifth Edition.
3. Electric Circuits, David A. Bell, Oxford University Press, 2009, Seventh Edition.
4. Introductory Circuit Analysis, Robert L Boylestad, Pearson Publications, 2023, Fourteenth Edition.
5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, Seventh Revised Edition.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2. https://nptel.ac.in/courses/108104139
3. https://nptel.ac.in/courses/108106172
4. https://nptel.ac.in/courses/117106108

I Year-II Semester

L	T	P	C
0	0	2	1

COMMUNICATIVE ENGLISH LAB

(Common to All Branches of Engineering)

Course Objectives:

The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

Course Outcomes:

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
CO2: Apply communication skills through various language learning activities.
CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.
CO5: Create effective Course Objectives:

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Suggested Software:

- Walden Infotech
- Young India Films

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India, 2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed), Kindle, 2013

Web Resources:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

I Year-II Semester

L	T	P	C
0	0	2	1

ENGINEERING PHYSICS LAB
(Common to All Branches of Engineering)

Course Objectives:

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

Course Outcomes: The students will be able to
CO1: Operate optical instruments like travelling microscope and spectrometer.
CO2: Estimate the wavelengths of different colours using diffraction grating.
CO3: Plot the intensity of the magnetic field of circular coil carrying current with distance.
CO4: Evaluate dielectric constant and magnetic susceptibility for dielectric and magnetic materials respectively.
CO5: Calculate the band gap of a given semiconductor.
CO6: Identify the type of semiconductor using Hall effect.

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's

experiment.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

References:

- A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

Web Resources

- www.vlab.co.in

https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

I Year-II Semester

L	T	P	C
0	0	2	1

IT WORKSHOP

(Common to all branches of Engineering)

Course Objectives:

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

Course Outcomes:

CO1: Perform Hardware troubleshooting.
CO2: Understand Hardware components and inter dependencies.
CO3: Safeguard computer systems from viruses/worms.
CO4: Document/ Presentation preparation.
CO5: Perform calculations using spreadsheets.

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is

no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:-Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

2. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
3. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
4. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
5. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
6. LaTeX Companion, Leslie Lamport, PHI/Pearson.
7. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
8. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

I Year-II Semester

L	T	P	C
0	0	3	1.5

ENGINEERING WORKSHOP
(Common to All branches of Engineering)

Course Objectives:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

Course Outcomes:

CO1: Identify workshop tools and their operational capabilities.
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
CO3: Apply fitting operations in various applications.
CO4: Apply basic electrical engineering knowledge for House Wiring Practice

SYLLABUS

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.

I Year-II Semester

L	T	P	C
0	0	3	1.5

ELECTRICAL CIRCUITS LAB

Course Objectives:

To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics. It also gives practical exposure to the usage of different circuits with different conditions.

Course Outcomes:

CO1: Understand the concepts of network theorems, node and mesh networks, series and parallel resonance and Locus diagrams.
CO2: Apply various theorems to compare practical results obtained with theoretical calculations.
CO3: Determine self, mutual inductances and coefficient of coupling values, parameters of choke coil.
CO4: Analyse different circuit characteristics with the help of fundamental laws and various configurations.
CO5: Create locus diagrams of RL, RC series circuits and examine series and parallel resonance.

List of Experiments:

1. Verification of Kirchhoff's circuit laws.
2. Verification of node and mesh analysis.
3. Verification of network reduction techniques.
4. Determination of cold and hot resistance of an electric lamp
5. Determination of Parameters of a choke coil.
6. Determination of self, mutual inductances, and coefficient of coupling
7. Series and parallel resonance
8. Locus diagrams of R-L (L Variable) and R-C (C Variable) series circuits
9. Verification of Superposition theorem
10. Verification of Thevenin’s and Norton’s Theorems
11. Verification of Maximum power transfer theorem
12. Verification of Compensation theorem
13. Verification of Reciprocity and Millman’s Theorems

Reference Books:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, Tata Mc Graw Hill Education, 2005, sixth edition.
2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised Third Edition

I Year-II Semester

L	T	P	C
0	0	1	0.5

HEALTH AND WELLNESS, YOGA AND SPORTS

(Common to All branches of Engineering)

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes: After completion of the course the student will be able to

CO1: Understand the importance of yoga and sports for Physical fitness and sound health.
CO2: Demonstrate an understanding of health-related fitness components.
CO3: Compare and contrast various activities that help enhance their health.
CO4: Assess current personal fitness levels.
CO5: Develop Positive Personality

UNIT I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and

Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
   Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Department of ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE STRUCTURE
(Applicable from the academic year 2023-24 onwards)
B.Tech.– II Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	BS	Complex Variables & Numerical Methods	3	0	0	3
2	HSMC	Universal Human Values – Understanding Harmony and Ethical Human Conduct	2	1	0	3
3	ES	Electromagnetic Field Theory	3	0	0	3
4	PCC	Electrical Circuit Analysis-II	3	0	0	3
5	PCC	DC Machines & Transformers	3	0	0	3
6	PCC	Electrical Circuit Analysis-II and Simulation Lab	0	0	3	1.5
7	PCC	DC Machines & Transformers Lab	0	0	3	1.5
8	SEC	Data Structures Lab	0	1	2	2
9	Audit Course	Environmental Science	2	0	0	-
Total			**15**	**2**	**10**	**20**

B.Tech. II Year-II Semester

S.No.	Category	Title	L	T	P	Credits
1	Management Course- I	Managerial Economics & Financial Analysis	2	0	0	2
2	ES /Basic Science	Analog Circuits	3	0	0	3
3	PCC	Power Systems-I	3	0	0	3
4	PCC	Induction and Synchronous Machines	3	0	0	3
5	PCC	Control Systems	3	0	0	3
6	PCC	Induction and Synchronous Machines Lab	0	0	3	1.5
7	PCC	Control Systems Lab	0	0	3	1.5
8	SEC	Python Programming Lab	0	1	2	2
9	Engineering Science	Design Thinking & Innovation	1	0	2	2
Total			**15**	**1**	**10**	**21**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation						

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

COMPLEX VARIABLES AND NUMERICAL METHODS

Course Outcomes:

After successful completion of this course, the students should be able to:

- Analyze limit, continuity and differentiation of functions of complex variables and Understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions.
- Understand Cauchy theorem, Cauchy integral formulas and apply these to evaluate complex contour integrals. Classify singularities and poles; find residues and evaluate complex integrals using the residue theorem.
- Apply numerical methods to solve algebraic and transcendental equations
- Derive interpolating polynomials using interpolation formulae
- Solve differential and integral equations numerically

UNIT I:
Complex Variable – Differentiation
Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method.

UNIT II:
Complex Variable – Integration
Line integral-Contour integration, Cauchy's integral theorem(Simple Case), Cauchy Integral formula, Power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

UNIT III:
Solution of Algebraic & Transcendental Equations
Introduction-Bisection Method-Iterative method, Regula-falsi method and Newton Raphson method.
Interpolation: Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae.

UNIT - IV:
Curve fitting: Fitting of straight line, second-degree and Exponential curve by method of least squares.
Numerical Differentiation and Integration-Trapezoidal rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule

UNIT- V:

Solution of Initial value problems to Ordinary differential equations

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's and modified Euler's methods-Runge-Kutta methods (second and fourth order).

Textbooks:

1. B.S.Grewal,Higher Engineering Mathematics, KhannaPublishers,2017, 44th Edition
2. S S Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2018, 10th Edition.
2. B.V.Ramana, Higher Engineering Mathematics, by Mc Graw Hill publishers
3. R.K.Jainand S.R.K.Iyengar, advanced Engineering Mathematics, Alpha Science International Ltd.,2021 5th Edition (9th reprint)

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UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

- Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)
- Identify one’s self, and one’s surroundings (family, society nature) (L1, L2)
- Apply what they have learnt to their own self in different day-to-day settings in real life (L3)
- Relate human values with human relationship and human society. (L4)
- Justify the need for universal human values and harmonious existence (L5)
- Develop as socially and ecologically responsible engineers (L3, L6)

Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher’s Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I

Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: self-exploration as the Process for Value Education

Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II

Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the self and the body.

Lecture 8: Distinguishing between the Needs of the self and the body

Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.

Lecture 9: The body as an Instrument of the self

Lecture 10: Understanding Harmony in the self

Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self

Lecture 11: Harmony of the self with the body

Lecture 12: Programme to ensure self-regulation and Health

Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction

Lecture 14: 'Trust' – the Foundational Value in Relationship

Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust

Lecture 15: 'Respect' – as the Right Evaluation

Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 16: Other Feelings, Justice in Human-to-Human Relationship

Lecture 17: Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order

Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among

the Four Orders of Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V

Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for

UNIT I – Introduction to Value Education

PS1 Sharing about Oneself

PS2 Exploring Human Consciousness

PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being

PS4 Exploring the difference of Needs of self and body

PS5 Exploring Sources of Imagination in the self

PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society

PS7 Exploring the Feeling of Trust

PS8 Exploring the Feeling of Respect

PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature

PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct

PS13 Exploring Humanistic Models in Education

PS14 Exploring Steps of Transition towards Universal Human Order

Readings:

Textbook and Teachers Manual

a. The Textbook

R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj – PanditSunderlal

9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11. India Wins Freedom - Maulana Abdul Kalam Azad

12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on

the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

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ELECTROMAGNETIC FIELD THEORY

Pre-requisite: Concepts of Differential Equations, Vector Calculus and Basic Electrical Circuits

Course Objectives:

- To study the production of electric field and potentials due to different configurations of static charges.
- To study the properties of conductors and dielectrics, calculate the capacitance of different configurations. Understand the concept of conduction and convection current densities.
- To study the magnetic fields produced by currents in different configurations, application of Ampere's law and the Maxwell's second and third equations, magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops.
- To develop the concept of self and mutual inductances and the energy stored.
- To study time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced EMF.

Course Outcomes:

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

CO1: Compute electric fields and potentials using Gauss law/ solve Laplace's or Poisson's equations for various electric charge distributions.

CO2: Analyse the behaviour of conductors in electric fields, electric diploe and the capacitance and energy stored in dielectrics.

CO3: Calculate the magnetic field intensity due to current carrying conductor and understanding the application of Ampere's law, Maxwell's second and third law magnetic force and Equations

CO4: Estimate self and mutual inductances and the energy stored in the magnetic field.

CO5: Understand the concepts of Faraday's laws, Displacement current, Poynting theorem and Poynting vector.

UNIT - I

Vector Analysis:

Vector Algebra: Scalars and Vectors, Unit vector, Vector addition and subtraction, Position and distance vectors, Vector multiplication, Components of a vector.

Coordinate Systems: Rectangular, Cylindrical and Spherical coordinate systems.

Vector Calculus: Differential length, Area and Volume. Del operator, Gradient of a scalar, Divergence of a vector and Divergence theorem (definition only). Curl of a vector and Stoke's theorem (definition only).

Electrostatics:

Coulomb's law and Electric field intensity (EFI) – EFI due to Continuous charge distributions (line and surface charge), Electric flux density, Work done in moving a point charge in an electrostatic field, Electric Potential- properties of potential function, Potential gradient, Gauss's law (Maxwell's first equation, $\nabla.\vec{D} = \rho_v$), Laplace's and Poison's equations.

UNIT - II

Conductors – Dielectrics and Capacitance:

Behaviour of conductor in Electric field, Electric dipole and dipole moment – Potential and EFI due to an electric dipole, Torque on an Electric dipole placed in an electric field, Current density-conduction and convection current densities, Ohm's law in point form, Behaviour of conductors in an electric field, Polarization, dielectric constant and strength, Continuity equation and relaxation time, Boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space, Capacitance of parallel plate, coaxial and spherical capacitors, Energy stored and density in a static electric field.

UNIT - III

Magneto statics, Ampere's Law and Force in magnetic fields:

Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Magnetic flux density and Maxwell's second Equation ($\nabla.\vec{B} = 0$), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation ($\nabla \times \vec{H} = \vec{J}$).

Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, Magnetic dipole, Magnetic torque, and moment.

UNIT - IV

Self and mutual inductance:

Self and mutual inductance – determination of self-inductance of a solenoid, toroid, coaxial cable and mutual inductance between a straight long wire and a square loop wire in the same plane – Energy stored and energy density in a magnetic field.

UNIT - V

Time Varying Fields:

Faraday's laws of electromagnetic induction, Maxwell's fourth equation $\left(\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}\right)$, integral and point forms of Maxwell's equations, statically and dynamically induced EMF, Displacement current, Modification of Maxwell's equations for time varying fields, Poynting theorem and Poynting vector.

Textbooks:

1. "Elements of Electromagnetics" by Matthew N O Sadiku, Oxford Publications, 7th edition, 2018.
2. "Engineering Electromagnetics" by William H. Hayt& John. A. Buck Mc. Graw-Hill, 9th Editon.2020.

Reference Books:

1. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt. Ltd,4th edition,2020
2. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson India, 1st edition, 2011.
3. "Fundamentals of Engineering Electromagnetics" by Sunil Bhooshan, Oxford University Press, 2012.
4. Schaum's Outline of Electromagnetics by Joseph A. Edminister, Mahamood Navi,4th Edition,2014.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/117103065

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ELECTRICAL CIRCUIT ANALYSIS-II

Pre-requisite: Analysis of DC and Single-phase AC Circuits, Concepts of differentiation and integration.

Course Objectives:

- To understand three phase circuits
- To analyse transients in electrical systems
- To evaluate network parameters of given electrical network
- To apply Fourier analysis to electrical systems
- To understand graph theory for circuit analysis and to understand the behaviour of filters

Course Outcomes:

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

CO1: Analyse the balanced and unbalanced 3 phase circuits for power calculations.
CO2: Analyse the transient behaviour of electrical networks in different domains.
CO3: Estimate various Network parameters.
CO4: Apply the concept of Fourier series to electrical systems.
CO5: Analyse the filter circuit for electrical circuits.

UNIT - I

Analysis of three phase balanced circuits:

Phase sequence, star and delta connection of sources and loads, relationship between line and phase quantities, analysis of balanced three phase circuits, measurement of active and reactive power.

Analysis of three phase unbalanced circuits:

Loop method, Star-Delta transformation technique, measurement of active and reactive power.

UNIT – II

Laplace transforms – Definition and Laplace transforms of standard functions (Impulse, Step, Ramp, Parabolic) – Shifting theorem – Laplace Transforms of derivatives and integrals, Inverse Laplace transforms.

Transient Analysis: Transient response of R-L, R-C and R-L-C circuits for D.C. and sinusoidal excitations – Initial conditions - Solution using differential equation approach and Laplace transform approach.

UNIT - III

Network Parameters: Impedance parameters, Admittance parameters, Hybrid parameters, Transmission (ABCD) parameters, conversion of Parameters from one form to other, Conditions for Reciprocity and Symmetry, Interconnection of Two Port networks in Series, Parallel and Cascaded configurations- problems.

UNIT - IV

Fourier Analysis:

Trigonometric and exponential form of Fourier series, evaluation of Fourier coefficients, Symmetry in Fourier Series – Even Symmetry, Odd Symmetry, Half Wave Symmetry, Quarter Wave Symmetry, Average & RMS values of periodic waveforms, Analysis of Electric Circuits with Periodic Excitation.

UNIT - V

Filters: Classification of filters-Low pass, High pass, Band pass and Band Elimination filters, Constant-k filters -Low pass and High Pass, Design of Filters - Low pass and High pass.

Textbooks:

1. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, 9th Edition McGraw-Hill, 2020
2. Fundamentals of Electric Circuits, Charles K. Alexander, Mathew N. O. Sadiku, 7th Edition, Tata McGraw-Hill, 2022

Reference Books:

1. Network Analysis, M. E. Van Valkenburg, 3rd Edition, PHI, 2019.
2. Network Theory, N. C. Jagan and C. Lakshminarayana, 3rd Edition, B. S. Publications, 2015.
3. Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan S. Palli, 5th Edition, Tata McGraw-Hill, 2017.
4. Engineering Network Analysis and Filter Design (Including Synthesis of One Port Networks)- Durgesh C. Kulshreshtha Gopal G. Bhise, Prem R. Chadha ,Umesh Publications 2012.
5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, 7th Revised Edition.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/117/106/117106108/
2. https://archive.nptel.ac.in/courses/108/105/108105159/

DC MACHINES & TRANSFORMERS

Pre-requisite: Principles of Electromechanical Energy Conversion, Electromagnetic fields and Electrical Circuit Analysis.

Course Objectives:

Students will get exposure to

- Understand the characteristics and applications of DC Machines.
- Develop problem solving skills about the starting, speed control and testing of DC Machines.
- Understand the concepts of efficiency and regulation of a transformer by obtaining equivalent circuit.
- Understand the performance of single-phase transformers.
- Understand the connection diagrams of three-phase transformers.

Course Outcomes:

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

CO1: Understand the process of voltage build-up in DC generators and characteristics.

CO2: Understand the process of torque production, starting and speed control of DC motors and illustrate their characteristics.

CO3: Obtain the equivalent circuit of single-phase transformer and determine its efficiency & regulation.

CO4: Analyze the performance of Single- Phase Transformers

CO4: Analyse various configurations of three-phase transformers.

UNIT – I: DC Machines

Introduction to DC machines (Construction and principle of operation of DC machines) – EMF equation for generator –Excitation techniques – characteristics of DC generators –applications of DC Generators, Back-emf and torque equations of DC motor- Characteristics of DC motors - Applications of DC motors – Armature reaction and commutation.

UNIT – II: Starting, Speed Control and Testing of DC Machines

Necessity of a starter – starting by 3-point and 4-point starters – speed control by armature voltage and field current control – Testing of DC machines, losses and efficiency – brake test, Swinburne's test –Hopkinson's test–Field Test.

UNIT – III: Single-phase Transformers

Introduction to single-phase Transformers (Construction and principle of operation)–emf equation – operation on no-load and on load –lagging, leading and unity power factor loads – phasor diagrams– equivalent circuit –regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – auto transformer - all day efficiency.

UNIT –IV: Testing of Transformers

Open-Circuit and Short-Circuit tests – Sumpner's test – separation of losses— Parallel operation with equal and unequal voltage ratios— equivalent circuit – comparison with two winding transformers.

UNIT – V: **Three-Phase Transformers:**

Polyphase connections- Y/Y, Y/Δ, Δ/Y, Δ/Δ, open Δ and Vector groups – third harmonics in phase voltages– Parallel operation–three winding transformers- transients in switching –off load and on load tap changers–Scott connection.

Textbooks:

1. Electrical Machinery by Dr. P S Bimbhra, Fully Revised edition, Khanna Publishers, New Delhi,2021.
2. Performance and analysis of AC machines by M.G. Say, CBS, 2002.

Reference Books:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 5th edition, 2017.
2. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2017
3. Generalized Theory of Electrical Machines by Dr. P S Bimbhra, 7th Edition, Khanna Publishers, 2021.
4. Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria& Sons,2013.
5. Electric Machinery by Fitzgerald, A.E.,Kingsley, Jr.,C.,& Umans, S. D, 7th edition, McGraw-Hill Education, 2014.

Online Learning Resources:

1. nptel.ac.in/courses/108/105/108105112
2. nptel.ac.in/courses/108/105/108105155

ELECTRICAL CIRCUIT ANALYSIS-II AND SIMULATION LAB

Course Objectives:

- To measure three phase Active and Reactive power
- To analyse transient behaviour of circuits
- To determine 2-port network parameters
- To analyse electrical circuits using simulation tools

Course Outcomes:

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

CO1: Understand the power calculations in three phase circuits.

CO2: Evaluate the time response of given network.

CO3: Evaluate two port network parameters.

CO4: Simulate and analyse electrical circuits using suitable software.

List of Experiments

Any 10 of the following experiments are to be conducted:

1. Measurement of Active Power and Reactive Power for balanced loads.
2. Measurement of Active Power and Reactive Power for unbalanced loads.
3. Determination of Z and Y parameters.
4. Determination of ABCD and hybrid parameters
5. Verification of Kirchhoff's current law and voltage law using simulation tools.
6. Verification of mesh and nodal analysis using simulation tools.
7. Verification of super position and maximum power transfer theorems using simulation tools.
8. Verification of Reciprocity and Compensation theorems using simulation tools.
9. Verification of Thevenin's and Norton's theorems using simulation tools.
10. Verification of series and parallel resonance using simulation tools.
11. Simulation and analysis of transient response of RL, RC and RLC circuits.
12. Verification of self-inductance and mutual inductance by using simulation tools.

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DC MACHINES & TRANSFORMERS LAB

Pre-requisite: Principles of Electromechanical Energy Conversion, Electromagnetic fields and Electrical Circuit Analysis.

Course Objectives:

The objectives of this course is

- To conduct the experiment and plot the characteristics and applications of DC machines.
- To perform the starting, speed control and testing methods of DC Machines.
- To determine/Predetermine efficiency and regulation of the transformer through equivalent circuit.

Course Outcomes:

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

CO1: Demonstrate starting and speed control methods of DC Machines.
CO2: Apply theoretical concepts in analysing the performance characteristics of DC Machines.
CO3: Determine the performance characteristics of DC machines using different testing methods.
CO4: Determine the performance parameters of single-phase transformer.

List of Experiments

Any 10 of the following experiments are to be conducted:

1. Speed control of DC shunt motor by Field Current and Armature Voltage Control.
2. Brake test on DC shunt motor- Determination of performance curves.
3. Swinburne's test - Predetermination of efficiencies as DC Generator and Motor.
4. Hopkinson's test on DC Shunt Machines.
5. Load test on DC compound generator-Determination of characteristics.
6. Load test on DC shunt generator-Determination of characteristics.
7. Fields test on DC series machines-Determination of efficiency.
8. Brake test on DC compound motor-Determination of performance curves.
9. OC & SC tests on single phase transformer.
10. Sumpner's test on single phase transformer.
11. Scott connection of transformers.
12. Parallel operation of Single-phase Transformers.
13. Separation of core losses of a single-phase transformer.

Online Learning Resources:

1. https://ems-iitr.vlabs.ac.in/List%20of%20experiments.html

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DATA STRUCTURES LAB

Pre-requisite: Fundamentals in C Programming.

Course Objectives:

- To provide the knowledge of basic data structures and their implementations.
- To understand importance of data structures in context of writing efficient programs.
- To develop skills to apply appropriate data structures in problem solving.

Course Outcomes: At the end of the course, Student will be able to

CO1: Identify the role of data structures in organizing and accessing data.
CO2: Design, implement, and apply linked lists for dynamic data storage.
CO3: Develop applications using stacks and queues.
CO4: Design and implement algorithms for operations on binary trees and binary search trees.
CO5: Devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees.

UNIT I

Introduction to Data Structures: Definition and importance of Data structures, Abstract data types (ADTs) and its specifications, **Arrays**: Introduction, 1-D, 2-D Arrays, accessing elements of array, Row Major and Column Major storage of Arrays, **Searching Techniques**: Linear & Binary Search, **Sorting Techniques**: Bubble sort, Selection sort, Quick sort.

Sample Experiments:

1. Program to find min & max element in an array.
2. Program to implement matrix multiplication.
3. Find an element in given list of sorted elements in an array using Binary search.
4. Implement Selection and Quick sort techniques.

UNIT II

Linked Lists: Singly linked lists: representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists.

Sample Experiments:

1. Write a program to implement the following operations.
   a. Insert b. Deletion c. Traversal
2. Write a program to store name, roll no, and marks of students in a class using circular double linked list.
3. Write a program to perform addition of given two polynomial expressions using linked list.

UNIT III

Stacks: Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, Applications of stacks in expression evaluation, backtracking, reversing list etc.

Sample Experiments:

1. Implement stack operations using
   a. Arrays b. Linked list
2. Convert given infix expression into post fix expression using stacks.
3. Evaluate given post fix expression using stack.
4. Write a program to reverse given linked list using stack.

UNIT IV

Queues: Introduction to queues: properties and operations, Circular queues, implementing queues using arrays and linked lists, Applications of queues scheduling, etc.

Deques: Introduction to deques (double-ended queues), Operations on deques and their applications.

Sample Experiments:

1. Implement Queue operations using
   a. Arrays b. Linked list
2. Implement Circular Queue using
   a. Arrays b. Linked list
3. Implement Dequeue using linked list.

UNIT V

Trees: Introduction to Trees, Binary trees and traversals, Binary Search Tree – Insertion, Deletion & Traversal.

Sample Experiments:

1. Implement binary tree traversals using linked list.
2. Write program to create binary search tree for given list of integers. Perform in-order traversal of the tree. Implement insertion and deletion operations.
3.

Textbooks:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders.
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft.

3. Problem Solving with Algorithms and Data Structures by Brad Miller and David Ranum.
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick.

ENVIRONMENTAL SCIENCE

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.

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: 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:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem.
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation : Introduction 0 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: Definition, Cause, effects and control measures of :

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. 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: 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: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – 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..

Textbooks:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.Azeem Unnisa, “Environmental Studies” Academic Publishing Company

4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India), Pvt. Ltd.

References:

1. Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

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MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Course Objectives:

- To inculcate the basic knowledge of microeconomics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

Course Outcomes:

- Define the concepts related to Managerial Economics, financial accounting and management(L2)
- Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets (L2)
- Apply the Concept of Production cost and revenues for effective Business decision (L3)
- Analyze how to invest their capital and maximize returns (L4)
- Evaluate the capital budgeting techniques. (L5)
- Develop the accounting statements and evaluate the financial performance of business entity (L5)

UNIT - I Managerial Economics

Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting-Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

UNIT - II Production and Cost Analysis

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least- cost combination– Short run and long run Production Function- Isoquants and Is costs, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems).

UNIT - III Business Organizations and Markets

Introduction – Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies

UNIT - IV Capital Budgeting

Introduction – Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

UNIT - V Financial Accounting and Analysis

Introduction – Concepts and Conventions- Double-Entry Bookkeeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

Reference Books:

1. Ahuja Hl Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

Online Learning Resources:

https://www.slideshare.net/123ps/managerial-economics-ppt
https://www.slideshare.net/rossanz/production-and-cost-45827016
https://www.slideshare.net/darkyla/business-organizations-19917607
https://www.slideshare.net/balarajbl/market-and-classification-of-market
https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396
https://www.slideshare.net/ashu1983/financial-accounting

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ANALOG CIRCUITS

Pre-requisite: Knowledge of electronic components and semiconductor devices, number systems, binary arithmetic, Boolean or switching algebra, and logic gates.

Course Objectives:

- To acquire the basic knowledge on clippers, clampers & biasing circuits.
- To determine the h-parameters of a transistor circuit & understand the concepts of feedback amplifiers.
- To know the operation of oscillators and operational amplifier.
- To understand the applications of operational amplifier.
- To acquire the knowledge on IC 555 timer and their applications and know the operation of Analog to Digital Converters and Digital to Analog Converters.

Course Outcomes:

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

CO1**:** Analyze diode clipping and clamping circuits. Understand different types of biasing circuits of a transistor.

CO2**:** Use small signal modeling for transistor circuit analysis and illustrate the operation of feedback amplifiers.

CO3**:** Understand operation of oscillators, operational amplifiers.

CO4**:** Analyze the op-amp applications, comparators and wave form generators.

CO5**:** Use 555 timers in multi-vibrators, Schmitt Trigger and PLL applications and describe the operation of different ADC's and DAC's.

Unit – 1:

Diode clipping and clamping circuits: Diode Clippers-Positive and Negative clippers, Diode Clampers - Positive and Negative Clampers. Transfer characteristics of clippers and clampers.

DC biasing of BJTs: Load lines, Operating Point, Bias Stability, Collector-to-Base Bias, Self-Bias, Stabilization against Variations in V_{BE} and β for the Self-Bias Circuit, Bias Compensation, Thermal Runaway, Thermal Stability.

Unit – II:

Small Signals Modelling of BJT: Analysis of a Transistor Amplifier Circuit using h-parameters, Simplified CE Hybrid Model, Analysis of CE, CC, CB Configuration using Approximate Model, Frequency Response of CE and CC amplifiers.

Feedback Amplifiers: Classification of Amplifiers, the Feedback Concept, General Characteristics of Negative-Feedback Amplifiers, Effect of Negative Feedback upon Output and Input Resistances, Voltage-Series Feedback, Current-Series Feedback, Current-Shunt Feedback, Voltage-Shunt Feedback.

Unit – III:

Oscillator Circuits: Barkhausen Criterion of oscillation, Oscillator operation, R-C phase shift oscillator, Wien bridge Oscillator, Crystal Oscillator.

Operational Amplifiers: Introduction, Basic information of Op-Amp, Ideal Operational Amplifier, Block Diagram Representation of Typical Op-Amp, OP-Amps Characteristics: Introduction, DC and AC characteristics, 741 op-amp & its features.

Unit – IV:

OP-AMPS Applications: Introduction, Basic Op-Amp Applications, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converter, Sample and Hold Circuit, Log and Antilog Amplifier, Multiplier and Divider, Differentiator, integrator.

Comparators and Waveform Generators: Introduction, Comparator, Square Wave Generator, Monostable Multivibrator, Triangular Wave Generator, Sine Wave Generators.

Unit – V:

Timers and Phase Locked Loop: Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger, PLL block schematic, principles and description of individual blocks, 565 PLL, Applications of VCO (566).

Digital to Analog and Analog to Digital Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A-D Converters – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

Textbooks:

1. Electronic Devices and Circuits- J. Millman, C.Halkias, Tata Mc-Graw Hill, 4th Edition, 2015.
2. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 5th Edition, 2018.

Reference Books:

1. Electronic Devices and Circuit Theory – Robert L.Boylestad and Lowis Nashelsky, Pearson Edition, 2021.
2. Electronic Devices and Circuits–G.K. Mithal, Khanna Publisher, 23rd Edition, 2017.
3. Electronic Devices and Circuits – David Bell, Oxford Publications, 2010.
4. Electronic Principles–Malvino, Albert Paul, and David J. Bates, McGraw-Hill/Higher Education, 9th Edition 2021..
5. Operational Amplifiers and Linear Integrated Circuits– Gayakwad R.A, Pearson,4th edition, 2021.
6. Operational Amplifiers and Linear Integrated Circuits –Sanjay Sharma, Kataria& Sons, 2ndEdition, 2010.

Online Learning Resources:

1. https://nptel.ac.in/courses/122106025.
2. https://nptel.ac.in/courses/108102112.

POWER SYSTEMS - I

Pre-requisite: Fundamentals of Basic Electrical Engineering and electrical materials.

Course Objectives:

- To study the principle of operation of different components of hydro and thermal power stations.
- To study principle of operation of different components of a nuclear power stations.
- To study construction and operation of different components of an Air and Gas Insulated substations.
- To study different types of cables and distribution systems.
- To study different types of load curves and tariffs applicable to consumers.

Course Outcomes:

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

CO1: Understand the different types of power plants, operation of hydroelectric and thermal power plants.

CO2: Understand the operation of nuclear power plants.

CO3: Describe the different components of air and gas insulated substations.

CO4: Discuss the construction of single core and three core cables and describe distribution system configurations.

CO5: Analyse different economic factors of power generation and tariffs.

Unit I:

Hydroelectric Power Stations:

Selection of site, general layout of a hydroelectric power plant with brief description of major components and principle of operation

Thermal Power Stations:

Selection of site, general layout of a thermal power plant. Brief description of components: boilers, super heaters, economizers and electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.

Unit II:

Nuclear Power Stations:

Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants, types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

Unit III: Substations:

Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment. Bus bar arrangements in the sub-stations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

Gas Insulated Substations (GIS) – advantages of gas insulated substations, constructional aspects of GIS, comparison of air insulated substations and gas insulated substations.

Unit IV:

Underground Cables:

Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables. Grading of cables: capacitance grading and intersheath grading.

Distribution Systems:

Classification of Distribution systems, A.C Distribution, overhead versus Underground system, Connection schemes of Distribution system, Requirements of Distribution system, requirements of a Distribution system, Design considerations in Distribution system.

UNIT V: Economic Aspects & Tariff:

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block-rate, two-part, three–part, and power factor tariff methods.

Text Books:

1. I.J. Nagarath & D.P. Kothari, Power System Engineering, McGraw-Hill Education, 3rd Edition, 2019.
2. C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Publishers, 6th Edition, 2018.
3. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 3rd edition 2014.

Reference Books:

1. S. N. Singh, Electric Power Generation, Transmission and Distribution, PHI Learning Pvt Ltd, New Delhi, 2nd Edition, 2010
2. J.B.Gupta, Transmission and Distribution of Electrical Power, S.K.Kataria and sons,10th Edition, 2012
3. V. K. Mehta and Rohit Mehta, Principles of Power System, S. Chand, 4th Edition, 2005.
4. Handbook of Switchgear, BHEL, McGraw-Hill Education, 2007.

Online Learning Resources:

1. https://nptel.ac.in/courses/108102047

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INDUCTION AND SYNCHRONOUS MACHINES

Pre-requisite: Principles of Electromechanical Energy Conversion, Electromagnetic fields and Transformers.

Course Objectives:

Students will get exposure to understand the concepts of

- operation and performance of three phase induction motor
- performance of induction motor and their performance parameters.
- torque producing mechanism of single phase induction motor
- performance parameters of synchronous generators
- operation performance and starting methods of synchronous motors

Course Outcomes:

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

CO1: Explain the construction and operation of three-phase induction motor.
CO2: Analyse the performance of three-phase induction motor.
CO3: Describe the working of single-phase induction motors.
CO4: Analyse the performance of Synchronous generators
CO5: Analyse the performance of Synchronous motors

UNIT-I: 3-phase induction motors

Introduction to 3-phase induction motors (Construction of Squirrel cage and Slipring induction motors)– production of rotating magnetic field – principle of operation – rotor emf and rotor frequency – rotor current and power factor at standstill and during running conditions– rotor power input, rotor copper loss and mechanical power developed and their inter-relationship – equivalent circuit – phasor diagram

UNIT-II: Performance of 3-Phase induction motors

Torque equation – expressions for maximum torque and starting torque – torque-slip characteristics – double cage and deep bar rotors –No load, Brake test and Blocked rotor tests – circle diagram for predetermination of performance- methods of starting –starting current and torque calculations -speed control of induction motor with V/f control method, rotor resistance control and rotor emf injection technique –crawling and cogging – induction generator operation.

UNIT – III: Single- Phase Motors

Single phase induction motors – constructional features – double revolving field theory, Cross field theory – equivalent circuit- starting methods: capacitor start capacitor run, capacitor start induction run, split phase & shaded pole, AC series motor.

UNIT–IV: Synchronous Generator

Constructional features of non-salient and salient pole type alternators- armature windings – distributed and concentrated windings – distribution& pitch factors – E.M.F equation –armature reaction – voltage regulation by synchronous impedance method – MMF method and Potier triangle method –two reaction analysis of salient pole machines -methods of synchronization- Slip test – Parallel operation of alternators.

UNIT–V: Synchronous Motor

Synchronous motor principle and theory of operation – Effect of excitation on current and power factor– synchronous condenser –expression for power developed –hunting and its suppression – methods of starting.

Text Books:

1. Electrical Machinery, Dr. P.S. Bhimbra, Khanna Publishing, New Delhi, Fully Revised Edition, 2021.
2. Performance and analysis of AC machines by M.G. Say, CBS, 2002.

Reference Books:

1. Electrical machines, D.P. Kothari and I.J. Nagrath, McGraw Hill Education, 2017, Fifth Edition.
2. Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria & Sons, 2013.
3. Electric Machinery, A.E.Fitzgerald, Charles kingsley, Stephen D.Umans, McGraw-Hill, 2020, Seventh edition.

Online Learning Resources:

1. nptel.ac.in/courses/108/105/108105131
2. https://nptel.ac.in/courses/108106072

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CONTROL SYSTEMS

Pre-requisite: Basic Engineering Mathematics

Course Objectives:

- To obtain the mathematical models of physical systems and derive transfer function.
- To determine the time response of systems and analyse system stability.
- To analyse system stability using frequency response methods.
- To design compensators using Bode diagrams.
- To obtain the mathematical models of physical systems using state space approach and determine the response.

Course Outcomes:

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

CO1: Derive the transfer function of physical systems and determine overall transfer function using block diagram algebra and signal flow graphs.

CO2: Obtain the time response of first and specifications of second order systems and determine error constants. Analyze the absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.

CO3: Analyze the stability of LTI systems using frequency response methods.

CO4: Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode Diagrams.

CO5: Apply state space analysis concepts to represent physical systems as state models, derive transfer function and determine the response. Understand the concepts of controllability and observability

UNIT - I

Mathematical Modelling of Control Systems

Classification of control systems - open loop and closed loop control systems and their differences - Feedback characteristics - transfer function of linear system, differential equations of electrical networks- translational and rotational mechanical systems- block diagram reduction techniques – representation by signal flow graph – reduction using Mason's gain formula.

UNIT - II

Time Response Analysis:

Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants - effects of proportional (P) - proportional integral (PI) - proportional derivative (PD) proportional integral derivative (PID) systems.

Stability And Root Locus Technique:

The concept of stability – Routh's stability criterion – limitations of Routh's stability, root locus concept – construction of root loci (simple problems) - Effect of addition of Poles and Zeros to the transfer function.

UNIT – III: Frequency Response Analysis

Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram –Polar plots, Nyquist stability criterion- stability analysis using Bode plots (phase margin and gain margin).

UNIT – IV: Classical Control Design Techniques

Lag, lead, lag-lead compensators - physical realization - design of compensators using Bode plots.

UNIT – V: State Space Analysis of LTI Systems

Concepts of state - state variables and state model - state space representation of transfer function: Controllable Canonical Form - Observable Canonical Form - Diagonal Canonical Form - diagonalization using linear transformation - solving the time invariant state equations State Transition Matrix and its properties- concepts of controllability and observability.

Text Books:

1. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India, 5th edition, 2015.
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 9th Edition,2014.

Reference Books:

1. Control Systems principles and design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4th Edition.
2. Control Systems Engineering by Norman S. Nise, Wiley Publications, 7th edition
3. Control Systems by Manik Dhanesh N, Cengage publications.
4. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
5. Control Systems Engineering by S.Palani, Tata Mc Graw Hill Publications.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/107/106/107106081/
2. https://archive.nptel.ac.in/courses/108/106/108106098/
3. https://nptelvideos.com/video.php?id=1423&c=14

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INDUCTION AND SYNCHRONOUS MACHINES LAB

Pre-requisite: Principles of Electromechanical Energy Conversion, Electromagnetic fields.

Course Objectives:

The objectives of this course is

- To apply the concepts of speed control methods in 3-phase Induction Motor.
- To experimentally develop circle diagram and obtain equivalent circuit to analyse the performance of 3-phase induction motor
- To apply the concepts of power factor improvement on single phase Induction Motor
- To perform various testing methods on alternators for experimentally predetermine the regulation

Course Outcomes:

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

CO1: Analyse the speed control methods on 3-phase Induction Motor.

CO2: Evaluate the performance of 3-phase Induction Motor by obtaining the locus diagram and equivalent circuit of 3-phase Induction Motor

CO3: Adapt the power factor improvement methods for single phase Induction Motor

CO4: Pre-determine the regulation of 3-phase alternator

CO5: Determine the synchronous machine reactance of 3-phase alternator

List of Experiments

Any 10 experiments of the following are required to be conducted

1. Brake test on three phase induction motor.
2. Circle diagram of three phase induction motor.
3. Speed control of three phase induction motor by V/f method.
4. Equivalent circuit of single-phase induction motor.
5. Power factor improvement of single-phase induction motor by using capacitors.
6. Load test on single phase induction motor.
7. Regulation of a three -phase alternator by synchronous impedance.
8. Regulation of a three -phase alternator by MMF method.
9. Regulation of three-phase alternator by Potier triangle method.
10. V and Inverted V curves of a three-phase synchronous motor.
11. Determination of X_d, X_q & Regulation of a salient pole synchronous generator.
12. Determination of efficiency of three phase alternator by loading with three phase induction motor.
13. Parallel operation of three-phase alternator under no-load and load conditions.

Online Learning Resources:

1. https://em-coep.vlabs.ac.in/List%20of%20experiments.html

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CONTROL SYSTEMS LAB

Pre-requisite: Basic Engineering Mathematics and Fundamentals of MATLAB.

Course Objectives:

- To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors and Synchro's.
- To understand time and frequency responses of control system with and without controllers and compensators.
- To know the different logic gates and Boolean expressions using PLC.

Course Outcomes:

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

CO1: Analyse the time response of system (first order and second order system).

CO2: Design of PID controllers and compensators.

CO3: Determine the transfer function of D.C Motor

CO4: Judge the stability in time and frequency domain and Kalman's test for controllability and observability

CO5: Analyse the potentiometer and determine the state space analysis concepts to represent physical systems as state models in MATLAB

List of Experiments

Any 10 of the following experiments are to be conducted:

1. Analysis of First order system in time domain (For Step, Ramp Inputs)
2. Analysis of Second order system in time domain (For Step, Ramp Inputs)
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag Compensation - Magnitude and phase plot
5. Design of Lead Compensation - Magnitude and phase plot
6. Transfer function of DC Motor
7. Stability analysis of Linear Time Invariant system using Root Locus Technique (MATLAB)
8. Stability analysis of Linear Time Invariant system using Bode Plot Technique (MATLAB)
9. Stability analysis of Linear Time Invariant system using Nyquist Plot Technique (MATLAB)
10. Kalman's test of Controllability and Observability using MATLAB.
11. Potentiometer as an error detector
12. State space model for classical transfer function using MATLAB.

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PYTHON PROGRAMMING LAB

Pre-requisite: Fundamentals of Programming Language

Course Objectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Apply built-In functions, strings and lists
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Modules and Regular Expressions in Python Programming and to create practical and contemporary applications
- Apply basic functional data science programming with python

Course Outcomes:

The student will be able to

- Understand core concepts of python programming and conditional control statements.
- Usage of functions, strings and Lists.
- Create built in functions, dictionaries and Tuple operations
- Access files and modules in object-oriented programming
- Create the different types of data formats for storing and transmitting information

UNTI-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if-elif-else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II:

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.
5. Write a program to perform the given operations on a list:
   i.addition ii. insertion iii. slicing
6. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:

Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple () Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, using zip () Function, Sets, Set Methods, Frozenset ()

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. Write a program to check if a given key exists in a dictionary or not.
4. Write a program to add a new key-value pair to an existing dictionary.
5. Write a program to sum all the items in a given dictionary.

UNIT-IV:

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Python program to print each line of a file in reverse order.
3. Python program to compute the number of characters, words and lines in a file.
4. Write a program to create, display, append, insert and reverse the order of the items in the array.
5. Write a program to add, transpose and multiply two matrices.
6. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT-V:

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python Program to demonstrate NumPy arrays creation using array () function.
3. Python program to demonstrate use of ndim, shape, size, dtype.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:
    a) Apply head () function to the pandas data frame
    b) Perform various data selection operations on Data Frame
7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

1. Gowri Shankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://nptel.ac.in/courses/106106182

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DESIGN THINKING & INNOVATION

Course Objectives:

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

Course Outcomes:

- Define the concepts related to design thinking. (L1, L2)
- Explain the fundamentals of Design Thinking and innovation (L1, L2)
- Apply the design thinking techniques for solving problems in various sectors. (L3)
- Analyse to work in a multidisciplinary environment (L4)
- Evaluate the value of creativity (L5)
- Formulate specific problem statements of real time issues (L3, L6)

UNIT I

Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT II

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT III

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT IV

Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT V

Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown,Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

Online Learning Resources:

https://nptel.ac.in/courses/110/106/110106124/

https://nptel.ac.in/courses/109/104/109104109/

https://swayam.gov.in/nd1_noc19_mg60/preview

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Department of ELECTRICAL AND ELECTRONICS ENGINEERING COURSE STRUCTURE
(Applicable from the academic year 2023-24 onwards)

B.Tech. III Year-I Semester

S.No	Category	Course Code	Title	L	T	P	C
1	PC		Power Electronics	3	0	0	3
2	PC		Digital Circuits	3	0	0	3
3	PC		Power Systems-II	3	0	0	3
4	PCE-1		1. Signals and Systems 2. Computer Architecture and Organization 3. Communication systems	3	0	0	3
5	OE-1		1. Renewable Energy Sources 2. Electrical Machine Design 3. Intelligent Control Systems	3	0	0	3
6	PC Lab-1		Power Electronics Lab	0	0	3	1.5
7	PC Lab-2		Analog and Digital Circuits Lab	0	0	3	1.5
8	SEC		Soft Skills	0	1	2	2
9	ES		Tinkering Lab	0	0	2	1
10	Internship		Evaluation of Community Service Project Internship (Done during II-II Summer Vacation – 8 Weeks)	0	0	0	2
11	MC		Technical Paper Writing & IPR	2	0	0	0
Total				**17**	**1**	**10**	**23**

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III Year – I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
Power Electronics					

Pre-requisite:

Electrical Circuit Analysis, Semiconductor Physics, Control Systems

Course Objectives:

- To know the characteristics of various power semiconductor devices.
- To learn the operation of single phase controlled converters and perform harmonic analysis of input current.
- To learn the operation of three phase-controlled converters and AC/AC converters.
- To learn the operation of different types of DC-DC converters and control techniques.
- To learn the operation of PWM inverters for voltage control and harmonic mitigation.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Illustrate the static and dynamic characteristics of SCR, Power-MOSFET and Power-IGBT.
CO2: Analyse the operation of phase-controlled rectifiers.
CO3: Analyse the operation of three-phase full–wave converters, AC Voltage Controllers and Cycloconverters.
CO4: Examine the operation and design of different types of DC-DC converters.
CO5: Analyse the operation of Square wave inverters and PWM inverters for voltage control.

UNIT – I
Power Semi-Conductor Devices

Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design.
Static and Dynamic Characteristics of Power MOSFET and Power IGBT-Numerical problems.

UNIT – II
Single-phase AC-DC Converters

Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL load and RLE load - Continuous and Discontinuous conduction - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL load and RLE load – Continuous and Discontinuous conduction - Dual converter and its mode of operation - Numerical Problems.

UNIT – III
Three-phase AC-DC Converters & AC – AC Converters

Three-phase half-wave Rectifier with R and RL load - Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage - Numerical Problems.
Single-phase AC-AC power control by phase control with R and RL loads - Expression for rms output voltage – Single-phase step down and step up Cycloconverter - Numerical Problems.

UNIT – IV
DC–DC Converters

Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple – control techniques – Introduction to PWM control -Numerical Problems.

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UNIT – V
DC–AC Converters
Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads – Phase Displacement Control – PWM with bipolar voltage switching, PWM with unipolar voltage switching - Three-phase square wave inverters - 120^0 conduction and 180^0 conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

Text Books:

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons, 2002.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 2017.
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

1. Elements of Power Electronics–Philip T.Krein. Oxford University Press; Second edition, 2014.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics: by Daniel W.Hart, Mc Graw Hill, 2011.

Online Learning Resources:
1. https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007
2. https://archive.nptel.ac.in/courses/108/101/108101126

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III Year – I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
Digital Circuits					

Pre-requisite:

Knowledge of electronic components and semiconductor devices, number systems, binary arithmetic, Boolean or switching algebra and logic gates.

Course Objectives:

- To know the simplification methods of Boolean functions
- To understand the realization of arithmetic, data routing and memory logic circuits.
- To know the operation and design of various counters and registers.
- To understand the analysis and design of synchronous sequential circuits.
- To understand the basic concepts of digital integrated circuits.

Course Outcomes:

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

CO1: Use the concepts of Boolean algebra, K-map, tabulation method in minimization of switching functions and able to design the arithmetic combinational circuits.
CO2: Realize different types of data routing combinational circuits and PLDs.
CO3: Apply knowledge of flip-flops in designing of registers and counters.
CO4: Analyze synchronous sequential circuits and apply different methods for the design of synchronous sequential circuits.
CO5: Understand the logic families in the form of digital integrated circuits.

UNIT – I:
Combinational logic circuits – I

Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, simplification of logic functions using Boolean theorems, NAND and NOR implementations, Karnaugh maps – 3 and 4 variables, Incompletely specified functions (Don‘t care terms), Simplifying Max term equations, Quine-McCluskey minimization technique, General approach to combinational logic design, Look ahead carry adder, Cascading full adders, 4-bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder, Binary comparators.

UNIT – II:
Combinational logic circuits – II

Decoders, BCD decoders, 7 segment decoder, higher order decoder, multiplexer, higher order multiplexing, de-multiplexers, higher order de-multiplexing, realization of Boolean functions using decoders, multiplexers, encoders, priority encoder, Read only and Read/Write Memories, Programmable ROM, PAL, PLA-Basics structures, programming tables of PROM, PAL, PLA, realization of Boolean functions.

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Unit – III
Sequential logic circuits
Timing considerations of flip-flops, master-slave flip-flop, edge triggered flip-flops, characteristic equations, flip-flops with reset and clear terminals, excitation tables, conversion from one flip-flop to another flip-flop, design of asynchronous and synchronous counters, design of modulus-N counters, Johnson counter, ring counter, design of registers - buffer register, control buffer register, shift register, bi-directional shift register, universal shift register.

UNIT – IV
Sequential Circuit Design
Mealy and Moore models, State machine notation, Synchronous Sequential circuit analysis, Construction of state diagrams, Analysis of clocked sequential circuits, realization of sequence detector circuit, state reduction and assignments, design procedure.

UNIT – V
Digital integrated circuits:
Logic levels, propagation delay time, power dissipation, fan-out and fan-in, noise margin, logic families – RTL and DTL Circuits, TTL, Emitter-Coupled Logic, Metal-Oxide Semiconductor, Complementary MOS, CMOS Transmission Gate Circuits (Elementary approach only).

Textbooks:
1. Switching and finite automata theory Zvi. Kohavi, 3rd edition, Cambridge University Press, 2010.
2. M. Morris Mano and M. D. Ciletti, “Digital Design”, 4th Edition, Pearson Education,2006.

Reference Books:
1. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers, 5th Edition, 1992.
2. Switching Theory and Logic Design by A. Anand Kumar, Prentice Hall India Pvt., Limited, Third Edition, 2016.

Online Learning Resources:
1. https://nptel.ac.in/courses/117106086.
2. https://nptel.ac.in/courses/108105113.

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III Year – I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
Power Systems-II					

Pre-requisite:
Power systems-I, Electrical circuit Analysis.

Course Objectives:
- To understand the concepts of GMD & GMR to compute inductance& capacitance of transmission lines.
- To distinguish the models of short, medium and long length transmission lines and analyze their performance.
- To learn the effect of travelling waves on transmission lines with different terminal conditions.
- To learn the concepts of corona, the factors effecting corona and effects of transmission lines.
- To design the sag and tension of transmission lines as well as to learn the performance of line insulators.

Course Outcomes:
After the completion of the course the student should be able to:
CO1: Calculate parameters of transmission lines for different circuit configurations.
CO2: Analyze the performance of short, medium and long transmission lines.
CO3: Analyze the effect of travelling waves on transmission lines.
CO4: Estimate the effects of corona in transmission lines.
CO5: Calculate sag and tension of transmission lines and design the line insulators.

UNIT–I
Transmission Line Parameters Calculations
Conductor materials – Types of conductors – Composite Conductors - Calculation of resistance for solid conductors – Calculation of inductance for Single-phase and Three-phase single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors, Skin and Proximity effects. 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 without and with Bundled conductors.

UNIT–II
Performance Analysis of Transmission Lines
Classification of Transmission Lines – Short, medium, long lines and their model representation –Nominal-T, Nominal-π and A, B, C, D Constants for symmetrical Networks.
Rigorous Solution for long line equations –Representation of Long lines – Equivalent T and Equivalent π network models - Surge Impedance and Surge Impedance Loading of Long Lines - Regulation and efficiency for all types of lines – Ferranti effect.

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UNIT – III
Power System Transients
Types of System Transients – Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients.

Termination of lines with different types of conditions: Open Circuited Line–Short Circuited Line, Line terminated through a resistance and line connected to a cable. Reflection and Refraction at a T-Junction (Elementary approach only).

UNIT–IV
Corona & Effects of transmission lines
Description of the phenomenon – Types of Corona - critical voltages and power loss – Numerical Problems - Advantages and Disadvantages of Corona - Factors affecting corona - Radio Interference.

UNIT–V
Sag and Tension Calculations and Overhead Line Insulators:
Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice weight on conductor – Stringing chart and sag template and its applications.
Types of Insulators – Voltage distribution in suspension insulators–Calculation of string efficiency and Methods for String efficiency improvement – Capacitance grading and Static Shielding.

Text Books:

1. Electrical Power Systems – by C.L.Wadhwa, New Age International (P) Limited, 1998.
2. Power System Engineering by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 3rd Edition, 2019.

Reference Books:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar A.Chakrabarthy, DhanpatRai Co Pvt. Ltd.2016.
4. Electrical Power Systems by P.S.R. Murthy, B.S. Publications, 2017.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105104
2. https://archive.nptel.ac.in/courses/108/102/108102047

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III Year – I SEMESTER	Professional Core Elective- I	L	T	P	C
		3	0	0	3
Signals and Systems					

Course Objectives:

- This gives the basics of signals and systems required for all electrical engineering related courses.
- To understand the behavior of signal in time and frequency domain.
- To understand the characteristics of Linear Time Invariant (LTI) systems.
- Concepts of the correlation and sampling process.
- This give concepts of signals and Systems along with its analysis using different transform techniques.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Apply the knowledge of various signals and operations.
CO2: Analyze the spectral characteristics of periodic signals using Fourier Analysis.
CO3: Classify the systems based on their properties and determine the response of LSI system using convolution.
CO4: Understand the process of sampling and the effects of under sampling.
CO5: Apply Laplace and z-transforms to analyze signals and Systems (continuous & discrete).

UNIT – I
Introduction

Definition of Signals and Systems - Classification of Signals - Classification of Systems - Operations on signals: time-shifting - time-scaling - amplitude-shifting - amplitude-scaling. Problems on classification and characteristics of Signals and Systems. Complex exponential and sinusoidal signals – Singularity functions and related functions: impulse function - step function signum function and ramp function. Analogy between vectors and signals - orthogonal signal space - Signal approximation using orthogonal functions - Mean square error - closed or complete set of orthogonal functions - Orthogonally in complex functions. Related Problems.

UNIT – II
Fourier Series and Fourier Transform

Introduction to Fourier series and Fourier Transform, representation of continuous time periodic signals - properties of Fourier series - Dirichlet's conditions - Trigonometric Fourier series and Exponential Fourier series - Relation between Trigonometric and Exponential Fourier series - Complex Fourier spectrum. Deriving Fourier transform from Fourier series - Fourier transform of arbitrary signal - Fourier transform of standard signals - Fourier transform of periodic signals - properties of Fourier transforms - Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform. Related Problems.

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UNIT – III
Analysis of Linear Systems
Introduction - Linear system - impulse response - Response of a linear system - Linear time invariant (LTI) system - Linear time variant (LTV) system - Concept of convolution in time domain and frequency domain - Graphical representation of convolution - Transfer function of a LTI system - Related problems. Filter characteristics of linear systems. Distortion less transmission through a system - Signal bandwidth - system bandwidth - Ideal LPF - HPF and BPF characteristics – Causality and PolyWiener criterion for physical realization - relationship between bandwidth and rise time.

UNIT – IV
Correlation
Auto-correlation and cross-correlation of functions - properties of correlation function - Energy density spectrum - Parseval's theorem - Power density spectrum - Relation between Convolution and correlation - Detection of periodic signals in the presence of noise by correlation - Extraction of signal from noise by filtering.
Sampling Theorem
Graphical and analytical proof for Band Limited Signals - impulse sampling - Natural and Flat top Sampling - Reconstruction of signal from its samples - effect of under sampling – Aliasing - Introduction to Band Pass sampling - Related problems.

UNIT - V
Laplace Transforms
Introduction - Concept of region of convergence (ROC) for Laplace transforms - constraints on ROC for various classes of signals - Properties of L.T's - Inverse Laplace transform - Relation between L.T's - and F.T. of a signal. Laplace transform of certain signals using waveform synthesis.
Z–Transforms
Concept of Z- Transform of a discrete sequence. Region of convergence in Z-Transform - constraints on ROC for various classes of signals - Inverse Z-transform - properties of Z-transforms. Distinction between Laplace - Fourier and Z transforms.

Text Books:

1. Signals - Systems & Communications - B.P. Lathi - BS Publications - 2003.
2. Signals and Systems - A.V. Oppenheim - A.S. Willsky and S.H. Nawab - PHI - 2nd Edition1997
3. Signals & Systems - Simon Haykin and Van Veen - Wiley - 2nd Edition - 2007

Reference Books:

1. Principles of Linear Systems and Signals – BP Lathi - Oxford University Press - 2015
2. Signals and Systems – T K Rawat - Oxford University press - 2011.

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III Year – I SEMESTER	Professional Elective- I	L	T	P	C
		3	0	0	3
Computer Architecture and Organization					

Pre-requisite:

Basic knowledge in digital electronics, fundamentals of computers.

Course Objectives:

- To explain the basic working of a digital computer.
- To understand the register transfer language and micro operators.
- To learn various addressing modes supported by the processors.
- To be familiar with peripheral interfacing with processors.
- To understand memory hierarchy in computers.

Course Outcomes:

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

CO1: Demonstrate the instruction cycle of a computer.
CO2: Understand various micro operations and register transfer language.
CO3: Describe parallel processing and pipelining.
CO4: Interface different peripherals with processors.
CO5: Know the advantages of cache and virtual memory.

UNIT-I

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.

UNIT-II

Register Transfer and Micro operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit. Micro programmed Control: Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.

UNIT-III

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC) Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISK Pipeline, Vector Processing, Array Processors.

UNIT-IV

Input/output Organization: Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication.

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UNIT-V

Memory Organization: Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.

Text Books:

1. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., 3rd Edition, Sept. 2008.

References Books:

1. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003.
2. Computer Organization and Architecture, Linda Null, Julia Lobur, Narosa Publications ISBN 81- 7319-609-5
3. Computer System Organization by John. P. Hayes.

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III Year – I SEMESTER	Professional Elective- I	L	T	P	C
		3	0	0	3
Communication systems					

Course Objectives:

- To provide a comprehensive understanding of the principles of analog and digital communication systems.
- To analyze the performance of modulation and demodulation techniques.
- To understand the impact of noise on communication systems and study signal-to-noise ratio (SNR).
- To explore the fundamentals of information theory and source/channel coding.
- To examine various multiplexing and multiple access techniques used in modern communication systems.

Unit I:

Introduction to Communication Systems

Elements of communication systems, Types of communication: Analog and digital, Electromagnetic spectrum, signal types (deterministic, random, periodic, aperiodic),Time domain and frequency domain analysis, Amplitude Modulation (AM): Generation, demodulation, spectrum, power relations

Unit II:

Angle Modulation

Frequency Modulation (FM) and Phase Modulation (PM): Principles and mathematical representation, Generation and demodulation of FM signals, Bandwidth of FM signals (Carson’s Rule), Comparison between AM and FM, Noise in AM and FM systems

Unit III:

Pulse and Digital Modulation

Sampling theorem, aliasing, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Pulse Code Modulation (PCM) and Delta Modulation (DM), Digital modulation schemes: ASK, FSK, PSK, QPSK, Comparison of digital modulation techniques

Unit IV:

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Noise and Information Theory

Noise: Internal and external noise, signal-to-noise ratio (SNR), noise figure, Information theory basics: Entropy, mutual information, Source coding: Huffman coding, Channel capacity and Shannon's theorem, Error control coding: Parity checks, CRC, Hamming codes

Unit V:

Multiplexing and Multiple Access

Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Code Division Multiple Access (CDMA), Orthogonal Frequency Division Multiplexing (OFDM), Spread spectrum techniques, Communication system examples: Radio, television, cellular systems, satellite communications

Textbooks:

1. Simon Haykin, *Communication Systems*, Wiley.
2. B.P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford University Press.

Reference Books:

1. Taub and Schilling, *Principles of Communication Systems*, McGraw-Hill.
2. John G. Proakis and Masoud Salehi, *Fundamentals of Communication Systems*, Pearson.
3. Roddy and Coolen, *Electronic Communications*, Pearson Education.
4. Kennedy and Davis, *Electronic Communication Systems*, McGraw-Hill.

Course Outcomes:
After successful completion of this course, students will be able to:

- Explain the fundamental concepts of communication systems and modulation techniques.
- Analyze and compare analog and digital modulation schemes based on performance metrics.
- Understand and apply noise analysis to communication systems.
- Interpret key concepts of information theory, source and channel coding.
- Demonstrate understanding of multiplexing and multiple access schemes in modern communication networks.

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III Year – I SEMESTER	Open Elective-I	L	T	P	C
		3	0	0	3
Renewable Energy Sources					

Pre-requisite: Basic Electrical Engineering

Course Objectives:

- To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics.
- To understand the concept of Wind Energy Conversion & its applications.
- To study the principles of biomass, hydel and geothermal energy.
- To understand the principles of ocean Thermal Energy Conversion, waves and power associated with it.
- To study the various chemical energy sources such as fuel cell and hydrogen energy along with their operation and equivalent circuit.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.
CO2: Illustrate the components of wind energy systems.
CO3: Illustrate the working of biomass, hydel plants and Geothermal plants.
CO4: Demonstrate the principle of Energy production from OTEC, Tidal and Waves.
CO5: Evaluate the concept and working of Fuel cells & MHD power generation.

UNIT–I
Solar Energy

Introduction - Renewable Sources - prospects, solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.

UNIT–II
Wind Energy

Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.

UNIT–III
Biomass, Hydel and Geothermal Energy

Biomass: Introduction - Biomass conversion technologies- Photosynthesis. Factors affecting Bio digestion.
Hydro plants: Basic working principle – Classification of hydro systems**:** Large, small, micro hydel plants.
Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and

Environmental problems.

UNIT–IV
Energy From oceans, Waves & Tides:
Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India.
Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.
Tides: Basic principle of Tide Energy -Components of Tidal Energy.

UNIT–V
Chemical Energy Sources:
Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.
Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications
Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation - Types.

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell& Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

Reference Books:

1. S.P.Sukhatme &J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. ShobaNath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/103/103/103103206
2. https://archive.nptel.ac.in/courses/103/107/103107157

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III Year – I SEMESTER	Open Elective-I	L	T	P	C
		3	0	0	3
Electrical Machine Design					

Pre-requisite:

Basics of Conservation of Electrical Energy

Course Objectives:

- To introduce the fundamental principles of electrical machine design
- To analyze and apply thermal and mechanical considerations.
- To understand the selection and role of magnetic, electric, and insulating materials
- To explore the application of Computer Aided Design (CAD)
- To develop analytical skills to formulate and solve design-oriented problems

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Analyze the design factors and modern trends in electrical machine design.
CO2: Design different types of electrical machines based on performance requirements.
CO3: Evaluate materials and cooling methods for optimized machine performance.
CO4: Apply analytical and CAD tools for efficient machine design.
CO5: Solve design-oriented numerical problems and optimize parameters under constraints

UNIT–I

Fundamental Aspects of Electrical Machine Design

Design of machines - design factors - limitation in design - modern trends in electrical machine design – types of magnetic, electric and insulating materials – modes of heat dissipation – cooling of rotating machines – methods of cooling.

UNIT–II:

Design of transformers

Transformer windings – output equation – design of main dimensions – design of core - choice of flux density – determination of number of turns and length of mean term - resistance and leakage reactance – no load current calculation –cooling of transformers- calculation of number of tubes.

UNIT–III:

Design of DC Machines

Output equation –selection of specific magnetic and electric loadings - separation of D and L – estimation of number of conductors, armature slots and conduct dimensions – choice of number of poles and calculation of length of airgap – design of field systems, interpoles and brushes**.**

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UNIT–IV
Design of Induction motors
Output equation -main dimensions – choice of average flux density and ampere conduction for meter — design of stator slots and rotor slots- design of rotor bars end rings– design of wound rotor – design of no-load current.

UNIT–V
Design of Synchronous Machines
Types of construction – output equation - main dimensions – short circuit ratio and its effects on the performance – design of rotor –Design of field winding – Design of turbo alternators – Rotor design temperature rise and its effects.

Text Books:

1. A.K.Sawhney , "A Course in Electrical Machines Design" , Dhan path Rai & Co. 6th edition 2010.

Reference Books:
1. AE Clayton and NN Hancock, "The Performance and Design of Direct Current Machines", CBS Publishers, 3rd edition, 2004.
2. M.G. Say, "Performance and Design of A.C. Machines", ELBS and Pitman & Sons, 4th edition, 2013.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Company Pvt. Ltd. New Delhi, 2nd edition,2006.
4. K. M. Vishnu Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 1st edition 2008.

Online Learning Resources:
1. https://cusp.umn.edu/electric-machine-design-videos
2. https://nptel.ac.in/courses/108102146
3. https://nptel.ac.in/courses/108/105/108105017

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III Year – I SEMESTER	Open Elective-I	L	T	P	C
		3	0	0	3
Intelligent Control Systems					

Course Objectives:

- To introduce the fundamentals of intelligent control systems and their applications in modern engineering.
- To develop the ability to design intelligent controllers for complex, nonlinear, and uncertain systems.
- To explore various intelligent control techniques, including fuzzy logic, neural networks, genetic algorithms, and hybrid systems.
- To implement intelligent control systems using real-world applications in robotics, automation, and process control.
- To study the hybridization of different intelligent techniques to improve the performance of control systems.

Course Outcomes:

After the completion of the course the student should be able to

- Explain the fundamental principles of intelligent control systems and their components.
- Develop artificial neural networks (ANNs) and apply them for control system applications.
- Design and implement fuzzy logic controllers for nonlinear systems.
- Apply genetic algorithms (GA) for optimization and controller tuning in intelligent control systems.
- Analyze and solve complex control problems using hybrid intelligent techniques

UNIT-I
Introduction to Intelligent Control Systems
Overview of traditional control systems vs. intelligent control systems. Intelligent control paradigms: Fuzzy Logic, Neural Networks, Genetic Algorithms, Expert Systems. Components and structure of intelligent control systems. Advantages and limitations of intelligent control. Applications of intelligent control systems in various industries.

UNIT-II
Artificial Neural Networks (ANNs)
Biological foundations of neural networks. Neurons, activation functions, and architecture of ANNs. Supervised and unsupervised learning algorithms. Perceptrons and multi-layer perceptrons (MLP). Backpropagation algorithm and gradient descent. Applications of neural networks in control system design. Training neural networks for control applications.

UNIT-III
Fuzzy Logic Systems
Introduction to fuzzy sets and membership functions, Linguistic variables and fuzzy rules. Fuzzy inference systems: Mamdani and Sugeno methods. Defuzzification techniques: centroid, mean of maximum, etc. Fuzzy controllers design for nonlinear systems. Applications of fuzzy logic in control systems.

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UNIT-IV
Genetic Algorithms (GAs)
Fundamentals of genetic algorithms: selection, crossover, mutation, and fitness function. Representation of solutions in GAs (chromosomes). GA-based optimization for control system design. Hybrid GA-based optimization and neural networks. Applications of GAs in optimizing controllers for complex systems. Tuning control parameters using genetic algorithms with an example.

UNIT-V
Hybrid Intelligent Systems and Applications
Overview of hybrid systems: combining fuzzy logic, neural networks, and genetic algorithms. Neuro-fuzzy systems and their design. Adaptive control using hybrid intelligent systems.
Case studies: Intelligent control in robotics, process control, and automation. Real-time applications and challenges in intelligent control systems. Simulation tools for implementing intelligent control systems (MATLAB, Simulink, etc.).

Textbooks:
1. "Fuzzy Control Systems" by Driankov, Hellen Doorn, and Rein frank.
2. "Neural Networks for Control" by W. Thomas Miller II and Richard S. Sutton
3. "Genetic Algorithms in Search, Optimization, and Machine Learning" by David E. Goldberg
4. "Fuzzy Logic with Engineering Applications" by Timothy J. Ross

Reference Books:
1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. "Intelligent Control Systems with LabVIEW" by D. R. Kiran and R. K. Gupta.
3. "Soft Computing and Intelligent Systems Design" by P. S. Karray and D. de Silva.
4. "Handbook of Intelligent Control: Neural, Fuzzy, and Adaptive Approaches" by Dan W. Patton, Jorge D. Suykens, and Tim Miller.
5. "Intelligent Control Systems" by K. Ogata.

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III Year – I SEMESTER	Professional Core Lab - 1	L	T	P	C
		0	0	3	1.5
Power Electronics Lab					

Course objectives:

- To learn the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter and Boost converter.
- To understand the working of single-phase & three-phase inverters.

Course outcomes:

After the completion of the course the student should be able to:

CO1: Analyse characteristics of various power electronic devices and design firing circuits for SCR.
CO2: Analyse the performance of single–phase dual, three–phase full–wave bridge converters and dual converter with both resistive and inductive loads.
CO3: Examine the operation of Single-phase AC voltage regulator and Cycloconverter with resistive and inductive loads.
CO4: Differentiate the working and control of Buck converter and Boost converter.
CO5: Differentiate the working & control of Square wave inverter and PWM inverter.

Any 10 of the Following Experiments are to be conducted

1. Characteristics of SCR - Power MOSFET & Power IGBT.
2. R, RC & UJT firing circuits for SCR.
3. Single -Phase semi-converter with R & RL loads.
4. Single -Phase full-converter with R & RL loads.
5. Three- Phase full-converter with R & RL loads.
6. Single-phase dual converter in circulating current & non circulating current mode of operation for R & RL Loads.
7. Single-Phase AC Voltage Regulator with R & RL Loads.
8. Single-phase step down Cycloconverter with R & RL Loads.
9. Boost converter in Continuous Conduction Mode operation.
10. Buck converter in Continuous Conduction Mode operation.
11. Single -Phase half bridge inverter with R & RL Loads.
12. Single -Phase full bridge inverter with R & RL Loads.
13. Single - Phase Half Bridge PWM inverter.
14. Single - Phase Full Bridge PWM inverter.
15. Three-phase bridge inverter with 120^0 and / or 180^0 conduction mode.

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III Year – I SEMESTER	Professional Core Lab - 2	L	T	P	C
		0	0	3	1.5
Analog and Digital Circuits Lab					

Course Objectives:
To impart knowledge on
- Analysis of transistor amplifiers
- Analysis of feedback amplifiers and oscillators
- Realization of digital circuits such data routing, registers and counters.

Course Outcomes:
At the end of the course, the student will be able to,
CO1: Analyse diode clipper/clamper circuits and transistor biasing.
CO2: Illustrate the operation of feedback amplifiers and oscillator circuits.
CO3: Analyze the applications of linear IC's
CO4: Demonstrate the operation of digital circuits such as arithmetic, data routing, registers and counters.

Any 5 of the Following Experiments are to be conducted from each PART.

PART-A

1. Analysis of clipper and clamper circuits.
2. Analysis of self-bias to a transistor.
3. Analysis of voltage series and current series feedback amplifiers.
4. Analysis of Wien Bridge oscillator and RC-phase shift oscillator.
5. Analysis of Integrator and Differentiator Circuits using IC 741.
6. Analysis of Monostable and Astable multivibrator operation using IC 555 Timer.
7. Analysis of Schmitt Trigger Circuits using IC 741 and IC 555.
8. Verify the PLL characteristics using IC 565.
9. Analysis of 8 bit A to D and D to A circuits

PART-B

1. Design of Full adder and Full Subtractor using logic gates.
2. Realization of parallel adder/subtractor using IC 7483.
3. Implementation of 3 to 8 line decoder using logic gates and IC 7445.
4. Implementation of 8 to 1 multiplexer using logic gates and IC 74151.
5. Verify the operation of master-slave JK flip-flop using IC7476.
6. Realization of the following shift registers using IC7495.
    a) SISO
    b) SIPO
    c) PISO
    d) PIPO
7. Implementation of Mod-10 ripple counter using flip-flops and IC 7490.
8. Implementation of Mod-8 synchronous up/down counters using flip-flops.
9. Implementation of 4 bit Ring Counter and Johnson Counter using D flip-flops/J-K flip-flops.

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III Year – I SEMESTER	Skill Enhancement course	L	T	P	C
		0	1	2	2
Soft skills					

Course Objectives

- To help students understand and develop key personal and interpersonal skills required in professional environments.
- To improve communication skills, emotional intelligence, and public speaking ability.
- To instill confidence, teamwork, and leadership skills for effective workplace behavior.
- To enhance time management, adaptability, and problem-solving capabilities.
- To prepare students for interviews, group discussions, and career advancement.

Unit I:

Communication Skills

Verbal and non-verbal communication, Listening skills and feedback techniques, Barriers to communication and how to overcome them, Email and business writing etiquette, Public speaking and group communication

Unit II:

Interpersonal & Team Skills

Building interpersonal relationships, Conflict resolution and negotiation, Leadership styles and team dynamics, Group behavior and decision-making, Working in diverse environments

Unit III:

Emotional Intelligence & Stress Management

Understanding emotional intelligence (EQ), Self-awareness, empathy, and social skills , Stress and anxiety: causes and coping strategies, Work-life balance and mental well-being, Assertiveness and self-confidence,

Unit IV:

Professional Etiquette & Ethics

Grooming and professional image, Business and social etiquette, Time management and goal setting, Ethics and values in the workplace, Respect for diversity and inclusion

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Unit V:

Interview Skills & Career Planning

Resume writing and cover letter drafting, Job search strategies and career planning, Interview techniques (HR and technical rounds), Group discussions and mock interviews, Feedback and improvement strategies

Textbooks

1. Barun K. Mitra, *Personality Development and Soft Skills*, Oxford University Press.
2. Meenakshi Raman & Sangeeta Sharma, *Technical Communication: Principles and Practice*, Oxford University Press.
3. Goleman, Daniel, *Emotional Intelligence*, Bantam Books.

Reference Books

1. Alex K., *Soft Skills: Know Yourself & Know the World*, S. Chand Publishing.
2. P. Subba Rao, *Management and Organizational Behavior*, Himalaya Publishing.
3. Pease, Allan & Barbara, *The Definitive Book of Body Language*, Bantam.
4. Carnegie, Dale, *How to Win Friends and Influence People*, Simon & Schuster.
5. Online platforms like NPTEL, Coursera, and LinkedIn Learning for video-based learning and activities.

Course Outcomes

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

- Communicate effectively in verbal and written formats in professional settings.
- Demonstrate improved interpersonal skills and emotional intelligence.
- Work collaboratively in teams and lead group activities or discussions.
- Manage time efficiently and adapt to changing work environments.
- Present themselves professionally during interviews, presentations, and group discussions.

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III Year – I SEMESTER	Engineering Science	L	T	P	C
		0	0	2	1
Tinkering Lab					

Course Objectives:

- To develop a mindset for innovation, creativity, and problem-solving through hands-on activities.
- To introduce students to basic tools, components, and systems used in prototyping (electronics, mechanical, software).
- To encourage interdisciplinary thinking and collaborative project development.
- To provide exposure to modern tools such as Arduino, Raspberry Pi, sensors, 3D printing, and simple mechanical assemblies.
- To build confidence in experimenting with ideas and transforming them into working prototypes.

List of Experiments

1. Familiarization with lab tools – Breadboard, multimeter, soldering station, power supply.
2. Basic electronic circuits – Series, parallel circuits, use of resistors, capacitors, LEDs.
3. Introduction to Arduino – Writing and uploading simple sketches.
4. Sensor interfacing – Temperature, light, motion, ultrasonic sensors.
5. Actuator control – Servo motor, DC motor, relay modules.
6. Serial communication – Between Arduino and PC.
7. Simple IOT application – Sending data to cloud (e.g., using ThingSpeak or Blynk).
8. Mobile App Integration – Basic app to control devices using Bluetooth.
9. Mechanical prototyping – Introduction to 3D printing and simple CAD modeling.

Textbooks

1. "Getting Started with Arduino" – Massimo Banzi and Michael Shiloh.
2. "Make: Electronics – Learning Through Discovery" – Charles Platt.
3. "Exploring Arduino" – Jeremy Blum.

Reference Books:

1. "Practical Electronics for Inventors" – Paul Scherz and Simon Monk.
2. "Arduino Cookbook" – Michael Margolis and Brian Jepson.
3. "Make: Sensors" – Tero Karvinen, Kimmo Karvinen, and Ville Valtokari.
4. "Python Programming for Raspberry Pi" – Tim Cox (if Raspberry Pi is included).

E resources: Arduino (www.arduino.cc), Raspberry Pi (www.raspberrypi.org), Instructables (www.instructables.com), and Tinkercad.

Course Outcomes
At the end of the course, students will be able to:

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- Identify and use basic electronic components and prototyping tools.
- Design and implement simple circuits and embedded systems using microcontrollers.
- Use sensors and actuators to create interactive systems.
- Apply mechanical fabrication techniques using 3D printers and simple mechanical tools.
- Collaborate effectively to build innovative, interdisciplinary prototypes or mini-projects.
- Present and communicate their design ideas and implementation clearly.

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III Year – I SEMESTER	Mandatory Course	L	T	P	C
		2	0	0	0
Technical Paper Writing & IPR					

Course Objectives

1. To develop an understanding of the structure, style, and ethics of technical and scientific writing.
2. To train students in effective academic communication, including research paper, thesis, and project report writing.
3. To create awareness about various forms of intellectual property and the process of securing IP rights.
4. To provide foundational knowledge on patents, copyrights, trademarks, and design rights.
5. To sensitize students about innovation, commercialization, and legal aspects of research.

Unit I:

Fundamentals of Technical Writing

Basics of technical communication,Types of technical documents: research papers, project reports, theses,Structure and components of a technical paper (Abstract, Introduction, Methods, Results, Discussion), Clarity, precision, and language usage in scientific writing, Ethics in writing: plagiarism, data falsification, multiple submissions

Unit II:

Writing for Publication

Selection of journal/conference, understanding journal impact factor, indexing, and scope, Manuscript preparation and formatting guidelines, Submission process and peer review system, Responding to reviewers and revisions

Unit III:

Presentation and Dissemination

Preparing abstracts, posters, and oral presentations,Tools for formatting and referencing (LaTeX, MS Word, EndNote, Mendeley, Zotero), Best practices for graphical and tabular data representation, Collaboration and authorship ethics, Copyright and open-access publishing

Unit IV:

Introduction to IPR

Definition and need for Intellectual Property, Categories: Patents, Copyrights, Trademarks, Trade

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Secrets, Industrial Designs, Basic principles of patentability: novelty, non-obviousness, utility, National and international IPR organizations (WIPO, IPO, USPTO, EPO), IPR protection mechanisms in India

Unit V:

Patent Filing and Innovation Management

Patent filing process in India and abroad, Patent search using free databases (Google Patents, Espace net, WIPO), Patent drafting basics: claims, specifications, drawings, Technology transfer and commercialization of IP, Role of incubation centers and start-up policy

Textbooks

1. M. Ashok Kumar & R. Murugesan, *Research Methodology and IPR*, Charulatha Publications.
2. R. N. Khandare, *Research Methodology & IPR*, S. Chand Publishing.
3. Michael Alley, *The Craft of Scientific Writing*, Springer.

Reference Books

1. B.L. Wadehra, *Law Relating to Intellectual Property*, Universal Law Publishing Co.
2. Deborah E. Bouchoux, *Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets*, Cengage Learning.
3. Day & Gastel, *How to Write and Publish a Scientific Paper*, Cambridge University Press.
4. Robin Jeffery & Michael Wilkinson, *Publishing Research Successfully*, SAGE.
5. Government of India: *IPR Policy Documents and Patent Office Guidelines* (available on https://ipindia.gov.in)

Course Outcomes

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

- Write effective technical papers and reports that conform to academic and professional standards.
- Present technical information clearly and ethically in various formats (papers, posters, presentations).
- Understand the process of peer review and publishing in journals/conferences.
- Identify and explain different types of intellectual property and how they are protected.
- Apply knowledge of IPR to protect and commercialize their innovations responsibly.

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B.Tech. III Year-II Semester

S.No	Category	Course Code	Title	L	T	P	C
1	PC		Electrical Measurements and Instrumentation	3	0	0	3
2	PC		Microprocessors and Microcontrollers	3	0	0	3
3	PC		Power System Analysis	3	0	0	3
4	PCE - II		1. Switchgear and Protection 2. Advanced Control Systems 3. Renewable and Distributed Energy Technologies	3	0	0	3
5	PCE - III		1. Electric Drives 2. Digital Signal Processing 3. High Voltage Engineering	3	0	0	3
6	OE - II		1. Fundamentals of Electric Vehicles 2. Electrical Wiring Estimation and Costing 3. Utilization of Electrical Energy	3	0	0	3
7	PC Lab-1		Electrical Measurements and Instrumentation Lab	0	0	3	1.5
8	PC Lab-2		Microprocessors and Microcontrollers Lab	0	0	3	1.5
9	SEC		IoT Applications of Electrical Engineering Lab	0	1	2	2
10	AC		Research Methodology	2	0	0	0
Total				**20**	**1**	**8**	**23**
Mandatory Industry Internship of 08 weeks duration during summer vacation							

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III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
Electrical Measurements and Instrumentation					

Pre-requisite:
Basics of Electrical and Electronics Engineering.

Course Objectives:

- To understand and analyze the factors that effect the various measuring units.
- To choose the appropriate meters for measuring of voltage, current, power, power factor and energy qualities and understand the concept of standardization.
- Describe the operating principle of AC & DC bridges for measurement of resistance, inductance and capacitance.
- To understand the concept of the transducer and their effectiveness in converting from one form to the other form for the ease of calculating and measuring purposes.
- To understand the operating principles of basic building blocks of digital systems, record and display units.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Know the construction and working of various types of analog instruments.
CO2: Describe the construction and working of wattmeter and power factor meters
CO3: Know the construction and working various bridges for the measurement resistance inductance and capacitance
CO4: Know the operational concepts of various transducers
CO5: Know the construction and operation digital meters

UNIT - I

Analog Ammeter and Voltmeters

Classification – deflecting, control and damping torques – PMMC, moving iron type and electrostatic instruments – Construction – Torque equation – Range extension – Errors and compensations – advantages and disadvantages. Instrument transformers: Current Transformer and Potential Transformer – theory – Ratio and phase angle errors–Numerical Problems.

UNIT - II

Analog Wattmeters and Power Factor Meters

Electrodynamometer type wattmeter (LPF and UPF) – Power factor meters: Dynamometer and M.I type (Single phase and Three phase) – Construction – torque equation – advantages and disadvantages. Potentiometers: Principle and operation of D.C Crompton's potentiometer – Standardization – Applications – AC Potentiometer (Polar and coordinate types) – Standardization – Applications – Numerical Problems.

UNIT - III

Measurements of Electrical parameters

DC Bridges: Method of measuring low, medium and high resistance –Wheat stone's bridge for measuring medium resistance – Kelvin's double bridge for measuring low resistance – Loss of charge method for measurement of high resistance – Megger – measurement of earth resistance – Numerical Problems.

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AC Bridges: Measurement of inductance and quality factor – Maxwell's bridge – Hay's bridge – Anderson's bridge. Measurement of capacitance and loss angle – Desauty's bridge – Schering Bridge – Wien's bridge –Numerical Problems.

UNIT - IV

Transducers

Definition – Classification – Resistive, Inductive and Capacitive Transducer – LVDT – Strain Gauge – Thermistors – Thermocouples – Piezo electric and Photo Diode Transducers – Hall effect sensors – Numerical Problems.

UNIT - V

Digital meters

Digital Voltmeters – Successive approximation DVM – Ramp type DVM and Integrating type DVM – Digital frequency meter – Digital multimeter – Digital tachometer – Digital Energy Meter – Q meter. CRO – measurement of phase difference and Frequency using lissajious patterns – Numerical Problems.

Text Books:

1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis - 5th Edition - Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper - PHI - 5th Edition - 2002.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co. Publications - 19th revised edition - 2011.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput - S.Chand - 3rd edition.
3. Electrical Measurements by Buckingham and Price - Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105153

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III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
Microprocessors and Microcontrollers					

Course Objectives:

- To impart knowledge of the architecture and functioning of 8086 microprocessor and 8051 microcontrollers.
- To familiarize students with assembly language programming concepts and their practical implementation.
- To understand memory interfacing and peripheral device interfacing with 8086 and 8051.
- To develop the ability to interface microcontrollers with external hardware components and sensors.
- To provide hands-on experience for designing embedded systems using 8051.

Unit I

8086 Microprocessors and Assembly Language Programming

Introduction to microcomputer, evolution of processors and semiconductor memories (RAM, ROM, EPROM, EEPROM), Architecture of 8086 microprocessor, register organization of 8086, Pipelining concept, Memory segmentation, Addressing Modes.

Instruction Set and Programming: Instruction set of 8086 microprocessors: Data transfer instructions, Arithmetic instructions, Logical Instructions, String instructions, Stack related instructions, Branching instructions, Assembler directives. Data transfer instructions of 8085 microprocessor,

Unit II

8086 Operational Modes and Memory Interfacing

Minimum and Maximum mode operations of 8086 with timing diagrams, Procedures and macros, Stack Structure of 8086, Static RAM Interfacing, Interfacing of 8255 Programmable Peripheral Interface with 8086 microprocessors. Dynamic RAM, Direct memory access

Unit III

8051 Microcontroller

Comparison between microprocessor and microcontroller, 8051 family microcontroller, RAM architecture of 8051, Integrated Development Environment (IDE), Pin description of 8051 microcontroller, Machine cycle. Addressing Modes, Instruction set of 8051: Data transfer instructions, Arithmetic instructions, Logical Instructions, Stack related instructions, Branching instructions. Programing and Applications of Timers, Interrupts, Universal Asynchronous Receiver Transmitter (UART). External memory interfacing with 8051 microcontroller, various constituents of hex file

Unit IV

Interfacing 8051 with Peripherals

Interfacing 8051 with: Matrix Keypad, LCD, Seven-segment displays, L293D Motor Driver, Stepper motor, Analog-to-Digital Converter (ADC 0804) and Digital-to-Analog Converter (DAC 0808)

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Unit V:

Sensor and Relay Interfacing with 8051

Interfacing of temperature sensor LM35 with 8051, Relay interfacing with 8051, Case studies and practical applications using 8051

Course Outcomes

After completion of the course, the student will be able to

- Understand the internal architecture and operations of 8086 microprocessor and write assembly language programs.
- Analyze and design memory and peripheral interfacing techniques for microprocessors and microcontrollers.
- Develop embedded applications using 8051 microcontroller and its instruction set.
- Interface 8051 with external peripherals such as LCDs, motors, keypads, ADCs/DACs, and sensors.
- Design simple embedded systems integrating sensors and actuators using the 8051 microcontrollers.

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III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
Power System Analysis					

Pre-requisite:
Concepts of electrical circuits and power systems-II.

Course Objectives:
- To develop the impedance diagram (p.u) and formation of Y_{bus}
- To learn the different load flow methods.
- To learn the Z_{bus} building algorithm.
- To learn short circuit calculation for symmetrical faults
- To learn the effect of unsymmetrical faults and their effects.
- To learn the stability of power systems and methods to improve stability.

Course Outcomes:
After the completion of the course the student should be able to:
- CO1: Draw impedance diagram for a power system network and calculate per unit quantities.
- CO2: Apply the load flow solution to a power system using different methods.
- CO3: Form Z_{bus} for a power system network and analyse the effect of symmetrical faults.
- CO4: Find the sequence components for power system Components and analyse its effects of unsymmetrical faults.
- CO5: Analyse the stability concepts of a power system.

UNIT - I
Circuit Topology
Graph theory definitions – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y_{bus} matrix by singular transformation and direct inspection methods.
Per Unit Representation
Per Unit Quantities–Single line diagram – Impedance diagram of a power system – Numerical Problems.

UNIT - II
Power Flow Studies
Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) – Decoupled and Fast Decoupled methods – Algorithmic approach – Numerical Problems on 3–bus system only.

UNIT - III
Z-Bus Algorithm
Formation of Z_{bus}**:** Algorithm for the Modification of Z_{bus} Matrix (without mutual impedance) – Numerical Problems.
Symmetrical Fault Analysis
Reactance's of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems – Numerical Problems.

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UNIT - IV

Symmetrical Components

Definition of symmetrical components – symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances and Sequence networks of Synchronous generator, Transformers and Transmission line- Numerical Problems.

Unsymmetrical Fault analysis

Various types of faults: LG– LL– LLG and LLL on unloaded alternator-Numerical problems.

UNIT - V

Power System Stability Analysis

Elementary concepts of Steady state – Dynamic and Transient Stabilities – Swing equation – Steady state stability – Equal area criterion of stability – Applications of Equal area criterion – Factors affecting transient stability – Methods to improve steady state and transient stability – Numerical problems.

Text Books:

1. Power System Analysis by Grainger and Stevenson - Tata McGraw Hill.2003
2. Modern Power system Analysis – by I.J.Nagrath & D .P.Kothari: Tata McGraw–Hill Publishing Company - 3rd edition - 2007.

Reference Books:

1. Power System Analysis – by A.R.Bergen - Prentice Hall - 2nd edition - 2009.
2. Power System Analysis by HadiSaadat – Tata McGraw–Hill 3rd edition - 2010.
3. Power System Analysis by B.R.Gupta - A H Wheeler Publishing Company Limited - 1998.
4. Power System Analysis and Design by J.Duncan Glover - M.S.Sarma - T.J.Overbye – Cengage Learning publications - 5th edition - 2011.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/117/105/117105140
2. https://archive.nptel.ac.in/courses/108/105/108105104

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III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
Switchgear and Protection					

Pre-requisite:

Basic concepts of Electrical Machines and Power Systems.

Course Objectives:

- To explain the working principles and applications of circuit breakers in power systems, including MCBs, oil, SF6, and vacuum breakers.
- To provide an understanding of electromagnetic protection mechanisms, particularly relays used in fault detection and system protection (overcurrent, under-voltage, directional, differential).
- To analyze protection techniques for generators and transformers, including fault protection schemes like percentage differential protection and Buchholz relays.
- To explore feeder and busbar protection methods using advanced relay systems such as distance and static relays.
- To study over-voltage protection systems including lightning arresters and neutral grounding methods to safeguard the power system.

Course Outcomes: At the end of the course, student will be able to

CO1: Understand and describe the operation of circuit breakers, including their ratings, principles of arc interruption, and types.
CO2: Analyze relay-based protection systems, identifying and explaining their roles in overcurrent, undervoltage, and fault detection.
CO3: Design protection schemes for generators and transformers, addressing faults like restricted earth faults and inter-turn faults.
CO4: Implement feeder and busbar protection using advanced relays such as distance, impedance, and static relays.
CO5: Evaluate over-voltage protection strategies, including the use of lightning arresters, and understand various neutral grounding techniques.

UNIT – I

Circuit Breakers

Miniature Circuit Breaker (MCB)– Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Concept of oil circuit breakers– Description and operation of Air Blast– Vacuum and SF_6 circuit breakers– Circuit Breaker ratings and specifications– Concept of Auto reclosing.

UNIT – II

Electromagnetic Protection

Relay connection – Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification–Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

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UNIT – III
Generator Protection
Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples.
Transformer Protection
Percentage differential protection– Design of CT's ratio– Buchholz relay protection–Numerical examples.

UNIT – IV
Feeder and Bus bar Protection & Static Relays:
Over current Protection schemes – PSM - TMS – Numerical examples – Carrier current and three zone distance relay using impedance relays. Protection of bus bars by using Differential protection. Static relays: Introduction – Classification of Static Relays – Basic Components of Static Relays.

UNIT – V
Protection against over voltage and grounding
Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters. Grounded and ungrounded neutral systems – Effects of ungrounded neutral on system performance – Methods of neutral grounding: Solid–resistance–Reactance–Arcing grounds and grounding Practices.

Text Books:
1. Power System Protection and Switchgear by Badri Ram and D.N Viswakarma - Tata McGraw Hill Publications - 2nd edition - 2011.
2. Power system protection- Static Relays with microprocessor applications by T.S.Madhava Rao - Tata McGraw Hill - 2nd edition.

Reference Books:
1. Fundamentals of Power System Protection by Paithankar and S.R.Bhide. - PHI - 2003.
2. Art & Science of Protective Relaying – by C R Mason - Wiley Eastern Ltd.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/107/108107167
2. https://archive.nptel.ac.in/courses/108/105/108105167

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III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
Advanced Control Systems					

Pre-requisite:

Basic concepts of Control Systems.

Course Objectives:

- To understand the concept of controllability, observability, and their tests for continuous-time systems, as well as the principle of duality in state-space analysis.
- To understand the state-space methods to assess controllability, observability, and design state feedback controllers via pole placement.
- To know the stability of nonlinear systems using phase-plane analysis, describing functions, and Lyapunov's stability theorems.
- To Learn optimal control strategies using the calculus of variations, including constrained minimization and the minimum principle.
- To learn Optimal control and state regulator problems.

Course Outcomes: At the end of the course, student will be able to

CO1: Explain controllability, observability, and the principle of duality in state-space systems.
CO2: Apply state-space methods to analyze controllability, observability, and design state feedback controllers.
CO3: Analyze the stability of nonlinear systems using phase-plane analysis and Lyapunov's stability theorems.
CO4: Examine the minimization of functional and control variable inequality constraints.
CO5: Formulate and solve the optimal regulator problems.

UNIT – I
Controllability - Observability and Design of Pole Placement

General concepts of controllability and observability -Tests for controllability and observability for continuous time systems - Principle of duality - Effect of state feedback on controllability and observability - Design of state feedback control through pole placement, full order and reduced order observers.

UNIT – II
Nonlinear Systems

Introduction to nonlinear systems - Types of nonlinearities. Introduction to phase plane analysis, construction of phase trajectories-Analytical and Isocline method, Describing function - Describing functions of on-off nonlinearity, on-off nonlinearity with hysteresis, and relay with dead zone.

UNIT – III
Stability analysis by Lyapunov Method

Stability in the sense of Lyapunov – Lyapunov's stability and Lyapunov's instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

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UNIT – IV
Calculus of Variations
Minimization of functionals - functionals of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints.

UNIT –V
Optimal Control
Necessary conditions for optimal control, Formulation of the optimal control problem, minimum time problem, minimum energy problem, minimum fuel problem, state regulator problem, output regulator problem.

Text Books:
1. Modern Control Engineering – by K. Ogata - Prentice Hall of India - 3rd edition - 1998.
2. Automatic Control Systems by B.C. Kuo - Prentice Hall Publication.

Reference Books:
1. Modern Control System Theory – by M. Gopal - New Age International Publishers - 2nd edition – 1996.
2. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
3. Control Systems Engineering by I.J. Nagarath and M.Gopal - New Age International (P) Ltd.

Online Learning Resources:
1. https://archive.nptel.ac.in/courses/108/103/108103007
2. https://archive.nptel.ac.in/courses/108/107/108107115

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III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
Renewable and Distributed Energy Technologies					

Pre-requisite: Power system I

Course Objectives:

- To understand the basic concepts on wind energy systems.
- To understand the various relations between speed, power and energy in the wind systems.
- To analyze the solar energy systems, various components of solar thermal systems, applications in the relevant fields and design of PV systems.
- To design the Hydel system components and to get an idea on different other sources like tidal, geothermal and gas based units.
- To understand the concepts of hybrid renewable energy systems.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Illustrate basic concepts of renewable and distributed sources of wind energy.
CO2: Demonstrate the components of wind energy conversion systems.
CO3: Model PV systems and analyze MPPT Techniques.
CO4: Illustrate the concept of Energy Production from Hydro - Tidal and Geothermal.
CO5: Explain the aspects of hybrid renewable energy systems.

UNIT – I
Introduction and Wind energy systems

Brief idea on renewable and distributed sources - their usefulness and advantages. Wind Energy Systems: Estimates of wind energy potential-wind maps- Aerodynamic and mechanical aspects of wind machine design - Conversion to electrical energy - Aspects of location of wind farms.

UNIT – II
Wind power and energy

Wind speed and energy - Speed and power relations - Power extraction from wind - Tip speed ratio (TSR) - TSR characteristics- Functional structure of wind energy conversion systems - Pitch and speed control - Power vs speed characteristics - Fixed speed and variable speed wind turbine control - Power optimization - Electrical generators - Self-Excited and Doubly-Fed Induction Generators operation and control.

UNIT – III
Solar PV Systems

Present and new technological developments in photovoltaic - estimation of solar irradiance - components of solar energy systems - solar thermal system- applications- Modelling of PV cell - current-voltage and power-voltage characteristics - Effects of temperature and irradiance - Solar array simulator - Sun tracking - Peak power operations - PV system - MPPT techniques: Perturb and observe method, hill climbing and incremental conductance methods-Effects of partial shading on the characteristic curves and associated MPPT techniques - Solar park design outline-Solar Pond- Types of PV systems.

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UNIT – IV
Small Hydro and other sources
Hydel: Small-Mini-Medium - Plant layouts Water power estimates -use of hydrographs - hydraulic turbine - characteristics and part load performance - design of wheels - draft tubes and penstocks.
Other sources**:** Tidal - geothermal - gas-based generations.

UNIT – V
Hybrid Renewable systems
Requirements of hybrid/combined use of different renewable and distributed sources -Need of energy storage- Control of frequency and voltage of distributed generation in Stand-alone and Grid-connected mode - use of energy storage and power electronics interfaces for the connection to grid and loads - Design and optimization of size of renewable sources and their storages.

Text Books:

1. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
2. G.D.Rai 'Non-Conventional Energy Sources' KHANNA PUBLISHERS.

Reference Books:

1. Studies' Craig Anderson and Rudolf I. Howard 'Wind and Hydropower Integration: Concepts - Considerations and Case - Nova Publisher - 2012.
2. Amanda E. Niemi and Cory M. Fincher 'Hydropower from Small and Low-Head Hydro Technologies' - Nova Publisher - 2011.
3. D. YogiGoswami - Frank Kreith and Jan F. Kreider 'Principles of Solar Engineering' - Taylor & Francis 2000.
4. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
5. S. Heier and R. Waddington 'Grid Integration of Wind Energy Conversion Systems' – Wiley - 2006.
6. Loi Lei Lai and Tze Fun Chan 'Distributed Generation: Induction and Permanent Magnet Generators' - Wiley-IEEE Press - 2007.
7. G.N. Tiwari 'Solar Energy Technology' - Nova Science Publishers - 2005.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/103/103/103103206
2. https://archive.nptel.ac.in/courses/103/107/103107157

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III Year – II SEMESTER	Professional Core Elective-III	L	T	P	C
		3	0	0	3
Electric Drives					

Pre-requisite: Electrical Circuit Analysis, Power electronics, Electrical Machines and Control Systems.

Course Objectives:

- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of three phase converter-controlled dc motors and four quadrant operation of dc motors using dual converters.
- To discuss the DC-DC converter control of dc motors.
- To understand the concept of speed control of induction motor by using AC voltage controllers, voltage source inverters and slip power recovery scheme.
- To learn the speed control mechanism of synchronous motors.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Explain the fundamentals of electric drive and different electric braking methods.
CO2: Analyze the operation of three-phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
CO3: Describe the DC-DC converter fed control of dc motors in various quadrants of operation
CO4: Know the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters and differentiate the stator side control and rotor side control
CO5: Learn the concepts of speed control of synchronous motor with different methods.

UNIT - I

Fundamentals of Electric Drives

Electric drive and its components– Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic Braking, Plugging and Regenerative Braking –Numerical problems.

UNIT - II

Converter Fed DC Motor Drives

Single phase half and fully-controlled converter fed separately and self-excited DC motor drive for continuous and discontinuous load current, 3-phase fully-controlled converter fed separately and self-excited DC motor drive for continuous load current - Output voltage and current waveforms - Speed-torque characteristics and expressions – 3-phase Dual converter fed DC motor drives – Numerical problems.

UNIT - III

DC–DC Converter Fed DC Motor Drives

Single quadrant, two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous Current Mode of operation - Output voltage and current waveforms – Speed-torque characteristics and expressions – Closed loop operation (qualitative treatment only) – Numerical problems.

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UNIT - IV

Control of 3-phase Induction motor Drives

Stator voltage control using 3-phase AC voltage regulators – Waveforms – Speed torque characteristics – Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop V/f control of induction motor drives (qualitative treatment only). Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics– Numerical problems.

UNIT - V

Control of Synchronous Motor Drives

Permanent Magnet Synchronous Motor (PMSM): Basic operation and advantages - Separate control of synchronous motor – self-control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive (qualitative treatment only) — Numerical problems.

Text Books:

1. Fundamentals of Electric Drives – G K Dubey - Narosa Publications - 2nd edition – 2002.
2. Power Semiconductor Drives - S.B.Dewan - G.R.Slemon - A.Straughen - Wiley India - 1984.

Reference Books:

1. Electric Motors and Drives Fundamentals - Types and Apllications - by Austin Hughes and Bill Drury - Newnes.4th edition - 2013.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications - 1987.
3. Power Electronic Circuits - Devices and applications by M.H.Rashid - PHI - 3rd edition - 2009.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/104/108104140
2. https://nptel.ac.in/courses/108104011

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III Year – II SEMESTER	Professional Elective-III	L	T	P	C
		3	0	0	3
Digital Signal Processing					

Pre-requisite:

Laplace Transforms, Z- Transforms, Fourier series and transforms.

Course Objectives:

- To explore the basic concepts of digital signal processing.
- To connect the time domain signal to frequency domain signals using Fourier transform.
- To understand the basic structures of IRR systems.
- To understand and design FIR Digital filters.
- To explore the concepts of multiple sampling rates for DSP.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Know the concepts of Digital signal processing - frequency domain representation & z- transform.
CO2: Compute discrete Fourier transform and fast Fourier transforms for different sequences.
CO3: Design IIR filters through analog filter approximation and basic structure of IIR filters.
CO4: Design FIR filters with window techniques and basic structure of FIR filters.
CO5: Learn the concepts of Multirate Signal Processing.

UNIT - I

Introduction to Digital Signal Processing

Discrete time signals & sequences - Classification of Discrete time systems - stability of LTI systems - Invertability - Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms - solution of difference equations using Z-transforms - System function.

UNIT - II

Discrete Fourier Transforms and FFT Algorithms

Discrete Fourier Series representation of periodic sequences -Properties of Discrete Fourier Series - Discrete Fourier transforms: Properties of DFT - linear filtering methods based on DFT - Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms - Inverse FFT.

UNIT - III

Design and Realizations of IIR Digital Filters

Analog filter approximations – Butterworth and Chebyshev filters - Design of IIR Digital filters from analog filters with examples. Analog and Digital frequency transformations.

Basic structures of IIR systems – Direct-Form Structures - Transposed Structures - Cascade-Form Structures - Parallel-Form Structures Lattice and Lattice-Ladder Structures.

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UNIT - IV

Design and Realizations of FIR Digital Filters

Characteristics of FIR Filters with Linear Phase -Frequency Response of Linear Phase FIR Filters - Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique - Comparison of IIR & FIR filters.

Basic structures of FIR systems – Direct-Form Structure - Cascade-Form Structures Linear Phase Realizations - Lattice structures.

UNIT - V

Multirate Digital Signal Processing

Decimation –Interpolation-Sampling Rate Conversion by a Rational Factor – Implementation of sampling rate converters – Applications of Multirate Signal Processing-Digital Filter Banks.

Text Books:

1. Digital Signal Processing - Principles Algorithms and Applications: John G. Proakis - Dimitris G.Manolakis - 4th Edition - Pearson Education / PHI - 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer - PHI.
3. Digital Signal Processing: A Computer based approach. Sanjit K Mitra - 4th Edition - TMH - 2014.

Reference Books:

1. Digital Signal Processing: Andreas Antoniou - TATA McGraw Hill - 2006.
2. Digital Signal Processing: MH Hayes - Schaum's Outlines - TATA Mc-Graw Hill - 2007.
3. DSP Primer - C. Britton Rorabaugh - Tata McGraw Hill - 2005.
4. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling - Sandra L.Harris - Thomson - 2007.
5. Digital Signal Processing – Alan V. Oppenheim - Ronald W. Schafer - PHI Ed. - 2006.
6. Digital Signal Processing – K Raja Rajeswari - 1st edition - I.K. International Publishing - House - 2014.

Online Learning Resources:

1. https://nptel.ac.in/courses/117102060
2. https://archive.nptel.ac.in/courses/108/101/108101174

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III Year – II SEMESTER	Professional Core Elective-III	L	T	P	C
		3	0	0	3
High Voltage Engineering					

Pre-requisite:
Material Science, Electromagnetic Fields and Basics of Transient Circuits.

Course Objectives:

- To understand HV breakdown phenomena in gases.
- To understand the breakdown phenomenon of liquids and solid dielectrics.
- To acquaint with the generating principle of operation and design of HVDC, AC voltages.
- To understand the generating principles of Impulse voltages & currents.
- To understand various techniques for AC, DC and Impulse measurements of high voltages and currents.

Course Outcomes:
After the completion of the course the student should be able to:

CO1: Recognise the dielectric properties of gaseous materials used in HV equipment.
CO2: Differentiate the break down phenomenon in liquid and solid dielectric materials.
CO3: Acquaint with the techniques of generation of high AC and DC voltages
CO4: Acquaint with the techniques of generation of high Impulse voltages and currents.
CO5: Getting the knowledge of measurement of high AC - DC - Impulse voltages and currents.

UNIT - I
Break down phenomenon in Gaseous and Vacuum:
Insulating Materials: Types, properties and its applications. Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases and its limitations – Streamers Theory of break down – time lag – Paschen's law- Paschen's curve, Penning Effect. Breakdown mechanisms in Vacuum.

UNIT - II
Break down phenomenon in Liquids:
Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquids- Mechanisms.
Break down phenomenon in Solids:
Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown –Breakdown of composite solid dielectrics.

UNIT - III
Generation of High DC voltages:
Voltage Doubler Circuit - Voltage Multiplier Circuit – Vande- Graaff Generator.
Generation of High AC voltages:
Cascaded Transformers – Resonant Transformers –Tesla Coil.

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UNIT - IV

Generation of Impulse voltages:
Specifications of impulse wave – Analysis of RLC circuits - Marx Circuit.
Generation of Impulse currents:
Definitions – Circuits for producing Impulse current waves – Wave shape control - Tripping and control of impulse generators.

UNIT - V

Measurement of High DC & AC Voltages:
Resistance potential divider - Generating Voltmeter - Capacitor Voltage Transformer (CVT) - Electrostatic Voltmeters – Sphere Gaps.
Measurement of Impulse Voltages & Currents:
Potential dividers with CRO - Hall Generator - Rogowski Coils.

Text Books:

1. High Voltage Engineering: Fundamentals by E.Kuffel - W.S.Zaengl - J.Kuffel by Elsevier - 2nd Edition.
2. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications - 3rd Edition.

Reference Books:

1. High Voltage Engineering and Technology by Ryan - IET Publishers - 2nd edition.
2. High Voltage Engineering by C.L.Wadhwa - New Age Internationals (P) Limited – 1997.
3. High Voltage Insulation Engineering by RavindraArora - Wolfgang Mosch - New Age International (P) Limited - 1995.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/104/108104048
2. https://bharatsrajpurohit.weebly.com/high-voltage-engineering-course.html

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III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
Fundamentals of Electric Vehicles					

Pre-requisite:

Basic knowledge in Physics, Chemistry and Basics of Electrical and Electronics.

Course Objectives:

- To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
- To understand various power converters used in electric vehicles.
- To be familiar all the different types of motors suitable for electric vehicles.
- To know various architecture of hybrid electric vehicles.
- To have knowledge on latest developments in batteries and other storage systems.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Illustrate the use and advantages of different types of electric vehicles.
CO2: Use suitable power converters for EV application.
CO3: Select suitable electric motor for EV power train.
CO4: Design HEV configuration for a specific application.
CO5: Analyse various storage systems and battery management system for EVs.

UNIT – I

Introduction

Fundamentals of vehicles – Vehicle model – Calculation road load and tractive force – Components of conventional vehicles – Drawbacks of conventional vehicles – Need for electric vehicles – Advantages and applications of Electric Vehicles – History of Electric Vehicles – EV Market in India and outside India – Types of Electric Vehicles.

UNIT – II

Components of Electric Vehicles

Main components of Electric Vehicles – Electric Traction Motor and Controller – Power Converters – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.

UNIT – III

Motors for Electric Vehicles

Characteristics of traction drive – requirements of electric machines for EVs – Comparison of Different motors for Electric and Hybrid Vehicles – Induction Motors – Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only).

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UNIT – IV

Hybrid Electric Vehicles

Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs – Series and Parallel HEVs – Complex HEVs – Range extended HEVs – Examples – Merits and Demerits.

UNIT – V

Energy Sources for Electric Vehicles

Batteries – Types of Batteries – Lithium-ion – Nickel-metal hydride – Lead-acid – Comparison of Batteries – Battery Charging – Fast Charging – Battery Management System – Ultra capacitors – Flywheels – Compressed air energy storage (CAES) – Fuel Cell – it's working.

Text Books

1. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.
2. Tom Denton, Hayley Pells - Electric and hybrid vehicles, Third Edition, 2024

Reference Books:

1. Kumar - L. Ashok - and S. Albert Alexander. Power Converters for Electric Vehicles. CRC Press - 2020.
2. Chau - Kwok Tong. Electric vehicle machines and drives: design - analysis and application. John Wiley & Sons - 2015.
3. Berg - Helena. Batteries for electric vehicles: materials and electrochemistry. Cambridge University Press - 2015.

Online Learning Resources:

1. MOOC at https://www.edx.org/learn/electric-cars
2. https://archive.nptel.ac.in/courses/108/106/108106170

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III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
Electrical Wiring Estimation and Costing					

Pre-requisite:
Electrical Circuits, Basics of Power Systems and Electrical Machines.

Course Objectives:
- Introduce the electrical symbols and simple electrical circuits
- Able to learn the design of electrical installations.
- Able to learn the design of electrical installation for different types of buildings and small industries.
- Learn the basic components of electrical substations.
- Familiarize with the motor control circuits

Course Outcomes:
After the completion of the course the student should be able to:
CO1: Demonstrate the various electrical apparatus and their interconnections.
CO2: Examine various components of electrical installations.
CO3: Estimate the cost for installation of wiring for different types of building and small industries.
CO4: Illustrate the components of electrical substations.
CO5: Design suitable control circuit for starting of three phase induction motor and synchronous motor.

UNIT - I
Electrical Symbols and Simple Electrical Circuits
Identification of electrical symbols - Electrical wiring Diagrams - Methods of representation of wiring diagrams - introduction to simple light and fan circuits - system of connection of appliances and accessories.

UNIT - II
Design Considerations of Electrical Installations
Electric supply system - Three-phase four wire distribution system - protection of electric installation against overload - short circuit and earth fault - earthing - neutral and earth wire - types of loads - systems of wiring - permissible of voltage drops and sizes of wires - estimating and costing of electrical installations.

UNIT - III
Electrical Installation for Different Types of Buildings and Small Industries
Electrical installations for electrical buildings - estimating and costing of material - simple examples on electrical installation for residential buildings - electrical installations for commercial buildings - electrical installation for small industries-case study.

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UNIT - IV
Substations
Introduction - types of substations - outdoor substations-pole mounted type - indoor substations-floor mounted type - simple examples on quantity estimation-case studies.

UNIT - V
Motor control circuits
Introduction to AC motors - starting of three phase squirrel cage induction motors - starting of wound rotor motors - starting of synchronous motors - contractor control circuit components - basic control circuits - motor protection – Schematic and wiring diagrams for motor control circuits.

Text Books:

1. Electrical Design and Estimation Costing - K. B. Raina and S.K.Bhattacharya – New Age International Publishers - 2007.

References Books:

1. Electrical wiring estimating and costing – S.L.Uppal and G.C.Garg – Khanna publishers - 6th edition - 1987.
2. A course in electrical installation estimating and costing – J.B.Gupta –Kataria SK & Sons - 2013.

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III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
Utilization of Electrical Energy					

Course Objectives:
The objectives of this course is to acquire knowledge on
- operating principles and characteristics of electric drives.
- different types of electric heating and welding techniques.
- basics of illumination and design of lightning system.
- features of traction motor and speed time curves.
- basic principle and method of calculation for tractive effort

Course Outcomes:
The students should be able to
- identify a suitable motor for electric drives and industrial applications
- identify most appropriate heating or welding techniques for suitable applications.
- estimate the illumination levels
- design determine the speed/time characteristics of different types of traction motors.
- estimate energy consumption levels at various modes of operation.

UNIT I
Selection of Motors
Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise Applications of electric drives–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization.

UNIT II
Electric Heating
Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating – Arc furnaces – Direct and indirect arc furnaces
Electric Welding
Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

UNIT III
Illumination fundamentals
Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter Discharge lamps, MV and SV lamps – Lumen or flux method of calculation - Sources of light. Various Illumination Methods, Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and Design of lighting and flood lighting–LED lighting, principle of operation, street lighting and domestic lighting.

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UNIT IV
Electric Traction – I
System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves-High speed transportation trains.

UNIT V
Electric Traction – II
Calculations of tractive effort– power –Specific energy consumption for given run–Effect of varying acceleration and braking retardation–Adhesive weight and braking, retardation adhesive weight and coefficient of adhesion–Principles of energy efficient motors-Modern traction motors.

Text Books:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Sons.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.

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III Year – II SEMESTER	Professional Core Lab - 1	L	T	P	C
		0	0	3	1.5
Electrical Measurements and Instrumentation Lab					

Course Objectives:

- To understand students how different types of meters work and their construction.
- To make the students understand how to measure resistance, inductance and capacitance by AC & DC bridges.
- To understand the testing of CT and PT.
- To Understand and the characteristics of Thermo couples, LVDT, Capacitive transducer, piezoelectric transducer and measurement of strain and choke coil parameters.
- To study the procedure for standardization and calibration of various methods.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Know about the phantom loading and calibration process.
CO2: Measure the electrical parameters voltage - current - power - energy and electrical characteristics of resistance - inductance and capacitance.
CO3: Gain the skill knowledge of various bridges and their applications.
CO4: Learn the usage of CT's - PT's for measurement purpose.
CO5: Know the characteristics of transducers and measure the strains - frequency and phase difference.

Any 10 of the following experiments are to be conducted

1. Calibration of dynamometer wattmeter using phantom loading
2. Measurement of resistance using Kelvin's double Bridge and Determination of its tolerance.
3. Measurement of Capacitance using Schering Bridge.
4. Measurement of Inductance using Anderson Bridge.
5. Calibration of LPF Wattmeter by direct loading.
6. Measurement of 3 phase reactive power using single wattmeter method for a balanced load.
7. Testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null deflection method.
8. P.T. testing by comparison – Vibration Galvanometer as Null detector – Measurement of percentage ratio error and phase angle error of the given P.T.
9. Determination of the characteristics of a Thermocouple.
10. Determination of the characteristics of a LVDT.
11. Determination of the characteristics for a capacitive transducer.
12. Measurement of strain for a bridge strain gauge.
13. Measurement of Choke coil parameters
14. Measurement of single-phase power using three voltmeter method.
15. Measurement of single-phase power using three ammeter method.
16. Calibration of single-phase Induction Type Energy Meter.
17. Calibration of DC ammeter and voltmeter using Crompton DC Potentiometer.
18. AC Potentiometer : Polar Form / Cartesian Form - Calibration of AC voltmeter - Parameters of choke.

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III Year – II SEMESTER	Professional Core lab - 2	L	T	P	C
		0	0	3	1.5
Microprocessors and Microcontrollers Lab					

Course Objectives

- To understand the architecture and operation of 8086 microprocessor and 8051 microcontroller.
- To develop assembly language programs for 8086 and 8051.
- To interface memory and peripherals with 8086 and 8051.
- To understand the operation of programmable interface devices like 8255.
- To implement real-time applications using microcontrollers interfaced with sensors, motors, and displays.

List of Experiments:

1. Write a data transfer program using different addressing modes in assembly language programming.
2. Perform arithmetic operations on 8 bit and 16-bit numbers in assembly language programming.
3. Data transfer program using string instruction in assembly language programming.
4. Program for data conversion in assembly language programming.
5. Implement stack operations using PUSH and POP instructions.
6. Write assembly language program using procedure.
7. Write assembly language program using macro.
8. Program to reject negative numbers from a series of bytes.
9. Interfacing 8086 with 8255 PPI to display data on LEDs.
10. Perform Arithmetic operations on 8bit numbers in assembly language programming using 8051 microcontrollers.
11. Program to toggle the LED.
12. Programming and interfacing of traffic light logic.
13. Program to generate square wave using interrupts.
14. Programming and interfacing of the key pad matrix.
15. Programming and interfacing of seven-segment display.
16. Programming and interfacing of the LCD

17. Programming and interfacing of the relay.
18. Programming and interfacing of the dc/Stepper motor.

Text Books

1 Douglas V. Hall, Microprocessors and Interfacing: Programming and Hardware, Tata McGraw-Hill.

2 Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International.

3 Muhammad Ali Mazidi & Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education.

Reference Books:

1 Kenneth Ayala, The 8051 Microcontroller, Cengage Learning.

2 Barry B. Brey, The Intel Microprocessors 8086/88, 80186/188, 80286, 80386, and 80486, Pearson Education.

3 Krishna Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design, PHI.

Course Outcomes:
After successful completion of this course, students will be able to:

- Describe the internal architecture of 8086 and 8051.
- Develop and execute assembly language programs for 8086 and 8051.
- Interface peripheral devices such as LCDs, keypads, and motors with 8051.
- Demonstrate interfacing of RAM, ROM, ADC, DAC, and sensor modules with microprocessors and microcontrollers.
- Analyze and implement microcontroller-based real-world applications.

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III Year – II SEMESTER	Skill Enhancement course	L	T	P	C
		0	1	2	2
IoT Applications of Electrical Engineering Lab					

Pre-requisite: Concepts of Computer Organization, Computer Networks.

Course Objectives:
- To understand the working of Arduino.
- To learn the programming of Raspberry PI.
- To know various sensors with Arduino/Raspberry Pi.
- To interface various displays with Arduino/Raspberry Pi.
- To connect with various wireless communication devices

Course Outcomes:
At the end of the course - students will be able to:
CO1: Operate the Arduino Integrated Development Environment with embedded c.
CO2: Program the embedded Python in Raspberry Pi OS.
CO3: Interface various sensors with Arduino/Raspberry Pi in the IoT environment.
CO4: Connect different displays with Arduino/Raspberry Pi
C05: Inter connect with wireless communication technologies.

Topics to be covered in Tutorials

Module–1: Programming using Arduino: (3 hrs)
Arduino - Classification of Arduino Boards - Pin diagrams – Arduino Integrated Development Environment (IDE) – Programming using Arduino.

Module–2: Sensors: (5 hrs)
Working of temperature sensor, proximity sensor, IR sensor, Light sensor, ultrasonic sensor, PIR Sensor, Colour sensor, Soil Sensor, Heart Beat Sensor, Fire Alarms etc. Actuators: Stepper Motor, Servo Motor and their integration with Arduino/Raspberry Pi.

Module–3: Raspberry Pi: (2 hrs)
Introduction, Classification of Rasperberry Pi Series - Pin diagrams – Programming Rasperberry Pi.

Module–4: Display: (2 hrs)
Working of LEDs, LED, OLED display, LCDs, Seven Segment Display, Touch Screen etc. Analog Input and Digital Output Converter etc. and their integration with Arduino/Raspberry Pi.

Module–5: Wireless Communication Devices: (4 hrs)
Working of Bluetooth, Wi-Fi, Radio Frequency Identification (RFID), GPRS/GSM Technology, ZigBee, etc and their integration with Arduino/Raspberry Pi. Features of Alexa.

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List of experiments
Any 10 of the following experiments are to be conducted:

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. Interfacing of LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. Interfacing of Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. Interfacing of temperature sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. Interfacing of Organic Light Emitting Diode (OLED) with Arduino/Raspberry Pi
6. Interfacing of Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
7. Interfacing of Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0’ is received from smartphone using Bluetooth.
8. Write a program on Arduino/Raspberry Pi to upload and retrieve temperature and humidity data to thing speak cloud.
9. Interfacing of 7 Segment Display with Arduino/Raspberry Pi
10. Interfacing of Joystick with Arduino/Raspberry Pi
11. Interfacing of Analog Input & Digital Output with Arduino/Raspberry Pi
12. Night Light Controlled & Monitoring System
13. Interfacing of Fire Alarm Using Arduino/Raspberry Pi
14. IR Remote Control for Home Appliances
15. A Heart Rate Monitoring System
16. Alexa based Home Automation System

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III Year – II SEMESTER	Audit Course	L	T	P	C
		2	0	0	0
Research Methodology					

Course Objectives

1. To introduce the fundamentals of research and its methodologies.
2. To equip students with the skills needed to identify research problems and design effective research strategies.
3. To develop understanding of quantitative and qualitative research techniques.
4. To familiarize students with literature review, citation, and plagiarism avoidance.
5. To prepare students to write research proposals, reports, and academic papers.

Unit I:

Introduction to Research

Meaning and objectives of research

Types of research (Basic, Applied, Qualitative, Quantitative, Mixed methods), Research approaches and ethics, Characteristics of good research, Research process overview

Unit II:

Research Problem & Design

Identifying and defining a research problem, Review of literature and gap analysis, Hypothesis formulation, Research design – Exploratory, Descriptive, Experimental, Diagnostic, Variables and sampling techniques

Unit III:

Data Collection Methods

Primary and secondary data, Methods of data collection: surveys, interviews, observations, questionnaires, Measurement scales: Nominal, Ordinal, Interval, Ratio, Reliability and validity, Use of online tools for survey and data collection (Google Forms, etc.)

Unit IV:

Data Analysis and Interpretation

Descriptive statistics – mean, median, mode, standard deviation, Inferential statistics – correlation, regression, hypothesis testing, Use of software tools like Excel/SPSS/R for analysis, Data visualization:

tables, charts, graphs, Interpretation of results

Unit V:

Research Documentation and Report Writing

Research paper structure and writing style, Plagiarism and reference management tools (Zotero, Mendeley), Citation styles – APA, IEEE, MLA, Research proposal writing, Publishing in journals, conferences, patents – overview

Textbooks

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International Publishers.
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners*, SAGE Publications.

Reference Books

1. John W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, SAGE.
2. Wayne Goddard & Stuart Melville, *Research Methodology: An Introduction*.
3. Uma Sekaran, *Research Methods for Business: A Skill Building Approach*, Wiley.
4. Leedy & Ormrod, *Practical Research: Planning and Design*, Pearson.
5. Research articles from journals like IEEE, Elsevier, Springer, Taylor & Francis (for case-based teaching).

Course Outcomes

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

- Formulate and define a research problem with clear objectives.
- Design a research methodology suitable for different types of problems.
- Apply appropriate tools for data collection, analysis, and interpretation.
- Conduct a structured literature review using academic databases and tools.
- Write high-quality research proposals, papers, and reports adhering to academic standards.

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B.Tech. IV Year-I Semester

S.No	Category	Course Code	Title	L	T	P	C
1	PC		Power System Operation and Control	3	0	0	3
2	Management Course-II		Energy Management & Auditing	2	0	0	2
3	PCE – IV		1. HVDC Transmission 2. FACTS 3. Design of PV systems	3	0	0	3
4	PCE - V		1. Electric Vehicles 2. Switched Mode Power Conversion 3. Electrical Distribution System	3	0	0	3
5	OE - III		1. Battery Management Systems 2. Concepts of Smart Grid Technologies 3. Introduction to Artificial Intelligence (APSCHE)	3	0	0	3
6	OE - IV		1. Concepts of Power Quality 2. Programmable Logic Controllers 3. Quantum Computing (APSCHE)	3	0	0	3
7	SEC		Power Systems Simulation Lab	0	0	4	2
8	AC		Constitution of India	2	0	0	0
9	Internship		Evaluation of Industry Internship (done during III-II Summer Vacation – 8 Weeks)	0	0	0	2
Total				19	0	4	21

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IV B.TECH I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
Power System Operation and Control					

Course Objectives:
The objectives of this course is to acquire knowledge on

- optimal dispatch of generation with and without losses.
- optimal scheduling of hydro thermal systems.
- optimal unit commitment problem.
- load frequency control for single and two area systems with and without controllers
- reactive power control and compensation of transmission lines.

Course Outcomes:

- compute optimal scheduling of Generators.
- Compute hydrothermal scheduling.
- solve unit commitment problem.
- design PID controllers in single area and two area systems.
- apply reactive power control and compensation for transmission line.

UNIT–I:
Economic Operation of Power Systems
Optimal operation of Generators in Thermal power stations, – Heat rate curve – Cost Curve – Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

UNIT–II:
Hydrothermal Scheduling
Optimal scheduling of Hydrothermal System: Hydroelectric power plant models – Scheduling problems – Short term hydrothermal scheduling problem.

UNIT–III:
Unit Commitment
Optimal unit commitment problem – Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming**.**

UNIT–IV:
Load Frequency Control
Modeling of steam turbine - Modeling of Hydro turbine – Generator – Mathematical modeling of speed governing system – Transfer function –Necessity of keeping frequency constant –Control area – Single area power system – Block diagram representation of an isolated power system – Steady state analysis - Dynamic response of Uncontrolled case. Proportional plus Integral control of single area- Steady State Response .Tieline bias control, Block diagram development of Load Frequency Control of two area system- uncontrolled case and controlled case, Economic dispatch control.

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UNIT–V:
Reactive Power Control
Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – Uncompensated and compensated transmission lines: Shunt and series compensation.

Text Books:
1. Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw–Hill Publishing Company Ltd., Second edition.
2. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd, 2nd edition.

Reference Books:
1. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma., Thompson,3rdEdition.
2. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
3. Power System Analysis by HadiSaadat – TMH Edition.
4. Power System stability & control, PrabhaKundur,TMH

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IV B.TECH I SEMESTER	Management Course-II	L	T	P	C
		3	0	0	3
Energy Management & Auditing					

Course Objectives:
The objectives of this course is to acquire knowledge on

- energy efficiency, scope, conservation and technologies.
- design energy efficient lighting systems.
- estimation /calculate power factor of systems and propose suitable compensation techniques.
- energy conservation in HVAC systems.
- costing analysis and return on investment on energy efficient technologies.

Course Outcomes:
The student should be able to

- explain energy efficiency, conservation and various technologies.
- design energy efficient lighting systems.
- calculate power factor of systems and propose suitable compensation techniques.
- explain energy conservation in HVAC systems.
- calculate life cycle costing analysis and return on investment on energy efficient technologies.

Unit-I:
Basic Principles of Energy Audit and management
Energy audit - Definitions - Concept - Types of audit - Energy index - Cost index - Pie charts - Sankey diagrams - Load profiles - Energy conservation schemes and energy saving potential - Numerical problems - Principles of energy management - Initiating, planning, controlling, promoting, monitoring, reporting - Energy manager - Qualities and functions - Language - Questionnaire - Check list for top management.

Unit-II:
Lighting
Modification of existing systems - Replacement of existing systems - Priorities: Definition of terms and units - Luminous efficiency - Polar curve - Calculation of illumination level - Illumination of inclined surface to beam Luminance or brightness - Types of lamps - Types of lighting - Electric lighting fittings (luminaries) - Flood lighting - White light LED and conducting Polymers - Energy conservation measures.

Unit-III:
Power Factor and energy instruments
Power factor - Methods of improvement - Location of capacitors - Power factor with non linear loads - Effect of harmonics on Power factor - Numerical problems. Energy Instruments - Watt-hour meter - Data loggers Thermocouples - Pyrometers - Lux meters - Tong testers - Power analyzer.

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Unit-IV:
Space Heating and Ventilation
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 heating systems - Energy conservation methods.

Unit-V
Economic Aspects and Analysis
Economics Analysis - Depreciation Methods - Time value of money - Rate of return - Present worth method - Replacement analysis - Life cycle costing analysis - Energy efficient motors (basic concepts). Calculation of simple payback method - Net present worth method - Power factor correction - Lighting - Applications of life cycle costing analysis - Return on investment**.**

Text Books:
1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995

Reference Books:
1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company
2. Ltd. New Delhi.
3. Energy management by Paul o' Callaghan, Mc-Graw Hill Book company-1st edition, 1998.
4. Energy management hand book by W.C.Turner, John wiley and sons.
5. Energy management and conservation –K V Sharma and P Venkata Seshaiah-I K International
6. Publishing House pvt.ltd,2011.
7. http://www.energymanagertraining.com/download/Gazette of IndiaPartIISecI-37 25-08-2010.pdf

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IV B.TECH I SEMESTER	Professional Core Elective - IV	L	T	P	C
		3	0	0	3
HVDC Transmission					

Course Objectives:

- To analyse the operation of HVDC converters.
- To learn the principles of HVDC system control.
- To learn about converters faults and protection schemes of HVDC systems.
- To understand the requirements of reactive power control and filtering technique in HVDC
- system.
- To learn about MTDC systems and DC circuit breakers.

Course Outcomes:

After the completion of the course the student should be able to:

- Learn the basic concepts of HVDC Transmission & their converters.
- Understand the HVDC System Control Strategies with respect to protection.
- Understand the concepts of HVDC systems protection.
- Understand the various sources of reactive power
- Understand the Multi Terminal HVDC Systems.

UNIT - I
DC Power Transmission Technology

Introduction - Historical Development - Comparison of AC and DC transmission - types of DC links - Existing HVDC Projects in INDIA. Modern Trends in HVDC Technology.
Analysis of HVDC Converters Three Phase 6-Pulse bridge converter - simplified analysis - waveform with and without overlap - Current and voltage relationship - Equivalent circuits of converters - Analysis of 12 pulse converters.

UNIT - II
HVDC System Control

Principles of DC link control - converter control characteristics - constant current and constant extinction angle control - constant ignition angle control - starting and stopping of HVDC link - power control & power reversal in HVDC link.

UNIT - III
Converter Faults and Protection

Over voltages in converter station - Surge arrestors - Protection against over voltages and over currents. Converter faults - Protection against faults in voltage source converter-Smoothing Reactor - Transient over voltages for DC line – Protection of DC lines.

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UNIT - IV
Reactive Power Control
Sources of reactive power - Static VAR system – SVC and STATCOM - Reactive power control during transients. Harmonics & Filters Generation of harmonics – Types and design of various AC filters - DC filters – Active Filters.

UNIT - V
Multi Terminal HVDC Systems & DC Circuit Breakers
Types of MTDC systems - Control and Protection of MTDC system – HVDC insulation – DC line insulators – DC breakers – Characteristics and types of DC breakers.

Text Books

1. K. R. Padiyar - "HVDC Power Transmission Systems Technology and System Interactions" New Age International (p) Limited - New Delhi - 2003.
2. Edward Wilson Kimbark - "Direct current Transmission" - Wiley Interscience - Vol. I - New York - 1971.

Reference Books

1. Vijay K. Sood - "HVDC and FACTS Controller: Application of Static Converters in power systems" - IEEE Power Electronics and Power Systems series - Kluwer Academic publishers - Boston - First edition January 2004.
2. C. Adamson and N.G. Hingorani - "High voltage DC power Transmission" - Garraway Limited - England - 1960.
3. Mohan - Undeland and Robbins - "Power Electronics Converters - Applications and Design - John Wiley & Son - Inc. - 2003.
4. J. Arrialga - "HVDC Transmission" - Peter Peregrinus Ltd. - London - 1983.

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IV B.TECH I SEMESTER	Professional Core Elective - I	L	T	P	C
		3	0	0	3
FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. basics of power flow control in transmission lines using FACTS controllers.
ii. operation and control of voltage and current source converter.
iii. shunt compensation using static VAR compensators.
iv. series compensation methods.
v. operation of Unified Power Flow Controller (UPFC).

Course Outcomes
The students should be able to

- know the power flow control in transmission lines using facts controllers.
- explain the operation and control of voltage and current source converter
- analyze method of shunt compensation using static var compensators.
- evaluate different methods of compensation using series compensators.
- apply unified power flow controller (UPFC) on transmission systems.

Unit I
Introduction to FACTS Power flow in an AC System
Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high-power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

Unit II
Voltage source and Current source converters
Concept of voltage source converter (VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.

Unit III
Shunt Compensators
Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping. Thyristor Switched Capacitor (TSC) – Thyristor Controlled Reactor (TCR). Static VAR compensator (SVC) and Static Compensator (STATCOM): The regulation and slope transfer function and dynamic performance – Transient stability enhancement and power oscillation damping– Operating point control and summary of compensation control.

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Unit IV
Series Compensators
Static series compensators: Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. Static Synchronous Series Compensator (SSSC) - GTO thyristor-controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC).

Unit V
Combined Controllers
Schematic and basic operating principles of Unified Power Flow Controller (UPFC) -Interline Power Flow Controller (IPFC)– Application.

Text Books:

1. "Understanding FACTS" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available: Standard Publications, 2001.
2. "FACTS Controllers in Power Transmission and Distribution" Padiyar.K.R, New Age Int. Publishers, 2007

Reference Books:

1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.Mohan Mathur and Rajiv K.Varma, Wiley

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IV B.TECH I SEMESTER	Professional Core Elective - I	L	T	P	C
		3	0	0	3
Design of PV Systems					

Course Objectives:

- Understand the characteristics and modeling of PV cells and their interconnection.
- Learn solar energy fundamentals, insolation estimation, and PV system sizing.
- Explore MPPT techniques and converter integration for PV systems.
- Gain knowledge on battery interfaces, charge control, and water pumping using PV.
- Understand the principles and methods for interfacing PV systems with the grid.

Course Outcomes:

After the completion of the course the student should be able to:

- Analyze PV cell behavior, efficiency, and protection methods in arrays.
- Estimate solar energy on different surfaces and design basic PV systems.
- Apply MPPT algorithms and DC-DC converter concepts to maximize PV output.
- Design battery storage systems and apply PV for thermal and pumping needs.
- Implement PV grid interface using modern control techniques and topologies.

UNIT-I
PV Cell
Historical Perspective, PV cell characteristics and equivalent circuit, model of PV cell, cell efficiency, I-V & P-V Characteristics - effect of temperature and irradiance, fill factor. Series and parallel connection of identical and non-identical cells, protecting cell in series and parallel, interconnecting modules, solar panels and PV System.

UNIT-II
Energy from Sun
Insolation and irradiance, solar geometry, insolation and energy on horizontal plate, sunrise and sunset hour angles. Incident energy estimation: energy on a tilted flat plate, energy plots in octave, atmospheric effects, airmass, Sizing PV: sizing PV applications without batteries, Batteries, battery selection, PV system design.

UNIT-III
Maximum Power Point tracking
MPPT concept – DC-DC converters, MPPT algorithms- Perturb & Observe, Incremental Conductance - Case study of PV system design with MPPT algorithm.

UNIT-IV
PV Battery Interfaces
Direct PV- Battery connection, charge controller, battery charger, batteries in series and parallel. Peltier Cooling: Peltier device, Peltier element, thermal aspects and Water Pumping: water pumping principle, hydraulic energy and power, total dynamic head, centrifugal pumps, reciprocating pump.

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UNIT-V
PV Grid Interface
Grid connection principles, PV to Grid Topologies, 3phase d-q controlled grid connection- AC to DC transformation, DC to AC transformation, complete 3 phase grid connection. SVPWM-discrete and analog implementation, application of integrated magnetics.

Text Books:

1. Chenming, H. and White, R.M., Solar Cells from B to Advanced Systems, McGraw Hill Book Co, 1983.

Reference Books:

1. Ruschenbach, HS, Solar Cell Array Design Hand Varmostrand, Reinhold, NY, 1980
2. Proceedings of IEEE Photovoltaics Specialists Conferences, Solar Energy Journal.

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IV B.TECH I SEMESTER	Professional Core Elective - II	L	T	P	C
		3	0	0	3
Electric Vehicles					

Course Objectives:
The objectives of this course is to acquire knowledge on
- basics concepts related to mechanics, kinetics and dynamics of electric vehicles.
- technical characteristics and properties of batteries.
- different ratings of motor and engine to design an electric vehicle.
- various components of electric vehicle drive.
- different configurations of drive train.

Course Outcomes:
After the completion of the course the student should be able to:
- design propulsion system for an electric vehicle.
- know technical characteristics and properties of batteries and also to design battery pack.
- know the ratings and requirements of electrical machines.
- apply the regenerative braking and sizing of motors.
- configure and design the components of hybrid electric vehicles.

UNIT I
ELECTRIC VEHICLES
Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II
BATTERY
Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III
DC & AC ELECTRICAL MACHINES
Motor and Engine rating, Requirements, DC machines, Three phase A.C machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV
ELECTRIC VEHICLE DRIVE TRAIN
Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V
HYBRID ELECTRIC VEHICLES
Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

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Text books:

1. IqbalHussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.
2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

Reference Books:

1. MehrdadEhsani, YiminGao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
2. SandeepDhameja, "Electric Vehicle Battery Systems", Newnes, 2000
3. http://nptel.ac.in/courses/108103009/

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IV B.TECH I SEMESTER	Professional Core Elective - II	L	T	P	C
		3	0	0	3
Switched Mode Power Conversion					

Course Objectives:

- Understand the fundamentals and operating modes of various SMPS topologies including Cuk converters.
- Learn thyristor commutation methods and device selection for SMPS.
- Explore transformer-isolated converter types and their configurations.
- Study the design of magnetic components used in power converters.
- Analyze switching regulator control and the benefits of soft-switching techniques.

Course Outcomes:

After the completion of the course the student should be able to:

- Explain the principles and operating modes of Cuk and related converters.
- Classify and compare various commutation techniques and select suitable devices for SMPS.
- Analyze transformer-isolated converter topologies like flyback, forward, and push-pull.
- Design magnetic components tailored for different converter applications.
- Apply small-signal modeling and evaluate performance of soft-switched converters.

UNIT-I

Introduction to Switch Mode Power Converters - about Switch Mode Power Conversion, SMPS requirements. Cuk converters - and their principles of operation; continuous and discontinuous modes of operation.

UNIT-II

Thyristor Commutation Techniques - Review of Recent developments in power devices for switch mode power supplies. Selection of devices, Commutation: Load Commutation, Resonant Pulse Commutation, Complementary Commutation, Impulse Commutation, External Pulse Commutation.

UNIT-III

Transformer-Isolated Converters Single-switch and multi-switch transformer-isolated DC-DC converters. Flyback and forward converters; transformer isolated half-bridge, full - bridge converters. Push-pull converters. Voltage fed and current-fed converters.

UNIT-IV

Magnetic Component Design Magnetic core materials and performance; basic inductor and transformer design; practical magnetic design; design aspects to be considered for designing transformers for specific applications – flyback, push-pull converters.

UNIT-V

Switching Regulator Control, Soft-Switched Dc-Dc Power Converters Small-signal models for switching regulators. Performance analysis and design of closed-loop system under different control methods, and operating modes. Measurement of small signal transfer functions. Soft Switched DC-DC Power Converters -Motivation. Hard-switching vs soft-switching.

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Text Books:

1. N Mohan, T M Undeland and W P Robbins, "Power Electronics: Converters, Applications and Design", Wiley, 3rd Edition, 2007
2. Abraham Pressman, Keith Billings, Taylor Morey, "Switching Power Supply Design", McGraw-Hill.3rd Edition, 2009

Reference Books:

1. K. Kit Sum, Switch Mode Power Conversion: Basic Theory and Design 1st Edition, Kindle Edition,2017

Web Links:

1. https://nptel.ac.in/courses/108108036

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IV B.TECH I SEMESTER	Professional Core Elective - II	L	T	P	C
		3	0	0	3
Electrical Distribution Systems					

Course Objectives:

- Understand the basic structure, load characteristics, and factors influencing distribution systems.
- Learn substation placement and feeder design for efficient distribution networks.
- Analyze voltage drop and power loss in various load conditions across distribution lines.
- Explore protective devices and their coordination in distribution systems.
- Study compensation techniques for power factor and voltage control in distribution networks.

Course Outcomes:

After the completion of the course the student should be able to

- Classify different loads and apply factors like load factor, loss factor, and coincidence factor in system planning.
- Design optimal substation locations and feeder layouts for radial and loop systems.
- Calculate voltage drops and power losses in distribution lines with various loading scenarios.
- Select and coordinate protection devices to ensure safety and reliability of the distribution system.
- Implement capacitive compensation and voltage control methods for system efficiency and economy.

UNIT – I
General Concepts
Introduction to distribution systems, Load modeling and characteristics – Coincidence factor – Contribution factor-loss factor – Relationship between the load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT – II
Substations & Distribution Feeders
Location of substations: Rating of distribution substation – Service area with ‘n’ primary feeders – Benefits and methods of optimal location of substations.
Design Considerations of distribution feeders: Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic Design practice of the secondary distribution system.

UNIT – III
System Analysis
Voltage drop and power–loss calculations: Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads – Numerical problems - Three phase balanced primary lines.

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UNIT – IV
Protective devices and Coordination
Objectives of distribution system protection – Types of common faults and procedure for fault calculations for distribution system – Protective devices: Principle of operation of fuses – Circuit reclosures – Line sectionalizes and circuit breakers, Coordination of protective devices, General coordination procedures - Various types of coordinated operation of protective devices - Residual Current Circuit Breaker

UNIT – V
Compensation for Power Factor Improvement and Voltage Control
Capacitive compensation for power factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location. Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Text Book:

1. "Electric Power Distribution system, Engineering" – by Turan Gonen, McGraw–hill Book Company.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
2. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers

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IV B.TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
Battery Management Systems					

Course Objectives:

- Understand the fundamentals of batteries, configurations, and charging processes.
- Learn the functional requirements and architecture of a Battery Management System (BMS).
- Explore methods for estimating battery state of charge and health, along with balancing techniques.
- Study modeling approaches for simulating batteries and electric vehicle performance.
- Analyze design considerations for practical implementation of BMS in multi-battery systems.

Course Outcomes:

After the completion of the course the student should be able to

- Describe basic battery concepts, charging modes, and cell connections.
- Explain BMS functionalities including sensing, protection, communication, and estimation tasks.
- Apply SOC and SOH estimation methods and design balancing circuits for lithium-ion cells.
- Use circuit and physics-based models to simulate battery and EV performance.
- Develop BMS designs considering practical parameters such as load, range, and energy distribution.

UNIT-I
Introduction
Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cells, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging.

UNIT-II
Battery Management System Requirement
Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power.

UNIT-III
Battery State of Charge and State of Health Estimation, Cell Balancing
Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing.

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UNIT-IV
Modelling and Simulation
Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, Simulating an electric vehicle, Vehicle range calculations, Simulating constant power and voltage, Simulating battery packs.

UNIT-V
Design of Battery BMS:
Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system.

Text Books:

1. Plett, Gregory L. Battery management systems, Volume I: Battery modeling. Artech House, 2015.
2. Plett, Gregory L. Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.

References:

1. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.
2. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010
3. Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery-powered applications. Vol. 9. Springer Science & Business Media, 2008.

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IV B.TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
Concepts of Smart Grid Technologies					

Course Objectives:

- Understand the architecture, components, and need for smart grids in modern power systems.
- Explore communication technologies and measurement tools essential for smart grid operation.
- Analyze performance through load flow, stability, and security studies tailored for smart grids.
- Apply computational and optimization tools to improve smart grid efficiency and ensure cyber security.
- Study the integration of renewable energy sources, storage, and microgrids into smart grid infrastructure.

Course Outcomes:

After the completion of the course the student should be able to

- Explain the structure, benefits, and interoperability standards of smart grid systems.
- Identify and apply appropriate communication and metering technologies for smart grid implementation.
- Perform performance and security analyses for smart grid operations using advanced tools.
- Utilize computational techniques for optimization and address security challenges in the smart grid.
- Evaluate integration strategies for renewable energy, storage systems, and demand response mechanisms.

UNIT I
Smart Grid Architecture
Challenges in power grid, Advantages of building integrated and distributed power systems concept of smart grid, need for smart grid, smart grid components and their limitations, grid vision based on the intelligent architecture, Whole sale energy market in smart grid, Stake holders' roles and function, Approach to smart grid interoperability standards.

UNIT II
Communications and Measurements
Latest wired and wireless technologies, Characteristics of smart grid communications technology and communication techniques, Switching techniques and communication channels, Wide area monitoring systems, Phasor measurements units, Key components of smart metering, Communication infrastructure and protocols for smart metering, Advanced metering infrastructure, Multi agent systems for smart grid implementation

UNIT III
Performance Analysis Tools
Load flow studies for smart grid, extended formulations and algorithms, Smart Grid - Security assessment, Contingency studies, Voltage stability and Energy management.

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UNIT IV

Computational Tools and Security

Introduction to computational tools, Optimization techniques and applications to smart grid, Evolutionary computation techniques and computational challenges, Network security: Encryption and decryption, cyber-attacks, Authentication and cyber security standards

UNIT V

Renewable Energy and Storage

Benefits of renewable generation, Importance of micro grid, Demand response issues, PHEV technology, Energy storage technologies, Grid integration issues of renewable energy sources.

Text Books:

1. James Momoh, “Smart Grid – fundamentals of design and analysis”, John Wiley and Sons, 2012
2. Stuart Borlase, “Smart Grids, Infrastructure, Technology and Solutions”, CRC press, 2013
3. Clark W. Gellings, “The Smart Grid- Enabling energy efficiency and demand response”, CRC press, 2009

Reference Books:

1. Janaka Ekanayake, “Smart Grid-Technology and Applications”, John Wiley and Sons, 2012
2. Fereidoon P.Sioshansi, “Smart grid- integrating renewable, distributed and efficient energy”, Elsevier, 2012

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IV B.TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
Introduction to Artificial Intelligence					

Course Description

This course provides engineering students with a comprehensive introduction to the field of Artificial Intelligence (AI). Students will explore the fundamental concepts, methodologies, and applications of AI, including problem-solving techniques, knowledge representation, reasoning under uncertainty, and ethical considerations. The course combines theoretical foundations with practical implementations, enabling students to understand both the capabilities and limitations of modern AI systems while developing critical thinking about the societal implications of AI technologies.

Teaching Objectives

- Introduce students to the fundamental concepts, history, and evolution of artificial intelligence
- Develop students' understanding of various AI problem-solving approaches and search algorithms
- Enable students to represent knowledge and perform reasoning in AI systems
- Familiarize students with probabilistic reasoning and decision-making under uncertainty
- Foster critical thinking about ethical and societal implications of AI technologies
- Provide hands-on experience implementing basic AI algorithms and applications

Course Outcomes

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

- Explain the fundamental concepts, history, and approaches in artificial intelligence and identify appropriate AI techniques for solving different types of problems (Understand/Apply)
- Implement and evaluate various search algorithms to solve problems in the AI domain (Apply/Analyze)
- Design knowledge representation schemes and reasoning mechanisms for different AI applications (Create/Evaluate)
- Apply probabilistic reasoning methods and decision theory to address uncertainty in AI systems (Apply/Analyze)
- Assess the ethical and societal implications of AI systems and develop responsible AI solutions that consider fairness, privacy, and societal impact (Evaluate/Create)

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Unit 1: Foundations of AI

Unit Description

This unit introduces students to the core concepts, history, and evolution of artificial intelligence. Students will explore different types of AI, fundamental problem-solving approaches, and the wide range of AI applications across various domains. The unit also covers the basic structure of intelligent agents and their interactions with environments.

Syllabus Topics

1. Introduction to AI
    - Definitions and scope of artificial intelligence
    - Historical development and milestones in AI research
    - The AI winter periods and recent resurgence
    - Strong vs. weak AI concepts
2. Types of AI Systems
    - Narrow (weak) vs. general (strong) AI
    - Reactive machines vs. theory of mind systems
    - Self-aware systems and AI consciousness debates
    - Current state-of-the-art AI capabilities
3. Problem-Solving Approaches in AI
    - State space representation
    - Production systems
    - Problem reduction
    - Means-ends analysis
4. Agent-Based View of AI
    - Simple reflex agents
    - Model-based reflex agents
    - Goal-based agents
    - Utility-based agents
    - Learning agents
5. Application Domains of AI
    - Computer vision and image recognition
    - Natural language processing
    - Robotics and automation
    - Healthcare applications
    - Financial services applications
    - Autonomous vehicles

Examples/Applications/Case Studies

- Case Study: The evolution of chess-playing AI from Deep Blue to AlphaZero
- Application Example: Virtual assistants (Siri, Alexa, Google Assistant)
- Case Study: IBM Watson's journey from Jeopardy! champion to healthcare applications

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- Application Example: Facial recognition systems in security and consumer technology

Exercise/Project Problems

1. Research and create a timeline of significant AI milestones from 1950 to present
2. Design a simple reflex agent for a specified environment (e.g., a vacuum cleaner agent)
3. Compare and contrast narrow AI applications in two different domains
4. Analyze a real-world problem and determine appropriate AI approaches

Tool Studies

- Introduction to Python programming for AI
- Overview of AI development frameworks (TensorFlow, PyTorch, scikit-learn)
- Jupyter notebooks for interactive AI experimentation
- GitHub repositories with AI examples and implementations

Learning Outcomes

After completing this unit, students will be able to:

- Trace the historical development of AI and identify key milestones (Remember)
- Distinguish between different types of AI systems and their capabilities (Understand)
- Represent problems in forms suitable for AI solution approaches (Apply)
- Classify intelligent agents based on their architecture and capabilities (Analyze)
- Identify appropriate AI applications for different problem domains (Analyze)

References/E-Resources

- Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. Chapters 1-2. http://aima.cs.berkeley.edu/
- Stanford University's "AI Index Annual Report" https://aiindex.stanford.edu/report/
- MIT OpenCourseWare: Introduction to AI https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/

Unit 2: Search Algorithms

Unit Description

This unit focuses on search algorithms as fundamental problem-solving techniques in AI. Students will learn how to formulate problems as search problems, implement uninformed and informed search strategies, and apply these techniques to various domains including adversarial scenarios and game playing.

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Syllabus Topics

1. Problem Formulation
    - State space representation
    - Initial and goal states
    - Actions and transition models
    - Path cost and step cost functions
    - Problem types and complexity analysis
2. Uninformed Search Strategies
    - Breadth-first search
    - Depth-first search
    - Depth-limited search
    - Iterative deepening search
    - Bidirectional search
    - Uniform cost search
    - Time and space complexity analysis
3. Informed Search Strategies
    - Best-first search
    - Greedy best-first search
    - A* search algorithm
    - Heuristic functions: properties and design
    - Admissibility and consistency
    - Local search algorithms and optimization
4. Constraint Satisfaction Problems
    - Problem formulation as CSP
    - Constraint propagation
    - Backtracking search
    - Local search for CSPs
    - Applications of CSPs
5. Adversarial Search and Game Playing
    - Minimax algorithm
    - Alpha-beta pruning
    - Stochastic games
    - Partially observable games
    - Monte Carlo tree search
    - Game theory concepts

Examples/Applications/Case Studies

- Case Study: Route finding applications like Google Maps
- Application Example: Puzzle solving (8-puzzle, Rubik's cube)
- Case Study: AlphaGo's strategies and their implications
- Application Example: Scheduling and resource allocation problems

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Exercise/Project Problems

1. Implement breadth-first and depth-first search algorithms for the 8-puzzle problem
2. Design and implement an A* search for a pathfinding problem with different heuristics
3. Develop a constraint satisfaction solver for Sudoku puzzles
4. Create a simple game AI using minimax algorithm with alpha-beta pruning

Tool Studies

- Python implementation of search algorithms
- Visualization tools for search algorithms (e.g., pathfinding visualizers)
- Game AI frameworks and libraries
- NetworkX library for graph representation and algorithms

Learning Outcomes

After completing this unit, students will be able to:

- Formulate problems as state space search problems (Apply)
- Implement and compare uninformed search strategies (Apply)
- Design effective heuristic functions for informed search algorithms (Create)
- Apply constraint satisfaction techniques to appropriate problem domains (Apply)
- Evaluate and optimize adversarial search algorithms for games (Evaluate)

References/E-Resources

- Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. Chapters 3-5. http://aima.cs.berkeley.edu/
- Berkeley AI Materials: Search http://ai.berkeley.edu/search.html
- Visualization of Search Algorithms: https://qiao.github.io/PathFinding.js/visual/
- Interactive Game Theory Tutorials: https://gametheory101.com/courses/

Unit 3: Knowledge Representation

Unit Description

This unit explores methods for representing and organizing knowledge in AI systems. Students will learn about various knowledge representation schemes including logic-based approaches, semantic networks, frames, and ontologies. The unit also covers reasoning mechanisms that operate on these knowledge representations to derive new information and make inferences.

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Syllabus Topics

1. Logic and Inference
    - Propositional logic: syntax and semantics
    - First-order logic: quantifiers, variables, and predicates
    - Inference rules: modus ponens, resolution
    - Forward and backward chaining
    - Unification and substitution
2. Semantic Networks
    - Network structure and node types
    - Inheritance hierarchies
    - Spreading activation
    - Semantic relationships
    - Implementation approaches
3. Frames and Scripts
    - Frame structure and slots
    - Default values and demons
    - Inheritance in frame systems
    - Scripts for representing procedural knowledge
    - Event and situation representation
4. Ontologies and Knowledge Graphs
    - Ontology components and design principles
    - Web Ontology Language (OWL)
    - Knowledge graph construction
    - Entity-relationship modeling
    - Linked data concepts
5. Rule-Based Systems
    - Production rules
    - Rule-based expert systems
    - Conflict resolution strategies
    - Explanation facilities
    - Certainty factors and confidence

Examples/Applications/Case Studies

- Case Study: WordNet as a lexical semantic network
- Application Example: DBpedia and Wikidata as knowledge graphs
- Case Study: Google's Knowledge Graph and its applications in search
- Application Example: MYCIN and DENDRAL as early expert systems

Exercise/Project Problems

1. Implement a small propositional logic reasoning system
2. Design a semantic network for a specific domain (e.g., university courses)

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3. Create a frame-based representation for a common object or concept
4. Develop a simple rule-based expert system for a diagnostic task

Tool Studies

- Protégé ontology editor
- SWI-Prolog for logic programming
- RDF and OWL tools for semantic web applications
- Python libraries for knowledge representation (NLTK, NetworkX)

Learning Outcomes

After completing this unit, students will be able to:

- Apply logical representation and reasoning to knowledge-based problems (Apply)
- Design semantic networks for organizing domain knowledge (Create)
- Construct frame-based representations for objects and concepts (Create)
- Develop ontologies and knowledge graphs for information organization (Create)
- Implement rule-based systems for inference tasks (Apply)

References/E-Resources

- Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. Chapters 7-10. http://aima.cs.berkeley.edu/
- Stanford University: Introduction to Knowledge Representation https://web.stanford.edu/class/cs227/
- Protégé Ontology Editor Tutorials https://protegewiki.stanford.edu/wiki/Protege5Tutorials
- W3C Semantic Web Standards https://www.w3.org/standards/semanticweb/

Unit 4: Reasoning Under Uncertainty

Unit Description

This unit addresses methods for handling uncertainty in AI systems. Students will review probability theory fundamentals and learn about probabilistic reasoning techniques including Bayesian networks and Markov models. The unit also covers decision theory and its applications to AI decision-making under uncertainty.

Syllabus Topics

1. Probability Theory Review
    - Random variables and probability distributions
    - Joint, conditional, and marginal probabilities
    - Bayes' theorem and its applications
    - Independence and conditional independence
    - Expectation and variance

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2. Bayesian Networks
    - Graphical representation of probability distributions
    - Conditional independence in Bayesian networks
    - d-separation and Markov blanket
    - Inference in Bayesian networks
    - Parameter learning from data
    - Structure learning algorithms
3. Markov Models
    - Markov chains and transition matrices
    - Hidden Markov Models (HMMs)
    - Viterbi algorithm
    - Forward-backward algorithm
    - Baum-Welch algorithm
    - Applications in temporal reasoning
4. Decision Theory
    - Utility theory and utility functions
    - Decision networks (influence diagrams)
    - Value of information
    - Risk assessment and management
    - Multi-attribute utility theory
5. Probabilistic Reasoning Applications
    - Medical diagnosis systems
    - Spam filtering and text classification
    - Financial risk assessment
    - Speech recognition
    - Robot localization and mapping

Examples/Applications/Case Studies

- Case Study: Naive Bayes classifiers for text categorization
- Application Example: Medical diagnosis expert systems
- Case Study: Speech recognition using Hidden Markov Models
- Application Example: Recommender systems using probabilistic models

Exercise/Project Problems

1. Implement a Naive Bayes classifier for spam detection
2. Build a simple Bayesian network for a diagnostic problem
3. Create a Hidden Markov Model for part-of-speech tagging
4. Develop a decision network for a personal finance recommendation system

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Tool Studies

- Python libraries for probabilistic modeling (PyMC3, PyStan)
- Bayesian network tools (BayesiaLab, Hugin)
- Probabilistic programming languages (Stan, Pyro)
- WEKA machine learning toolkit for classification

Learning Outcomes

After completing this unit, students will be able to:

- Apply Bayesian probability principles to reasoning problems (Apply)
- Construct Bayesian networks for probabilistic modeling (Create)
- Implement Markov models for sequential data analysis (Apply)
- Develop decision-theoretic approaches for problems under uncertainty (Create)
- Evaluate the effectiveness of probabilistic reasoning techniques (Evaluate)

References/E-Resources

- Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. Chapters 12-16. http://aima.cs.berkeley.edu/
- Koller, D., & Friedman, N. (2009). Probabilistic Graphical Models: Principles and Techniques. MIT Press. https://pgm.stanford.edu/
- Carnegie Mellon University: Probabilistic Graphical Models https://www.cs.cmu.edu/~epxing/Class/10708/
- Tutorials on Bayesian Networks https://www.bayesserver.com/docs/

Unit 5: Ethical and Societal Implications

Unit Description

This unit explores the ethical and societal dimensions of artificial intelligence. Students will examine issues of bias and fairness in AI systems, privacy concerns, the impact of automation on employment, and approaches to AI governance and regulation. The unit emphasizes responsible AI development practices and frameworks for assessing the broader implications of AI technologies.

Syllabus Topics

1. AI Bias and Fairness
    - Sources of bias in AI systems
    - Fairness metrics and definitions
    - Bias detection and mitigation methods
    - Representation and inclusion in AI development
    - Case studies of algorithmic bias

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2. Privacy and AI
    - Data collection and consent
    - Anonymization and de-identification techniques
    - Privacy-preserving AI methods
    - Differential privacy
    - Surveillance and privacy implications

3. Automation and Employment
    - Labor market impacts of AI automation
    - Skill-biased technological change
    - Future of work scenarios
    - Economic policy responses
    - Education and retraining approaches
4. AI Governance and Regulation
    - Regulatory frameworks for AI
    - Standards and certifications
    - Self-regulation and industry initiatives
    - International cooperation on AI governance
    - Risk assessment frameworks
5. Responsible AI Development
    - AI ethics principles
    - Explainable AI methods
    - Human-in-the-loop systems
    - Value alignment problem
    - Long-term AI safety considerations

Examples/Applications/Case Studies

- Case Study: COMPAS recidivism prediction and racial bias
- Application Example: Privacy-preserving federated learning
- Case Study: Automation in manufacturing and service industries
- Application Example: Explainable AI in healthcare decision-making

Exercise/Project Problems

1. Analyze a dataset for potential sources of bias and propose mitigation strategies
2. Design a privacy-preserving AI system for a sensitive application
3. Develop an impact assessment framework for an AI deployment scenario
4. Create an explainable AI approach for a black-box model

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Tool Studies

- Fairness-aware machine learning libraries (AI Fairness 360, Fairlearn)
- Explainable AI tools (LIME, SHAP, InterpretML)
- Privacy-preserving AI frameworks (PySyft, TensorFlow Privacy)
- Ethical assessment frameworks and checklists

References/E-Resources

- Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. Chapter 27. http://aima.cs.berkeley.edu/
- The Ethics of Artificial Intelligence. Bostrom, N., & Yudkowsky, E. (2014). https://nickbostrom.com/ethics/artificial-intelligence.pdf
- AI Ethics Guidelines Global Inventory by Algorithm Watch https://inventory.algorithmwatch.org/
- IEEE Ethics in Action https://ethicsinaction.ieee.org/
- Partnership on AI https://www.partnershiponai.org/resources/

Textbooks and References

Primary Textbooks

1. Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.
2. Luger, G. F. (2020). *Artificial Intelligence: Structures and Strategies for Complex Problem Solving* (6th ed.). Pearson.

Additional References

1. Poole, D. L., & Mackworth, A. K. (2017). *Artificial Intelligence: Foundations of Computational Agents* (2nd ed.). Cambridge University Press.
2. Nilsson, N. J. (2009). *The Quest for Artificial Intelligence: A History of Ideas and Achievements*. Cambridge University Press.
3. Koller, D., & Friedman, N. (2009). *Probabilistic Graphical Models: Principles and Techniques*. MIT Press.
4. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
5. Kaplan, J. (2016). *Artificial Intelligence: What Everyone Needs to Know*. Oxford University Press.
6. O'Neil, C. (2016). *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. Crown.
7. Tegmark, M. (2017). *Life 3.0: Being Human in the Age of Artificial Intelligence*. Knopf.
8. Ertel, W. (2018). *Introduction to Artificial Intelligence* (2nd ed.). Springer.

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IV B.TECH I SEMESTER	Open Elective - IV	L	T	P	C
		3	0	0	3
Power Quality and Custom Power Devices					

Course Objectives:
The objectives of this course is to acquire knowledge on

- significance of power quality and power quality parameters.
- types of transient over voltages and protection of transient voltages.
- harmonics, their effects, harmonic indices and harmonic minimization techniques.
- importance of power devices and their applications.
- different compensation techniques to minimize power quality disturbances.

Course Outcomes:
After the completion of the course the student should be able to

- identify the issues related to power quality in power systems.
- address the problems of transient and long duration voltage variations in power systems.
- analyze the effects of harmonics and study of different mitigation techniques.
- identify the importance of custom power devices and their applications.
- acquire knowledge on different compensation techniques to minimize power quality disturbances.

UNIT I
Introduction to Power Quality
Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations- Power quality terms – Voltage sags, Voltage swells, harmonics interruptions, voltage flicker and voltage spikes – Sources of voltage sag, swell and interruptions – Nonlinear loads.

UNIT II
Transient and Long Duration Voltage Variations
Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.
Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources.

UNIT III
Harmonic distortion and solutions
Voltage vs. Current Distortion, Harmonics vs. Transients - Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Sources of harmonics, Locating Sources of Harmonics, System Response Characteristics, Effects of Harmonic Distortion, Inter harmonics, Harmonic Solutions Harmonic Distortion Evaluation, Devices for Controlling Harmonic Distortion, Harmonic Filter Design, Standards on Harmonics

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UNIT IV
Custom Power Devices
Custom power and custom power devices, voltage source inverters, reactive power and harmonic compensation devices, compensation of voltage interruptions and current interruptions, static series and shunt compensators, compensation in distribution systems, interaction with distribution equipment, installation considerations.

UNIT V
Application of custom power devices in power systems
Static and hybrid Source Transfer Switches, Solid state current limiter - Solid state breaker. P-Q theory – Control of P and Q, Dynamic Voltage Restorer (DVR): Operation and control – Interline Power Flow Controller (IPFC): Operation and control of Unified Power Quality Conditioner (UPQC); Generalized power quality conditioner.

Text Books:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
3. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, ArindamGhosh, Kluwer Academic Publishers, 2002.
4. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002.

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
4. Power Quality c.shankaran, CRC Press, 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis).
6. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S. Masoum Elsevier
7. Power Quality, C. Shankaran, CRC Press, 2001
8. Instantaneous Power Theory and Application to Power Conditioning, H. Akagiet.al., IEEE Press, 2007.
9. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.
10. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000

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IV B.TECH I SEMESTER	Open Elective - IV	L	T	P	C
		3	0	0	3
Programmable Logic Controllers					

Course Objectives:
The objectives of this course is to acquire knowledge to

- have knowledge on PLC.
- acquire knowledge on programming of PLC.
- understand different PLC registers and their description.
- have knowledge on data handling functions of PLC.
- know how to handle analog signals and converting of A/D in PLC.

Course Outcomes:
After the completion of the course the student should be able to:

- know the PLCs and their I/O modules.
- develop control algorithms to PLC using ladder logic.
- manage PLC registers for effective utilization in different applications.
- design PID controller with PLC.
- handle analog signal and converting of A/D in PLC

Unit I
Introduction
PLC Basics: PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

Unit II
PLC Programming
Input instructions, outputs, operational procedures, programming examples using contacts and coils. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams and sequence listings, ladder diagram construction.

Unit III
Programmable Timers and Counters
Timer instructions – On delay time instruction – Off delay timer instruction – Retentive timer – Counter instructions – Up counter – Down counter – Cascading counters – Incremental encoder – Counter applications – Combining counter and timer functions.

Unit IV
Program Control Instructions
Master control reset instruction – Jump instructions and sub routines – Immediate input and output instructions. Data manipulation – Data transfer operation – Data compare instruction – Data manipulation programs – Numerical data I/O interfaces – Math instructions – Addition, subtraction, multiplication.

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Unit V
Applications
Control of water level indicator – Alarm monitor - Conveyor motor control – Parking garage – Ladder diagram for process control – PID controller.

Text Books:

1. Programmable logic controllers by Frank D.Petruzella- McGraw Hill – 3rd Edition.
2. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI

Reference Books:

1. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.
2. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher

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IV B.TECH I SEMESTER	Open Elective - IV	L	T	P	C
		3	0	0	3
Quantum Computing					

Course 1: Introduction to Quantum Computing

1. **Classical Computing Foundations**
   - Binary representation and Boolean logic
   - Complexity theory and computational limits
   - Linear algebra review for quantum computing
   - Reversible computing
2. **Quantum Mechanics Fundamentals**
   - Wave-particle duality and superposition
   - Measurement and uncertainty principles
   - Quantum states and probability amplitudes
   - Hilbert spaces and Dirac notation
3. **Quantum Bits and Gates**
   - Qubit representation and Bloch sphere
   - Single-qubit gates (X, Y, Z, H, S, T)
   - Multi-qubit gates and entanglement
   - Universal gate sets
4. **Quantum Circuits**
   - Circuit notation and composition
   - Basic circuit identities and simplifications
   - Quantum circuit simulation
   - Introduction to quantum algorithms
5. **Quantum Computing Platforms**
   - Superconducting qubits
   - Trapped ions
   - Photonic quantum computing
   - Current quantum hardware landscape

Course 2: Quantum Algorithms I

1. **Quantum Algorithm Fundamentals**
   - Quantum parallelism and interference
   - Quantum algorithm design principles
   - Quantum query model
   - Probability amplification techniques
2. **Quantum Oracles and Black Box Problems**
   - Classical vs. quantum oracles
   - Bernstein-Vazirani algorithm
   - Deutsch-Jozsa algorithm
   - Simon's algorithm

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3. **Quantum Fourier Transform**
    - Discrete Fourier transform review
    - Quantum Fourier transform construction
    - QFT circuit implementation
    - Applications in quantum algorithms
4. **Period Finding and Shor's Algorithm**
    - Number theory background
    - Quantum phase estimation
    - Period finding algorithm
    - Shor's factoring algorithm
5. **Quantum Search**
    - Unstructured search problems
    - Grover's algorithm fundamentals
    - Amplitude amplification
    - Applications and limitations

Course 3: Quantum Information Theory

1. **Classical Information Theory Review**
    - Entropy and information content
    - Data compression
    - Channel capacity
    - Error correction fundamentals
2. **Quantum States and Measurements**
    - Density matrix formalism
    - POVM measurements
    - Quantum state discrimination
    - Quantum state tomography
3. **Quantum Entanglement**
    - Bell states and entanglement measures
    - Bell's inequalities and non-locality
    - Entanglement as a resource
    - Applications in quantum protocols
4. **Quantum Channels and Operations**
    - Quantum operations and Kraus representation
    - Completely positive maps
    - Quantum channel capacity
    - Quantum noise models
5. **Quantum Shannon Theory**
    - Von Neumann entropy
    - Holevo bound
    - Quantum data compression
    - Quantum channel capacity theorems

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Course 4: Quantum Error Correction

1. **Quantum Noise and Decoherence**
   - Sources of quantum errors
   - Error models and characterization
   - Decoherence mechanisms
   - Quantum error mitigation techniques
2. **Classical Error Correction Review**
   - Linear codes
   - Parity check matrices
   - Syndrome decoding
   - Classical code families
3. **Quantum Error Correction Fundamentals**
   - No-cloning theorem challenges
   - Quantum error correction criteria
   - Error detection vs. correction
   - Stabilizer formalism
4. **Quantum Error Correcting Codes**
   - Three-qubit code
   - Shor's nine-qubit code
   - Steane code
   - Surface codes introduction
5. **Fault-Tolerant Quantum Computing**
   - Fault-tolerance principles
   - Threshold theorem
   - Logical operations on encoded qubits
   - Magic state distillation

Course 5: Quantum Algorithms II and Applications

1. **Advanced Quantum Search Techniques**
   - Quantum walks
   - Quantum minimum finding
   - Amplitude amplification extensions
   - NAND tree evaluation
2. **Quantum Machine Learning**
   - Quantum data encoding
   - Quantum neural networks
   - HHL algorithm for linear systems
   - Quantum support vector machines
3. **Quantum Simulation**
   - Hamiltonian simulation
   - Trotter-Suzuki formulas
   - Quantum chemistry applications
   - Materials science applications

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4. **Quantum Optimization**
    - Quantum approximate optimization algorithm (QAOA)
    - Quantum adiabatic algorithm
    - Quantum annealing
    - Variational quantum algorithms
5. **Emerging Quantum Applications**
    - Quantum finance
    - Quantum networking and cryptography
    - Quantum sensing and metrology
    - Quantum computational advantage demonstrations

Course 6: Quantum Software Development and Programming

1. **Quantum Programming Fundamentals**
    - Classical vs. quantum programming models
    - Quantum algorithm implementation strategies
    - Quantum-classical hybrid computing
    - Cloud-based quantum computing services
2. **Quantum Programming Languages**
    - Qiskit ecosystem
    - Cirq and other Google frameworks
    - Q# and Microsoft quantum development kit
    - PyQuil and other frameworks
3. **Quantum Circuit Optimization**
    - Circuit depth reduction
    - Gate decomposition
    - Transpilation strategies
    - Hardware-specific optimizations
4. **Quantum Software Testing and Verification**
    - Quantum program verification
    - Testing strategies for quantum software
    - Benchmarking quantum programs
    - Performance analysis techniques
5. **Quantum Software Project**
    - Project planning and requirements
    - Algorithm implementation
    - Testing and optimization
    - Results analysis and presentation

This minor program provides comprehensive coverage of quantum computing fundamentals, algorithms, information theory, error correction, applications, and software development, giving undergraduate students a strong foundation in this emerging field.

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IV B.TECH I SEMESTER	Skill Enhancement Course	L	T	P	C
		0	0	4	2
Power Systems Simulation Lab					

Course Objectives:

- To impart the practical knowledge of functioning of various power system components and determination of various parameters and simulation of load flows, transient stability, LFC and Economic dispatch.

Course Outcomes:

After the completion of the course the student should be able to:

- Estimate the sequence impedances of 3-phase Transformer and Alternators
- Evaluate the performance of transmission lines
- Analyse and simulate power flow methods in power systems
- Analyse and simulate the performance of PI controller for load frequency control.
- Analyse and simulate stability studies of power systems

Any of 5 experiments are to be conducted from each section:

Section I: Power Systems Lab:

1. Estimation of sequence impedances of 3-phase Transformer
2. Estimation of sequence impedances of 3-phase Alternator by Fault Analysis
3. Estimation of sequence impedances of 3-phase Alternator by Direct method
4. Estimation of ABCD parameters on transmission line model
5. Performance of long transmission line without compensation
6. Performance of long transmission line with shunt compensation
7. Analyze the Ferranti effect on long transmission line

Section II: Simulation Lab

8.Determination of Y_{bus} using direct inspection method
9.Load flow solution of a power system network using Gauss-Seidel method
10. Load flow solution of a power system network using Newton Raphson method.
11. Formation of Z_{bus} by building algorithm.
12. Economic load dispatch with & without losses
13. Load frequency control of a two area Power System without & with PI controller
14. Transient Stability analysis of single machine connected to an infinite bus (SMIB) using equal area criterion.

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IV B.TECH I SEMESTER	Audit Course	L	T	P	C
		2	0	0	0
Constitution of India					

Course Objectives

- Understand the historical development and philosophy behind the Indian Constitution.
- Gain insights into the structure, functioning, and powers of Union and State Governments.
- Comprehend the scope of fundamental rights, duties, and directive principles.
- Recognize the functioning of constitutional bodies and their roles in governance.
- Appreciate the significance of local self-governance and recent constitutional amendments.

Unit I: Constitutional Foundation and Historical Background

Constitutional history and the making of the Indian Constitution, Role of the Constituent Assembly, Salient features of the Indian Constitution, Significance of the Preamble, Process of constitutional amendments (Article 368)

Unit II:
Fundamental Rights, Duties, and Directive Principles

Citizenship provisions under the Constitution, Fundamental Rights (Articles 12–35), Directive Principles of State Policy (Articles 36–51), Fundamental Duties (Article 51A)

Unit III:
Union Government

President and Vice President: election, powers, and removal, Prime Minister and Council of Ministers, Structure and functions of Parliament, Judiciary: Structure and powers of the Supreme Court, Centre-State relations: legislative, administrative, and financial, Emergency provisions (Articles 352, 356, 360)

Unit IV:
State Government and Local Governance

Governor: Appointment, powers, and functions, State Legislature and Chief Minister, Role of High Courts, Rural and Urban Local Governments, 73rd and 74th Constitutional Amendment Acts (Panchayati Raj and Municipalities)

Unit V:
Constitutional and Statutory Bodies

Comptroller and Auditor General (CAG), Election Commission of India, Finance Commission, Attorney General and Advocate General, Union and State Public Service Commissions (UPSC & SPSC), Tribunals

and National Human Rights Commission (NHRC)

Textbooks:

1. J.C.Johari,IndianGovernmentandPolitics,VishalPublications,Delhi,2009.Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2012,MIT Press (Unit-2&3)
2. M. V. Pylee, Introduction to the Constitution of India, 5th Ed., Vikas Publishing House, Mumbai, 2007.

Reference Books:

1. D.D. Basu, Introduction to the Indian Constitution, 21st Ed., Lexis Nexis, Gurgaon, India, 2011. 2. Subhas C. Kashyap, Our Constitution, 2nd Ed., National Book Trust India, New Delhi, 2013

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc20_lw02/preview Evaluation of Industry Internship

Course Outcomes (COs)
After completion of the course, the student will be able to

- Explain the evolution and salient features of the Indian Constitution.
- Describe the structure of the Indian Government and its functioning at the Union and State levels.
- Analyze the significance of the Preamble, Fundamental Rights, and Duties.
- Evaluate the role of statutory and constitutional bodies in democratic governance.
- Interpret the importance of decentralization through Panchayati Raj and urban local bodies.

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IV B.TECH I SEMESTER	Internship	L	T	P	C
		0	0	0	2
Evaluation of Industry Internship (done during III-II Summer Vacation – 8 Weeks)					

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B.Tech. IV Year-II Semester

S.No	Category	Title	L	T	P	C
1	Internship & Project Work	Full Semester Internship & Project Work	0	0	24	12

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*Honors Engineering Courses offered to EEE Branch students Need to Acquire 18 credits

S.No.	Course Code	Title	L	T	P	C
1.		Electric Power Quality	3	0	0	3
2.		Smart Grid Technologies	3	0	0	3
3.		Power System Deregulation	3	0	0	3
4.		Real Time Control of Power Systems	3	0	0	3
5.		Advanced Power Systems Protection	3	0	0	3
6.		Grid Integration of Renewable Energy Sources	3	0	0	3
7.		AI applications in Power Systems	3	0	0	3
8.		Power Systems Lab	0	0	3	1.5
9.		Advanced Power Systems Simulation Lab	0	0	3	1.5
10.		Renewable Energy Technologies Laboratory	0	0	3	1.5
11.		Special Electrical Machines	3	0	0	3
12.		Machine Modelling and Analysis	3	0	0	3
13.		Power Electronic Converters	3	0	0	3
14.		Power Electronics for Renewable Energy systems	3	0	0	3
15.		Industrial Applications of Power Electronic Converters	3	0	0	3
16.		Advanced Electrical Drives	3	0	0	3
17.		Power Converters Laboratory	0	0	3	1.5
18.		Electric Drives Laboratory	0	0	3	1.5
19.		Electric Vehicles Laboratory	0	0	3	1.5
20.		Discrete Control Systems	3	0	0	3
21.		Process Dynamic and Control	3	0	0	3
22.		Optimal Control Theory	3	0	0	3

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*Honors Engineering Courses offered to EEE Branch students
Power Systems

I	Honors Engineering Courses (Power Systems)	L	T	P	C
		3	0	0	3
Electric Power Quality					

Pre-requisite: Power systems, Power Electronics.

Course Objectives:

- To learn effects responsible to power quality phenomena.
- To learn about the transient over voltages and over voltage protection.
- To identify sources for long duration over voltages and understand the working of voltage regulating equipment.
- Learn the effects of harmonic distortion on different electrical equipment.
- To explain the relationship between distributed generation and power quality and importance of monitoring.

Course Outcomes:

After the completion of the course the student should be able to:

- Differentiate between different types of power quality problems.
- Explain the sources transient over voltages and over voltage protection.
- Explain the principles long duration over voltages and voltage regulation improvement methods.
- Analyse voltage distortion and current distortion and their indices.
- Know the concepts of inter facing the distributed generation technologies and power quality monitoring.

UNIT - I

Introduction

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations – Voltage Sag – Voltage Swell.

UNIT - II

Transient over Voltages and over voltage protection

Sources of Transient over voltages - Principles of over voltage protection- Devices for over voltage protection – Utility Capacitor Switching Transients - Utility System Lightning Protection – Managing Ferro resonance – Switching Transient Problems with Loads.

UNIT - III

Long – Duration Voltage Variations and voltage regulation

Principles of regulating the voltage – Devices for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End user capacitor application – Regulating utility voltage with distributed resources – voltage flicker.

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UNIT - IV

Harmonic distortion and solutions

Voltage distortion verses current distortion –Harmonic indices: THD - TDD and True Power Factor– Sources of harmonics – Effect of harmonic distortion – Impact on capacitors, transformers, motors and meters – Concept of Point of common coupling – Passive and active filtering – Numerical problems.

UNIT - V

Distributed Generation and Monitoring

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks.

Monitoring

Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data.

Textbooks:

1. Electrical Power Systems Quality - Dugan R C - McGranaghan M F - Santoso S - and Beaty H W - Second Edition - McGraw–Hill - 2012 - 3rd edition.
2. Electric power quality problems –M.H.J.Bollen IEEE series-Wiley india publications - 2011.
3. Power Quality Primer - Kennedy B W - First Edition - McGraw–Hill - 2000.

Reference Books:

1. Understanding Power Quality Problems: Voltage Sags and Interruptions - Bollen M HJ - First Edition - IEEE Press; 2000.
2. Power System Harmonics - Arrillaga J and Watson N R - Second Edition -John Wiley & Sons - 2003.
3. Electric Power Quality control Techniques - W. E. Kazibwe and M. H. Sendaula - Van Nostrad Reinhold - New York.
4. Power Quality C.Shankaran - CRC Press - 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa–CRC Press (Taylor & Francis)
6. Power Quality in Power systems and Electrical Machines–EwaldF.fuchs- Mohammad A.S.Masoum–Elsevier.

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II	Honors Engineering Courses (Power Systems)	L	T	P	C
		3	0	0	3
Smart Grid Technologies					

Pre-requisite: Basic Electrical Engineering, Power Systems, Signals & Systems

Course Objectives:

- To introduce students to the architecture, functions, and components of smart grids.
- To explore the communication and control technologies integral to smart grids.
- To examine the integration of renewable energy and distributed generation.
- To understand demand-side management and smart grid applications.
- To highlight challenges related to security, privacy, and regulation in smart grid implementation.

Course Outcomes: At the end of the course, student will be able to

- Understand the structure and benefits of smart grids.
- Analyze communication technologies and protocols in smart grids.
- Evaluate smart grid components like smart meters, energy storage, and distributed generation.
- Apply concepts in demand response and load management.
- Identify and address cyber security challenges in smart grids

UNIT – I
Introduction to Smart Grids
Evolution of Power Grids: Traditional Grids vs. Smart Grids-Key Characteristics of Smart Grids: Efficiency, Reliability, Flexibility-Smart Grid Architecture: Components and Functions-Generation, Transmission, Distribution, and Consumption Sectors-Smart Grid Vision, Goals, and Benefits-Economic, Environmental, and Operational Benefits-Role of ICT in Smart Grids: Data Management and Communication Infrastructure.

UNIT – II
Smart Grid Communication and Networking:
Communication Technologies for Smart Grids: Wired (Ethernet, Fiber Optics) and Wireless (Zigbee, Wi-Fi, Cellular)-Power Line Communication (PLC) for Smart Metering and Control-Smart Metering Systems: Functionality and Communication Protocols: Advanced Metering Infrastructure (AMI)-Protocols in Smart Grids: IEC 61850, Modbus, DNP3, and others-Data Acquisition and Control Systems in Smart Grids-Integration of Internet of Things (IoT) in Smart Grid Communication.

UNIT – III
Smart Grid Components and Technologies
Smart Meters: Role, Functionality, and Types-Energy Storage Systems: Batteries, Supercapacitors, Flywheels, and Their Role in Grid Stability-Distributed Generation and Renewable Energy Integration: Solar, Wind, and Microgrids-Energy Management Systems (EMS): Load Flow Analysis and Optimization Techniques-Smart Grid Automation: SCADA Systems, Automated Metering, and Fault Detection-Real-Time Monitoring and Control: Techniques and Technologies.

UNIT – IV
Integration of Renewable Energy and Demand-Side Management
Challenges in Integrating Renewable Energy into the Grid: Variability, Intermittency, and Storage Solutions-Role of Smart Grids in Renewable Energy Integration: Grid Stability and Power Quality, Wind and Solar Power Forecasting Techniques-Demand-Side Management (DSM) and Smart Appliances: Load Shifting, Load Shedding, and Peak Demand Reduction, Role of Consumers in Grid Optimization (Smart Home Technologies)-Electric Vehicle (EV) Integration and Smart Charging Infrastructure

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UNIT – V

Security, Privacy, and Policy Issues in Smart Grids

Cyber security in Smart Grids: Threats, Vulnerabilities, and Risks: Cyber Attacks on Critical Infrastructure-Privacy Concerns and Data Protection in Smart Grid Systems: Consumer Data, Smart Meters, and Privacy Regulations-Authentication, Authorization, and Secure Communication Protocols: IEC 62351 Security Standards-Smart Grid Regulations and Policies: Global Standards and Frameworks.

NIST, IEC, IEEE Standards, Policy Challenges in Grid Modernization and Renewable Energy Adoption-Future Trends and Challenges in Smart Grid Development.

Textbooks:

1. "Smart Grids: Infrastructure, Technology, and Solutions" by Stuart Borlase
2. "Smart Grid: Fundamentals of Design and Analysis" by James A. Momoh
3. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
4. Smart Grid Security: An End-to-End View of Security in the New Electric Grid" by Tony Flick and Justin Morehouse

Reference Books:

1. "Smart Grid: Technology and Applications" by Janaka Ekanayake, Kithsiri Liyanage, Jiangzhou Wang, Nick Jenkins, and Xiangyu Zhang
2. "The Smart Grid: Enabling Energy Efficiency and Demand Response" by Galina P. L. P. Shapiro.
3. "The Smart Grid: Enabling Energy Efficiency and Demand Response" by Clark W. Gellings.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/107/108107113

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III	Honors Engineering Courses (Power Systems)	L	T	P	C
		3	0	0	3
Power System Deregulation					

Pre-requisite: Power System Analysis, Power System Operation and Control.

Course Objectives:

- To familiarize the students with concepts and need for deregulated power systems.
- To impart the knowledge of power market development in India and across the world.
- To understand the key factors in equipment specification and system design.
- To learn about Ancillary Services Management
- To familiarize with the Electric Energy Trading.

Course Outcomes: At the end of the course, student will be able to

- Illustrate the operation of deregulated electricity market systems and typical issues in electricity markets
- Analyze various types of electricity market operational and control issues using new mathematical models.
- Summarize power wheeling transactions and congestion management.
- Analyze impact of ancillary services.
- Understand the Power market scenarios and Electric Energy Trading in the World.

UNIT – I

Deregulation of The Electric Supply Industry

Introduction, concept of Deregulation, Different entities in deregulated electricity markets; Independent System Operator (ISO), Market Operator; Background to Deregulation and the Current Situation Around the World; Benefits from a Competitive Electricity Market; After-Effects of Deregulation.

Market Structure and Operation

Objectives of Market operations; Electricity Market Models –Pool Company, Bilateral Contracts and Hybrid; Power Market Types – Energy Services, Ancillary Services and Transmission Markets; Forward and Real-Time Markets; Market Power.

UNIT – II

Power System Operation in Competitive Environment

Introduction, Role of the Independent System Operator; Operational planning activities of ISO – in Pool and Bilateral Markets; Operational planning activities of a Genco – in Pool Markets, Bilateral Markets; Market participation issues; Unit Commitment in Deregulated Environment; Competitive Bidding.

UNIT – III

Transmission Open Access and Pricing Issues

Introduction, Power Wheeling; Transmission Open Access; Cost components in transmission; Pricing of Power Transactions – Embedded Cost Based and Incremental Cost Based Transmission Pricing. Security Management in Deregulated Environment; Congestion Management in Deregulation.

UNIT – IV

Ancillary Services Management

General description of some ancillary services; Ancillary Service Management in various countries; Check-List of Ancillary Services Recognized by Various markets; Reactive Power as an Ancillary service.

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UNIT – V
Electric Energy Trading
Introduction, Essence of Electric Energy Trading, Energy Trading Framework, Derivative Instruments of Energy Trading, Portfolio Management, Energy Trading Hubs, Brokers in Electricity Trading, Green Power Trading.

Text Books:
1. Operation of restructured power systems – K. Bhattacharya, M.H.J. Bollen and J.E. Daalder, Springer (For Units – 1,2.3, and 4)
2. Market operations in electric power systems – M. Shahidehpour, H. Yaminand Z. Li,Wiley (For Units – 1 and 5)

Reference Books:
1. Power System Economics: Designing markets for electricity – S. Stoft, wiley.
2. Loi LeiLai, "PowerSystemRestructuringandDeregulation", 1st edition, JohnWiley&Sons Ltd., 2012.

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IV	Honors Engineering Courses (Power Systems)	L	T	P	C
		3	0	0	3
Real Time Control of Power Systems					

Course Objectives:

- To understand the importance of state estimation in power systems.
- To know the importance of security and contingency analysis.
- To understand SCADA, its objectives and its importance in power systems.
- To know the significance of voltage stability analysis.
- To provide an in-depth understanding of the operation of deregulated electricity market systems.

Course Outcomes:

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

- Illustrate different types of state estimations
- Describe security and contingency evaluation
- Demonstrate the computer control of power systems
- To classify and compare the voltage stability issues.
- Describe the various conditions of deregulation

UNIT – I

State Estimation: Different types of State Estimations, Theory of WLS state estimation, sequential and non-sequential methods to process measurements. Observability, Pseudo measurements, Bad data detection, identification and elimination.

UNIT – II

Security and Contingency Evaluation: Security concept, Security Analysis and monitoring, Contingency Analysis for Generator and line outages by iterative linear power flow method, Fast Decoupled model, and network sensitivity methods.

UNIT – III

Computer Control of Power Systems: Need for real time and computer control of power systems, operating states of a power system, Supervisory Control and Data Acquisition (SCADA) systems implementation considerations, energy control centers, software requirements for implementing the above functions.

UNIT – IV

Voltage Stability, voltage collapse, and voltage security, relation of voltage stability to rotor angle stability. Voltage stability analysis Introduction to voltage stability analysis `P-V' curves and `Q-V' curves, voltage stability in mature power systems, long-term voltage stability, power flow analysis for voltage stability, voltage stability static indices and Research Areas.

UNIT – V

Need and conditions for deregulation. Introduction of Market structure, Market Architecture, Spot market, forward markets and settlements. Review of Concepts marginal cost of generation, least-cost operation, incremental cost of generation, power system operation.

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Text Books:

1. Allen J. Wood and Bruce F. Wollenberg: Power Generation operation and control, John Wiley & Sons, 1984.
2. John J.Grainger and William D.Stevenson, Jr.: Power System Analysis, McGraw-Hill, 1994, International Edition
3. Prabha Kundur: Power System Stability and Control -, McGraw Hill, 1994.
4. Steven stoft: Power System Economics-Designing Markets for Electricity, IEEE Press and Wiley – Interscience -2002.

Reference Books:

1. R.N.Dhar : Computer-Aided Power Systems Operation and Analysis, Tata McGraw Hill, 1982.
2. L.P.Singh: Advanced Power System Analysis and Dynamics, Wiley Eastern Ltd. 1986.

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V	Honors Engineering Courses (Power Systems)	L	T	P	C
		3	0	0	3
Advanced Power Systems Protection					

Pre-requisite: Basic Concepts of Power Electronics, Electronic circuits, and Power Systems.

Course Objectives:

- To analyze the static relay components and understand the role of components in static relay operation.
- To understand the fundamentals of amplitude and phase comparators and study the different types of comparators and apply comparator techniques in static relays.
- To explore the different types of static relays and understand the working mechanisms of each type in power system protection.
- To explain the importance and working principles of Pilot Relaying Schemes and study the various pilot relaying methods.
- To study the working of microprocessor-based relays and numerical relays and analyze the architecture and components of numerical relays

Course Outcomes: At the end of the course, student will be able to

CO1: Understand the fundamentals of static relays and analyze the working of static relay components.
CO2: Analyze and compare the operation of comparators and select suitable comparator techniques.
CO3: Explain the principles of static over current relays and apply in power system protection.
CO4: Apply pilot relaying in power system protection and evaluate the performance of pilot relaying schemes.
CO5: Illustrate the microprocessor and numerical relay protection

UNIT – I

Static Relays classification and Tools: Comparison of Static with Electromagnetic Relays, Basic classification, Level detectors and Amplitude and phase Comparators – Duality – Basic Tools – Schmitt Trigger Circuit, Multivibrators, Square wave Generation – Polarity detector – Zero crossing detector – Thyristor and UJT Triggering Circuits. Phase sequence Filters – Speed and reliability of static relays.

UNIT – II

Amplitude and Phase Comparators (2 Input): Generalized equations for Amplitude and Phase comparison – Derivation of different characteristics of relays – Rectifier Bridge circulating and opposed voltage type amplitude comparators – Averaging & phase splitting type amplitude comparators – Principle of sampling comparators.

Phase Comparison: Block Spike and phase Splitting Techniques – Transistor Integrating type, phase comparison, Rectifier Bridge Type Comparison – Vector product devices.

UNIT – III

Static over current (OC) relays – Instantaneous, Definite time, Inverse time OC Relays, static distance relays, static directional relays, static differential relays, measurement of sequence impedances in distance relays, multi input comparators, elliptic & hyperbolic characteristics, switched distance schemes, Impedance characteristics during Faults and Power Swings.

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UNIT – IV

Pilot Relaying Schemes: Wire Pilot Protection: Circulating current scheme – Balanced voltage scheme – Transley scheme – Half-wave comparison scheme - Carrier Current Protection Schemes, relative merits & demerits: Phase comparison protection – Carrier aided distance protection – transfer scheme, blocking scheme and acceleration scheme.

UNIT – V

Microprocessor based relays and Numerical Protection: Over current relays – impedance relay – directional relay – reactance relay.

Numerical Protection: Numerical relay - numerical relaying algorithms - mann-morrison technique - Differential equation technique and discrete fourier transform technique - numerical over current protection - numerical distance protection.

Text Books:

1. Power System Protection with Static Relays – by TSM Rao, TMH.
2. Power system protection & switchgear by Badri Ram & D N Viswakarma, TMH.

Reference Books:

1. Protective Relaying Vol-II Warrington, Springer.
2. Art & Science of Protective Relaying - C R Mason, Willey.
3. Power System Stability KimbarkVol-II, Willey.
4. Electrical Power System Protection –C.Christopoulos and A.Wright- Springer
5. Protection & Switchgear –Bhavesh Bhalaja, R.PMaheshwari, NileshG.Chothani-Oxford publisher

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VI	Honors Engineering Courses (Power Systems)	L	T	P	C
		3	0	0	3
Grid Integration of Renewable Energy Sources					

Pre-requisite: Fundamentals of Electrical Engineering, Power systems, Power Electronics

Course Objectives:
The objectives of this course is to acquire knowledge on the

- operation and control on the issues related to the integration of distributed renewable generation into the network.
- power system equipment's used for integration.
- power quality and its management along with approaches for grid stabilization.
- interpret grid stabilization scheduling and dispatch
- deep understanding about integration techniques for RE sources.

Course Outcomes:
After the completion of the course the student should be able to:

- explain operation and control on the issues related to the integration of distributed renewable generation into the network.
- analysis of stability in power system integration using synchronous generators and induction generators.
- determine challenges and issues in integration of renewable sources
- interpret the load scheduling and dispatch
- analysis of ac and dc integration techniques for multiple resources.

UNIT I
Introduction
Various techniques of utilizing power from renewable energy sources, concept of nano/micro/mini grid. Need of integrating large renewable energy sources, issues related to integration of large renewable energy sources, rooftop plants. Concept of VPP.

UNIT II
Power system equipment for grid integration
Synchronization/integration to existing grid, load sharing during parallel operation, stability (swing equation and solution) Induction Generator: working principle, classification, stability due to variable speed and counter measures Power Electronics: need of power electronic equipments in grid integration, converter, inverter, chopper, ac regulator and cyclo converters for AC/DC conversion.

UNIT III
Power quality and management
THD, voltage sag, voltage swell, frequency change and its effects, network voltage management, frequency management, system protection, grid codes.

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UNIT IV
Grid stabilization
Scheduling and dispatch, Forecasting, reactive power and voltage control, frequency control, operating reserve, storage systems, electric vehicles Ancillary services in Indian Electricity Market (regulatory aspect), CERC and CEA orders (technical and safety standards)

UNIT V
Integration of alternate sources of energy
Introduction, principles of power injection: converting technologies, power flow; instantaneous active and reactive power control approach; integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection

Text Books:

1. Integration of Alternative sources of Energy, Felix A. Farret and M. Godoy Simoes, IEEE Press – Wiley Interscience publication, 2006.
2. Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P.Kothari, CRC Press (Taylor & Francis group), 2017
3. Renewable Energy Grid Integration, Marco H. Balderas, Nova Science Publishers, New York, 2009.
4. Wind Power Integration connection and system operational aspects, B. Fox, D. Flynn L. Bryans, N. Jenkins, M. O' Malley, R. Watson and D. Milborrow, IET Power and Energy Series 50 (IET digital library), 2007

Reference Books:

1. Power Generation, Operation, and Control, Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé, John Wiley & Sons, New York, 2013 (3rd edition)
2. Power Electronics: Circuits, Devices, and Applications. M.H.Rashid, Pearson Education India, 2013
3. Advanced power system analysis and dynamics, L.P.Singh, New age international publishers, 2017

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VII	Honors Engineering Courses (Power Systems)	L	T	P	C
		3	0	0	3
AI applications in Power Systems					

Pre-requisites:

Fundamentals of Power systems, Artificial Intelligence, Optimization Techniques

Course Objectives:

- Understand the fundamentals of Artificial Neural Networks (ANN), including key terminologies, neuron models, activation functions, and learning strategies.
- Explore and apply advanced ANN paradigms such as Back Propagation, Radial Basis Function networks, and Kohonen's Self-Organizing Maps.
- Study classical and fuzzy sets, their properties, operations, and applications in handling uncertainty and decision-making.
- Design and implement Fuzzy Logic Controllers (FLC) for control systems using fuzzification, inference, and defuzzification techniques.
- Apply AI techniques like back propagation and fuzzy logic in real-world applications, such as load forecasting and load frequency control in power systems.

Course Outcomes: At the end of the course, student will be able to

- Describe the fundamental concepts and components involved in the functioning of ANN and Fuzzy Logic systems.
- Explain the functionality of different ANN models (e.g., perceptron, backpropagation) and fuzzy set operations.
- Apply ANN algorithms and fuzzy logic techniques to solve practical problems like load forecasting and control systems.
- Analyze the performance and limitations of various ANN models and fuzzy controllers in different applications.
- Design and implement ANN-based solutions and fuzzy logic controllers for engineering applications, such as power system control and frequency regulation.

UNIT– I

Introduction

Artificial Neural Networks (ANN) – Humans and computers – Biological Neural Networks – ANN Terminology – Models of Artificial neuron – activation functions –typical architectures – biases and thresholds – learning strategy (supervised, unsupervised and reinforced) learning rules, perceptron training and classification using Discrete and Continuous perceptron algorithms, limitations and applications of perceptron training algorithm– linear separability and non-separability with examples.

UNIT– II

ANN Paradigms

Generalized delta rule – Back Propagation algorithm- Radial Basis Function (RBF) network. Kohonen's self-organizing feature map (KSOFM), Learning Vector Quantization (LVQ) – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

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UNIT– III
Classical and Fuzzy Sets
Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT– IV
Fuzzy Logic Controller (FLC)
Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision-making system), Defuzzification methods.

UNIT– V
Application of AI Techniques
Load forecasting using back propagation algorithm –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

Reference Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by RajasekharanandPai – PHI Publication.
2. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam,SSumathi,S N Deepa TMGH.
3. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam,SSumathi,S N Deepa Springer, 2007.

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VIII	Honors Engineering Courses (Power Systems)	L	T	P	C
		0	0	3	1.5
Power Systems Lab					

Course Objectives:

- To Understand and determine sequence impedances of an alternator using direct methods and fault analysis techniques, including the application of sequence voltages.
- To Measure sequence impedance of three-phase transformers, analyze poly-phase connections of single-phase transformers, and determine the equivalent circuit of a three-winding transformer.
- To Study the Ferranti effect, measure ABCD parameters, and evaluate the performance of long transmission lines with and without compensation, including shunt and reactor compensation techniques.
- To determine differential and percentage bias relay operations, analyze overcurrent relay characteristics, and understand relay-based protection schemes for generators and transformers.
- To Apply theoretical concepts to practical scenarios, conduct experiments to measure system parameters, and analyze the impact of different protection and compensation techniques on power system performance.

Course Outcomes:

After the completion of the course, the student should be able to:

CO 1: Calculate the sequence impedances of the synchronous machine.
CO 2: Calculate the sequence impedances and explain the connections of the transformer.
CO 3: Describe the Ferranti effect and compensation in transmission lines.
CO 4: Analyze the performance and importance of transmission line parameters.
CO 5: Analyze the operation of various protection relays.

List of experiments

Any 10 of the following experiments are to be conducted:

1. Determination of Sequence Impendences of an Alternator by direct method.
2. Determination of Sequence impedances of an Alternator by fault Analysis.
3. Measurement of sequence impedance of a three-phase transformer
    a) By application of sequence voltage.
    b) Using fault analysis.
4. Poly-phase connection on three single phase transformers and measurement of phase angle.
5. Determination of equivalent circuit of 3-winding Transformer.
6. Study of Ferranti effect in long transmission line.
7. Measurement of ABCD parameters on transmission line.
8. Performance of medium transmission line with and without compensation
9. Performance of long transmission line with and without compensation.
10. To determine and verify the reactor compensation of transmission line.
11. Performance of long transmission line with shunt compensation.
12. To study the differential and percentage bias integrated relay operations.
13. Performance characteristics of Over current relay
14. To study the protection of generator and transformer.

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IX	Honors Engineering Courses (Power Systems)	L	T	P	C
		0	0	3	1.5
Advanced Power Systems Simulation Lab					

Course Objectives:

- To utilize advanced analytical and computational approaches to evaluate and enhance the stability of multi-machine power systems.
- To apply optimal power flow techniques to improve system efficiency and analyze unit commitment strategies for cost-effective power generation.
- To conduct load flow studies and assess contingency scenarios to ensure the reliability and resilience of power systems.
- To implement state estimation techniques and power quality improvement strategies to maintain system reliability and performance.
- To analyze the stability of Single Machine Infinite Bus (SMIB) systems under different conditions, with and without controllers, to improve system dynamics.

Course Outcomes:

After the completion of the course the student should be able to:

CO 1: Analyze the multi machine stability by advanced approaches.
CO 2: Calculate optimal power flows and analyze unit commitment by optimal methods.
CO 3: Analyze the load flow and contingency cases of power systems
CO 4: Illustrate the state estimations and power quality improvements
CO 5: Analyze the stability of SMIB with and without controllers

List of experiments

Any 10 of the following experiments are to be conducted:

1. Multi Machine Transient stability using modified Euler's method.
2. Multi Machine Transient stability using R-K 2nd order method.
3. Optimal Power Flow using Newton's method.
4. Unit Commitment using dynamic programming.
5. Optimal Power Flow using Genetic Algorithm.
6. Distribution system load flow solution using Forward-Backward sweep Method.
7. Contingency analysis of a Power System
8. State estimation of a power system using Weighted Least Squares Error Method
9. Stability Analysis of SMIB using State space approach without PSS controller
10. Stability Analysis of SMIB using State space approach with PSS controller
11. Power Quality improvement using D-STATCOM
12. Power Quality improvement using TSC and TSR

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X	Honors Engineering Courses (Power Systems)	L	T	P	C
		0	0	3	1.5
Renewable Energy Technologies Laboratory					

Course Objectives:

- **To understand Solar PV Characteristics** by developing and analyzing the mathematical model of a solar PV cell and study its characteristics under different operating conditions.
- To **evaluate PV Cell Combinations** by investigating the performance of solar PV modules in series and parallel configurations by analyzing their I-V and P-V characteristics.
- To **explore Power Electronic Converters** by examining the role of different power electronic converters in optimizing the performance of PV systems and improving energy conversion efficiency.
- To **implement MPPT Algorithms** by demonstrating the significance of Maximum Power Point Tracking (MPPT) algorithms to enhance the efficiency of solar PV systems.
- To a**nalyze Wind Energy Generation** – Study the working principles of wind turbines, analyze wind turbine performance curves, and evaluate power generation characteristics.
- To **model Uninterrupted Power Supply (UPS)** by designing and analyzing of an Uninterrupted Power Supply (UPS) system to ensure continuous power delivery in renewable energy applications.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Analyze the mathematical model and understand its solar PV cell characteristics.
CO2: Demonstrate the effect of series and parallel combination of PV cells by I-V and P-V curves.
CO3: Analyze the effect of suitable power electronic converters for PV system.
CO4: Demonstrate the significance of various MPPT algorithms on PV System.
CO5: Demonstrate wind power generation and wind turbine curves.
CO6: Analyze the model of Uninterrupted Power Supply.

List of experiments

Any 10 of the following experiments are to be conducted:

Software Based Experiments:

1. Simulate the Mathematical Model of a PV cell using Single Diode model and Two Diode model equivalent circuits.
2. Simulate the performance curves (I-V & P-V) of a Solar cell and their variation with change in temperature and irradiation.
3. Simulate the performance curves (I-V & P-V) for PV modules connect in series and their variation with temperature and irradiation.
4. Simulate the performance curves (I-V & P-V) for PV modules connect in parallel and their variation with temperature and irradiation.
5. Simulate the performance curves (I-V & P-V) for the effect of varying the series resistance on the fill factor of the PV cell.

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6. Simulate the Buck-Boost Converter with Closed Loop control.
7. Simulate the Maximum Power Point tracking of PV module using INC Algorithm.
8. Simulate the Maximum Power Point tracking of PV module using P & O Algorithm.
9. Simulate the Wind Power Plant model.
10. Simulate the Uninterrupted Power Supply model.

Hardware Based Experiments

Using Solar PV Training System:

11. Single PV module I-V and P-V characteristics with radiation and temperature changing effect.
12. I-V and P-V characteristics with series and parallel combination of modules.
13. Effect of shading on PV Module.
14. Effect of tilt angle on PV Module.
15. Demonstration of bypass and blocking diode on a PV Module.

Using Wind Energy Training System:

16. Evaluation of cut-in speed of wind turbine.
17. Evaluation of Tip Speed Ratio (TSR) at different wind speeds.
18. Evaluation of Coefficient of performance of wind turbine.
19. Characteristics of turbine (power variation) with wind speed.
20. Power curve of turbine with respect to the rotational speed of rotor at fix wind speeds.
21. Power analysis at turbine output with AC load for a Wind Energy System.

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XI	Honors Engineering Courses (Power Electronics)	L	T	P	C
		3	0	0	3
Special Electrical Machines					

Pre-requisite:
Basic knowledge on magnetic circuits and electrical machines.

Course Objective:
- To describe the operation and characteristics of permanent magnet dc motor.
- To understand the performance and control of stepper motors, and their applications.
- To explain operation and control of switched reluctance motor.
- To distinguish between brush dc motor and brush less dc motor**.**
- To explain the theory of travelling magnetic field and applications of linear motors.

Course Outcomes:
After the completion of the course the student should be able to:
- Demonstrate the merits of PM motors.
- Choose best control scheme for stepper motors.
- Construct the various converter circuits for Switched Reluctance Motors.
- Analyse the characteristics of Brushless dc Motor.
- Understand the applications and operation of Linear Induction Motors.

UNIT - I
Permanent Magnet Materials and PMDC motors
Introduction - classification of permanent magnet materials used in electrical machines - minor hysteresis loop and recoil line - Stator frames of conventional dc machines - Development of electronically commutated dc motor from conventional dc motor – Permanent magnet materials and characteristics - B-H loop and demagnetization characteristics-high temperature effects-reversible losses - Irreversible losses - Mechanical properties - handling and magnetization - Application of permanent magnets in motors - power density - operating temperature range - severity of operation duty- Hysteresis - Eddy current Motors.

UNIT - II
Stepper Motors
Principle of operation of Stepper Motor – Constructional details - Classification of stepper motors – Different configuration for switching the phase windings - Control circuits for stepper motors – Open loop and closed loop control of two-phase hybrid stepping motor.

UNIT - III
Switched Reluctance Motors
Construction and Principle of operation of Switched Reluctance Motor – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs.
Torque producing principle and torque expression – Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

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UNIT - IV

Permanent Magnet Brushless DC Motor

Principle of operation of BLDC motor - Types of constructions - Surface mounted and interior type permanent magnet BLDC Motors - Torque and EMF equations for Square wave & Sine wave for PMBLDC Motor – Torque - Speed characteristics of Square wave & Sine wave for PMBLDC Motor - Merits & demerits of Square wave & Sine wave for PMBLDC Motor - Performance and efficiency – Applications.

UNIT - V

Linear Induction Motors (LIM)

Construction– principle of operation – Double sided LIM from rotating type Induction Motor – Schematic of LIM drive for traction – Development of one-sided LIM with back iron - equivalent circuit of LIM.

Text Books:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special electrical Machines, K.Venkata Ratnam, University press, 2009, New Delhi.

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XII	Honors Engineering Courses (Power Electronics)	L	T	P	C
		3	0	0	3
Machine Modeling and Analysis					

Pre-requisites: Electrical Circuits and Electrical Machines

Course Objectives:

- To develop mathematical modeling of primitive machine & model the DC machines for steady state & transient analysis.
- To illustrate the phase/reference frame transformations and Develop mathematical modeling of three phase induction motor.
- To interpret the knowledge of reference frame theory and obtain d-q axis modeling of induction motors in different reference frames.
- To distinguish different inductances of a synchronous motor and obtain synchronous motor modeling in the rotor's dq0 reference frame.
- To develop the mathematical models of special electrical machines.

Course Outcomes:

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

- Develop mathematical modeling of primitive machine & model the DC machines for steady state & transient analysis.
- Illustrate the phase/reference frame transformations and Develop mathematical modeling of three phase induction motor.
- Interpret the knowledge of reference frame theory and obtain d-q axis modeling of induction motors in different reference frames.
- Distinguish different inductances of a synchronous motor and obtain synchronous motor modeling in the rotor's dq0 reference frame.
- Develop the mathematical models of special electrical machines.

UNIT– I

Basic Concepts of Modeling & DC Machine Modeling

Basic two-pole D.C. machine - Primitive 2-axis machine – Voltage and Current relationship – Torque equation. Mathematical model of separately excited D.C. motor and D.C. Series motor in state variable form – Mathematical model of D.C. shunt motor and D.C. Compound motor in state variable form, Steady state analysis – Transient state analysis, Transfer function of the D.C. motor, Sudden application of inertia load.

UNIT– II

Reference Frame Theory & 3-phase Induction Motor dq model

Linear transformation – Phase transformation (abc to $\alpha\beta0$) – Power equivalence, Active transformation ($\alpha\beta0$ to dq0), transformations in complex plane, Commonly used reference frames and transformation between reference frames, Circuit model of a 3 phase Induction motor – Flux linkage equation – dq transformation of flux linkages in the complex plane – voltage equations

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UNIT– III
Modeling of 3-phase Induction motor in various reference frames
Voltage equation transformation to a synchronous reference frame, dq model of induction motor in the stator reference frame, rotor reference frame and arbitrary reference frame, power equation, electromagnetic torque equation, state space model in induction motor with flux linkages as variables and current-flux variables

UNIT– IV
Modeling of 3-phase Synchronous Motor
Synchronous machine inductances – Circuits model of a 3-phase synchronous motor – derivation of voltage equations in the rotor's dq0 reference frame electromagnetic torque – State space model with flux linkages as variables.

UNIT– V
Special Machines
Modeling of Squirrel Cage Induction Machine, Modeling of DFIG, Modeling of Permanent Magnet Synchronous motor – Modeling of Brushless DC Motor, Analysis of Switch Reluctance Motors.

Text Books
1. Generalized theory of Electrical Machines - Fifth edition, Khanna Publishers P. S. Bimbhra, 1985.
2. AC Motor control and electric vehicle applications – Kwang Hee Nam – CRC press, Taylor & Francis Group, 2010
3. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press- Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013.

Reference Books:
1. Electric Motor Drives - Modeling, Analysis& control - R. Krishnan- Pearson Publications-1st edition -2002.
2. Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications - R.Krishnan , CRC Press, Year: 2001
3. Dynamic simulation of Electric machinery using Matlab / Simulink –Chee Mun Ong- Prentice Hall, 2003.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106023/

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XIII	Honors Engineering Courses (Power Electronics)	L	T	P	C
		3	0	0	3
Power Electronic Converters					

Pre-requisite: Power Electronics

Course Objectives:

- To learn the characteristics of switching devices and use of gate driver circuits
- To understand the need of isolation and analyse the performance of different isolated switch mode converters
- To learn the working of different multilevel inverters and understand their merits and demerits
- To apply PWM techniques for controlling fundamental voltage and mitigate harmonics in inverters

Course Outcomes: After the completion of the course the student should be able to

- Illustrate the characteristics of Switching devices and use gate drive circuits. Illustrate the operation of multilevel inverters and compare their features.
- Analyze the performance of isolated switch mode converters.
- Investigate the PWM Control of single-phase and three-phase inverters and compare various PWM techniques.
- Investigate the PWM Control of CHB and diode clamped multilevel inverters.

UNIT– I
Overview of Switching Devices
Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.

UNIT– II
Isolated DC-DC Converters
Need for isolated converters, Forward converter, forward converter with demagnetizing winding, flyback converter, push-pull converter, half-bridge converter, full bridge converter, flux walking capacitors in half-bridge and full-bridge converters.

UNIT– III
PWM Inverters
Voltage control of single-phase inverters employing phase displacement Control, Bipolar PWM, Unipolar PWM. Three-phase Voltage source inverters: Six stepped VSI operation-Voltage Control of Three-Phase Inverters employing Sinusoidal PWM, Third Harmonic PWM, Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters.

UNIT– IV
Multilevel Inverters
Introduction, Multilevel Concept, Types of Multilevel Inverters, Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode Clamped Inverter, Cascaded H-bridge Multilevel Inverter, Principle of Operation, Features of Cascaded H-bridge Inverter, Fault tolerant operation of CHB Inverter, Comparison of DCMLI & CHB, Modular multilevel converters, principle of operation.

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UNIT– V
PWM Multilevel Inverters
CHB Multilevel Inverter: Stair case modulation- Selective harmonic Elimination (SHE) PWM- Phase shifted Multicarrier Modulation-Level shifted PWM- Diode clamped Multilevel inverter: SHE PWM-Sinusoidal PWM- Space vector PWM-Capacitor voltage balancing.

Text Books

1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, ,William P. Robbins, John Wiley& Sons2nd Edition, 2003.
2. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint-2008.
3. High-power converters and AC drives -Wu, Bin, and Mehdi Narimani-John Wiley & Sons, 2017.

Reference Books:

1. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
2. Power Electronics Daniel W. Hart - McGraw-Hill, 2011.

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XIV	Honors Engineering Courses (Power Electronics)	L	T	P	C
		3	0	0	3
Power Electronics for Renewable Energy systems					

Pre-requisites:
Power Electronics, Electrical Machines Control Systems.

Course Objectives:
- To Illustrate the I-V characteristics of solar PV modules and use of blocking diodes and bypass diodes for shade mitigation
- To Understand MPPT, usage of power converters for PV and battery charging
- To Understand different Wind turbine technologies and converters for wind energy generation
- To Analyze PV and wind energy integrated systems

Course Outcomes: At the end of the course, student will be able to
- Illustrate the I-V characteristics of solar PV modules and use of blocking diodes and bypass diodes for shade mitigation
- Understand MPPT, usage of power converters for PV and battery charging
- Understand different Wind turbine technologies and converters for wind energy generation
- Analyze PV and wind energy integrated systems

UNIT – I
Solar spectrum, PV materials, Equivalent Circuit for PV cell, effect of series and shunt resistance, fill factor, Cells to Modules to Arrays, I–V Curves, standard test condition, Impacts of Temperature and Insolation on I–V curves, series and parallel connection of PV modules, Shading impacts on I–V curves, Bypass diodes and Blocking diodes for shade mitigation, I–V Curves for different loads.

UNIT – II
Perturb and observe MPPT method for solar PV inverter, Central inverters, String inverters, Micro inverters, leakage current issue, Transformer for leakage current elimination, Transformer less PV inverters. Battery charger, Characteristics of Batteries, Charge control, Battery charging using DC-DC converter, Dual Active Bridge converter for battery charging.

UNIT – III
Wind turbine technologies- horizontal axis and vertical axis turbines, power in the wind, wind turbine power curves, Betz limit ratio, advantages and disadvantages of wind energy system. Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Doubly Fed Induction Generator, Permanent Magnet Synchronous Generators and their characteristics.

UNIT – IV
Converters for wind generators: AC-DC-AC converters, matrix converters, multilevel converter, Maximum power point tracking for wind turbines, fault ride through capabilities.

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UNIT-V

Grid connection principle, Clarke's and Park's transformation, Grid connected photovoltaic system, Grid connected wind energy system, Filters, Grid synchronization & PLL, operation & control of hybrid energy systems, IEEE & IEC codes and standards for renewable energy grid integrations.

Text Books:

1. Renewable and Efficient Electric Power Systems, G. Masters, IEEE- John Wiley and Sons Ltd.
   Publishers, 2013, 2nd Edition.
2. Grid Converters for Photovoltaic and Wind Power Systems, Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Wiley, 2011, 2nd Edition.
3. Integration and Control of Renewable Energy in Electric Power System, Ali Keyhani Mohammad Marwali and Min Dai, John Wiley publishing company, 2010, 2nd Edition.

Reference Books:

1. Solar Photovoltaic: Fundamentals, technologies & Applications, C. S. Solanki, PHI Publishers, 2019.
2. Integration of Renewable Sources of Energy, F. A. Farret, M. G. Simoes, Wiley, 2017, 2nd Edition.

Online resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee71/preview

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XV	Honors Engineering Courses (Power Electronics)	L	T	P	C
		3	0	0	3
Industrial Applications of Power Electronic Converters					

Pre-requisites: Electrical Circuits and Power Electronics

Course Objectives:

- To analyze and design inverters for Induction Heating applications
- To analyze and design converters for Lighting, pumping and refrigeration Systems
- To analyze and design converters for High voltage power supplies
- To develop improved power converters for Low voltage High current applications
- To analyze and design Bi-directional converters for charge/discharge applications

Course Outcomes:

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

- Analyze and design inverters for Induction Heating applications
- Analyze and design converters for Lighting, pumping and refrigeration Systems
- Analyze and design converters for High voltage power supplies
- Develop improved power converters for Low voltage High current applications
- Analyze and design Bi-directional converters for charge/discharge applications

UNIT– I

Inverters for Induction Heating:

Inverters for induction cooking, induction hardening, melting, and welding applications.

UNIT– II

Power Converters for Lighting, pumping and refrigeration Systems

Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration Applications.

UNIT– III

High Voltage Power Supplies

Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications.

UNIT– IV

Low Voltage High Current Power Supplies

Power converters for modern microprocessor and computer loads.

UNIT– V

Bi-directional DC-DC (BDC) converters

Electric traction, Automotive Electronics, Battery charging converters, UPS and its applications, Line Conditioners and Solar Charge Controllers, Solar PV tracking.

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Text Books:

1. Switching Power Supply Design, Abraham I. Pressman, Keith Billings &Taylor Morey, McGraw Hill International, 2009, 3rd Edition.
2. Uninterruptible Power Supplies and Active Filters, Ali Emadi, A. Nasiri, and S. B. Bekiarov, CRC Press, 2005, 1st Edition.

Reference Books:

1. Hand book of Induction Heating, Valery Rudnev, Don Loveless, Raymond L. Cook, CRC Press, 2017, 2nd Edition.
2. Power Supplies for LED Driving, Steve Winder, Newnes, 2016, 2nd Edition.
3. Understanding Automotive Electronics: An Engineering Perspective, William Ribbens, Butterworth-Heinemann, 2017, 8th Edition.
4. Modern Electric, Hybrid Electric and Fuel Cell Vehicles, M. Ehsani, Yimin Gao, Stefano Longo, K Ebrahimi, CRC Press, 2018, 3rd Edition.

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XVI	Honors Engineering Courses (Power Electronics)	L	T	P	C
		3	0	0	3
Advanced Electrical Drives					

Pre-requisite: Knowledge of Power Electronics, Electrical Machines and Control Systems

Course Objectives:

- To Provide a fundamental understanding of scalar and vector control principles in induction motor drives.
- To Explore direct torque control (DTC) strategies and their applications in motor drives.
- To Examine control techniques for synchronous motor drives, emphasizing performance optimization.
- To Introduce switched reluctance motor (SRM) control strategies, including sensorless operation and torque regulation.
- To Cover the principles and control methods for brushless DC (BLDC) motor drives, ensuring effective operation.

Course Outcomes: After the completion of the course, student will be able to

CO1: Understand the concepts of scalar and vector control methods for drive systems.
CO2: Select and implement proper control techniques for induction motor and Synchronous motor for specific applications.
CO3: Analyze and design control techniques and converters for SRM drives
CO4: Analyze and design controllers and converters for BLDC drives.

Unit I
Vector Control of Induction Motor Drives
Principles of scalar and vector control, principle of direct vector control, indirect vector control, implementation-block diagram; estimation of flux, flux weakening operation.

UNIT-II
Direct Torque Control of Induction Motor Drives
Principle of Direct torque control (DTC), concept of space vectors, DTC control strategy of induction motor, comparison between vector control and DTC, applications, space vector modulation-based DTC of induction motors.

Unit III
Control of Synchronous Motor Drives
Synchronous motor and its characteristics- Control Strategies-Constant torque angle control- power factor control, constant flux control, flux weakening operation, load commutated inverter fed synchronous motor drive, motoring and regeneration, phasor diagrams.

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Unit-IV
Control of Switched Reluctance Motor Drives
SRM Structure-Stator Excitation-techniques of sensor less operation-convertor topologies-SRM Waveforms-SRM drive design factors-Torque controlled SRM-Torque Ripple-Instantaneous Torque control -using current controllers-flux controllers.

Unit-V
Control of BLDC Motor Drives
Principle of operation of BLDC Machine, Sensing and logic switching scheme, BLDM as Variable Speed Synchronous motor-methods of reducing Torque pulsations -Three-phase full wave Brushless dc motor - Sinusoidal type of Brushless dc motor - current controlled Brushless dc motor Servo drive.

Text Books:
1. Bose B. K., "Power Electronics and Variable Frequency Drives", IEEE Press, Standard Publisher Distributors. 2001.
2. Krishnan R., "Electric Motor Drives – Modelling, Analysis and Control", Prentice Hall of India Private Limited.

Reference Books:
1. Switched Reluctance Motors and Their Control-T. J. E. Miller, Magna Physics, 1993.
2. Power electronic converters applications and design-Mohan, Undeland, Robbins-Wiley Publications
3. De Doncker, Rik W., Pulle, Duco W.J., Veltman, Andre, "Advanced Electrical Drives", Springer, 2020.
4. Ned Mohan, "Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink®", John Wiley & Sons, Inc, 2014.

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XVII	Honors Engineering Courses (Power Electronics)	L	T	P	C
		0	0	3	1.5
Power Converters Laboratory					

Course Objectives:

- To illustrate the working of single and three-phase full converters and semi-converters.
- To analyze the performance of Square-wave inverters and PWM inverters.
- To analyze the performance of DC-DC converters.
- To analyze the performance of three level NPC and Five level CHB inverters.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Illustrate the working of single and three-phase full converters and semi-converters
CO2: Analyze the performance of Square-wave inverters and PWM inverters
CO3: Analyze the performance of DC-DC converters
CO4: Analyze the performance of Three level NPC and Five level CHB inverters

List of experiments

Any 10 of the following experiments are to be conducted:

1. Analysis of single-phase half-controlled bridge rectifier
2. Analysis of three-phase fully controlled rectifier.
3. Analysis of single-phase square wave inverter.
4. Analysis of three-phase inverter for 120º mode of conduction.
5. Analysis of three-phase inverter for 180º mode of conduction.
6. Analysis of single-phase inverter with unipolar PWM switching.
7. Analysis of single-phase inverter with bipolar PWM switching.
8. Analysis of three-phase inverter for Sine-PWM method.
9. Analysis of three-phase inverter with SVPWM method.
10. Analysis of Buck DC-DC converter.
11. Analysis of Boost DC-DC converter.
12. Analysis of Buck-Boost DC-DC converter.
13. Analysis of Sine-PWM technique for 3-phase 3-level NPC inverter.
14. Analysis of single-phase 5-level cascaded H-bridge inverter with staircase modulation.
15. Analysis of Phase shift PWM techniques for 3-phase 5-level cascaded H-bridge inverter.
16. Analysis of Level shift PWM techniques for 3-phase 5-level cascaded H-bridge inverter.

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XVIII	Honors Engineering Courses (Power Electronics)	L	T	P	C
		0	0	3	1.5
Electric Drives Laboratory					

Course Objectives:

- Understand motor speed control techniques using various methods and controllers.
- Analyze and simulate different motor drives under varying load conditions.
- Implement open and closed-loop control strategies for different motor types.
- Study braking and converter systems for improved motor performance.

Course Outcomes:
After the completion of the course the student should be able to:
CO1: Apply speed control methods for various types of motors.
CO2: Design and simulate motor drives for different applications.
CO3: Implement control techniques to optimize motor efficiency.
CO4: Evaluate braking and converter operations for motor drives.

List of experiments

Any 10 of the following experiments are to be conducted:

1. Speed control of three phase slipring motor using static rotor resistance control through rectifier and chopper circuit.
2. Design and simulation of three phase induction motor for different load condition.
3. V / f Control or Frequency Control of Three phase Induction Motor.
4. Open loop and closed loop control of BLDC motor.
5. Open loop and closed loop control of dc motor.
6. To study speed control of single-phase induction motor using micro controller
7. To study speed control of three phase induction motor using micro controller
8. To study the dc braking of three phase induction motor using MATLAB SIMULINK.
9. To perform the speed control test on slip ring induction motor by rotor resistance control method USING VIRTUAL LAB
10. To perform speed control of DC motor by using Ward- Leonard Method of speed control USING VIRTUAL LAB.
11. Speed control of DC Motor using 3 Phase Fully controlled Bridge Converter.
12. To Study Closed Loop Speed control of 4 quadrants DC motor drive.

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XIX	Honors Engineering Courses (Power Electronics)	L	T	P	C
		0	0	3	1.5
Electric Vehicles Laboratory					

Course Objectives:

- To simulate Power Converters for EVs by analyzing and implementing isolated and non-isolated DC-DC converters for electric vehicle applications using simulation tools.
- To evaluate Motor Control Strategies by Studying and simulating advanced motor control techniques such as Field-Oriented Control (FOC), Direct Torque Control (DTC), and closed-loop control for different EV propulsion motors.
- To design and analyze EV Battery Systems by developing and fabricating a Li-ion battery pack for EV applications and perform controlled charging and discharging experiments.
- To implement Hardware-Based Motor Control with Operation of induction motor and analyze its performance using V/F control and four-quadrant operation modes for EV applications.
- To assess EV System Performance by measuring and analyzing key parameters such as voltage, current, speed, torque, and power flow in propulsion systems under different operating conditions.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Simulate and analyze the performance of isolated and non-isolated DC-DC converters for electric vehicle applications.

CO2: Implement and evaluate field-oriented and direct torque control (DTC) strategies for induction motor drives in EVs.

CO3: Design and simulate a closed-loop control system for switched reluctance motor (SRM) and BLDC motor drives for EV applications.

CO4: Construct and analyze a Li-ion battery pack (48V/72V, 3/5 kWh) and study its charging and discharging characteristics.

CO5: Perform real-time analysis of propulsion motor speed, voltage, current, and power using throttle control.

CO6: Demonstrate V/F control of induction motors and study the four-quadrant operation of propulsion motors, including motoring and braking modes.

List of experiments

Any 10 of the following experiments are to be conducted:

Software Based Experiments:

1. Simulation of isolated and non-isolated DC-DC converters for EV application.
2. Simulation of Field oriented/DTC controlled Induction Motor drive for EV application.
3. Simulation of Closed loop control of SRM drive for electric vehicle application.
4. Simulation of Field oriented control of PMSM for electric vehicle application.
5. Simulation of closed loop control of BLDC motor drive for electric vehicle application.

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Hardware Based Experiments

6. Running the propulsion motor by throttle paddle and analyze the speed, voltage, current, power of the system.
7. Design and fabrication of 48V/72V, 3/5 kWh Li-ion battery pack.
8. Constant current mode of charging/discharging of EV Battery.
9. V/F Control of Induction motor drive for electric vehicle application.
10. Study of four quadrant operation of propulsion motor and analyse all the parameters like voltage, current, speed, toque, and power flow.
    a) Forward motoring mode
    b) Forward braking mode
    c) Reverse motoring mode
    d) Reverse braking mode

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XX	Honors Engineering Courses (Control Systems)	L	T	P	C
		3	0	0	3
Discrete Control Systems					

Course Objectives:
The objectives of this course is to acquire knowledge on

- elements of estimation for a dynamic model
- analysis of parameter estimation for large scale systems
- model reduction techniques and error minimization
- simplification using frequency domain techniques
- analysis of block-diagonalization of continuous systems

Course Outcomes:
After the completion of the course the student should be able to:

- apply estimation for a dynamic model in large scale systems
- analyse parameter estimation for large scale systems
- design model reduction techniques and error minimization
- analyse large scale systems using frequency domain techniques
- design block-diagonalization of continuous systems

UNIT I
Modelling and parameter estimation
Introduction to probability theory, elements of estimation theory, application to parameter estimation for a dynamical model, some methods for the determination of transfer functions.

UNIT II
Parameter estimation for large scale systems
Hierarchical parameter estimation, the multiple projection approach, recursive algorithm for the minimum variance estimator Aggregation of control systems, problem statement, properties of the aggregated system matrix, determination of the Aggregation matrix; Generation of feedback controls: linear dynamic optimization, bounds on sub optimality, eigenvalue assignment.

UNIT III
Model reduction techniques
Model analysis approach, mathematical development, three basic methods, and a general approach. Subspace projection methods, projection error minimization, and derivation of reduced model. Optimal order reduction, problem formulation, conditions of optimality, numerical algorithm, polynomial input functions. A comparative study. Extension to discrete systems, preliminary analysis, two model reduction techniques, output error minimization. Examples.

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UNIT IV
Model simplification using frequency domain techniques
Simplification by continued function expansions: three Cauer forms, a generalized Routh algorithm, simplified models, relationship to aggregation, and extension to discrete models; Approximation methods for simplification: time moment matching, Routh-Hurwitz method. Minimal realization algorithms: conditions of reliability, aggregated model of Routh approximants

UNIT V
Scale Analysis Block-Diagonalization of Continuous Systems Problem statement, numerical algorithms, basic properties, relation to model aggregation. Feedback control design: two stage eigenvalue placements. Decoupling of discrete systems: state feedback design.

Text Books:

1. Magdi S. Mahmoud and Madan G. Singh – "Large scale systems modeling", Pergamon press, Oxford.
2. Lan Lunze – "Feedback control of Large-scale system s", Prentice Hall International, NewYork.

Reference Books:

1. Magdi S. Mahmoud, Mohamed F. Hassan, Mohamed G. Darwish- "Large scale control systems - Theories and Techniques", Marcel Dekkar, Inc, New Y ork and Basel.
2. Andrew P. Sage, "Methodology for large-scale systems", McGraw-Hill, 1977
3. Efficient Modeling and Control of Large-Scale Systems, edited by Javad Mohammad pour, and Karolos M., Springer, 2010.

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XXI	Honors Engineering Courses (Control Systems)	L	T	P	C
		3	0	0	3
Process Dynamic and Control					

Course Objectives:
The objectives of this course is to acquire knowledge on
- classification and understand process control.
- dynamic behaviours and responses of different processes.
- feedback controllers and responses of control system instrumentation.
- design and analysis of dynamic system.
- design and different configurations of feedforward and ratio control.

Course Outcomes:
After the completion of the course the student should be able to:
- understand process control.
- Responses and behaviour of the system.
- understand the PID controllers and response of feedback system.
- Analyse closed loop system.
- Design the feedforward controller for dynamic models.

UNIT I
INTRODUCTION TO PROCESS CONTROL
Representative Process Control Problems, illustrative Example A Blending Process, Classification of Process Control Strategies, A More Complicated Example—A Distillation Column, The Hierarchy of Process Control Activities, An Overview of Control System Design

UNIT II
DYNAMIC BEHAVIOR OF PROCESSES
Laplace Transforms, Transfer Function Models, Properties of Transfer Functions, Linearization of Nonlinear Models, Dynamic Behaviour of First-Order and Second-Order Processes, Standard Process Inputs, Response of First-Order Processes, Response of Integrating Processes, Response of Second-Order Processes

UNIT III
FEEDBACK CONTROLLERS AND CONTROL SYSTEM INSTRUMENTATION
Introduction, Basic Control Modes, Features of PID Controllers, Digital Versions of PID Controllers, Typical Responses of Feedback Control Systems, On–Off Controllers, Sensors, Transmitters, and Transducers, Final Control Elements, Accuracy in Instrumentation.

UNIT IV
DYNAMIC BEHAVIOUR AND STABILITY OF CLOSED-LOOP CONTROL SYSTEMS
Block Diagram Representation, Closed-Loop Transfer Functions, Closed-Loop Responses of Simple Control Systems, Stability of Closed-Loop Control Systems, Root Locus Diagrams Frequency Response Analysis and Control System Design Sinusoidal Forcing of a First-Order Process, Sinusoidal Forcing of an n^{th}-Order Process, Bode Diagrams, Frequency Response Characteristics of Feedback Controllers, Bode Stability Criterion, Gain and Phase Margins

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UNIT V
FEED FORWARD AND RATIO CONTROL

Introduction to Feed forward Control, Ratio Control, feed forward Controller Design Based on Steady-State Models, Feed forward Controller Design Based on Dynamic Models, The Relationship Between the Steady State and Dynamic Design Methods, Configurations for Feed forward–Feedback Control, Tuning Feed forward Controllers.

Text Books:

1. Process Dynamics and Control, 2nd Edition By Dale E. Seborg, Thomas F. Edgar, and Duncan A.Mellichamp, Wiley, Hoboken, NJ, 2003, 736 pp.,
2. Coughnaowr, D. R., "Process Systems Analysis and Control", McGraw-Hill, Inc.
3. Stephanopolous, G., "Chemical Process Control", Prentice-Hall.

Reference Books:

1. P. Harriott, Process Control, Tata McGraw-Hill Publishing Co., Ltd.,New Delhi, 1984
2. A.Pollard, Process Control, Heinemann Educational Books, London,1981.
3. T. Webber, An Introduction to Process Dynamics and Control, JohnWiley & Sons, New York, 1973.
4. B.G. Liptak, Instrumentation in Processing Industries, Vol. II, Chilton Book Co., 1973.
5. Bequette, B. W., "Process Control: Modeling, Design, and Simulation", Prentice-Hall, Inc.
6. Chidambaram, M., "Computer Control of Processes" Narosa Publishing House Pvt. Ltd., Ind.
7. D.C. Sikdar," Instrumentation and Process Control", Khanna Book Publishing.

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XXII	Honors Engineering Courses (Control Systems)	L	T	P	C
		3	0	0	3
Optimal Control Theory					

Course Objectives:
The objectives of this course is to acquire knowledge on
- representation of state space system performance measures
- formulation of optimal control problem and linear regulator problems
- fundamentals and applications of calculus of variations
- optimal problems conditions and regulator problems
- applications of different numerical techniques of optimal controls

Course Outcomes:
After the completion of the course the student should be able to:
- apply state space analysis and optimal control problems.
- analyses the applications of dynamic programming and linear regulator problems.
- apply the calculus functional concepts to the system.
- assess the optimal control problems.
- Apply different numerical techniques for optimal control problems.

UNIT I
Introduction
Problem formulation- State variable representation of systems – Performance measures for optimal control problems – selecting a performance measure.

UNIT II
Dynamic programming
The optimal control law - principle of optimality and its application - optimal control system - interpolation - recurrence relation of dynamic programming-computational procedure for solving optimal control problems characteristics of dynamic programming solution-analytical results-discrete linear regulator problems- Hamilton- Jacobi-Bellman equation-continuous linear regulator problems Riccati Equation.

UNIT III
Calculus of variants:
Fundamental concepts- linearity of functional-closeness of functions-the increment of a functional-The variation of a functional- maxima and minima of functional- the fundamental theorem of the calculus of variations - Functional of a single function- the simplest variational problem

UNIT IV
Optimal control problems
Necessary conditions for optimal control - Linear regulator problem-Pontryagin's minimum principle and state inequality constraints.

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UNIT V

Iterative numerical techniques for finding optimal controls

Two-point boundary-value problems-The method of steepest descent-Features of the steepest descent algorithm.

Text Books:

1. Optimal control theory-An Introduction by Donald E.Kirk - Prentice Hall Networks series.
2. M. Gopal: Modern Control Systems Theory, Wiley Eastern Limited, New Delhi, 2005

Reference Books:

1. Katsuhiko Ogata: Modern control Engineering, Prentice-Hall of India, 2010
2. B.C.Kuo, Automatic control systems' (5th Edition), Prentice Hall of India, 1988.

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*Minor Engineering Courses offered by EEE Department for Other Branches (Except EEE Branch)
Need to Acquire 18 credits

S.No.	Course Code	Title	L	T	P	C
1		Concepts of Control Systems	3	0	0	3
2		Fundamentals of Electrical Measurements and Instrumentation	3	0	0	3
3		Concepts of Power System Engineering	3	0	0	3
4		Fundamentals of Power Electronics	3	0	0	3
5		Basics of Electric Drives and applications	3	0	0	3
6		Fundamentals of Utilization of Electrical Energy	3	0	0	3
7		Concepts of Renewable Energy Sources	3	0	0	3
8		EV Technologies	3	0	0	3
9		Basics of Electrical Machines	3	0	0	3

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I	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Concepts of Control Systems					

Pre-requisite:

Basic Engineering Mathematics

Course Objectives:

- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers.
- To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
- To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.
- To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
CO2: Determine time response specifications of second order systems and to determine error constants.
CO3: Analyze absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
CO4: Analyze the stability of LTI systems using frequency response methods.
CO5: Represent physical systems as state models and determine the response. Understanding the concepts of controllability and observability.

UNIT – I

Mathematical Modelling of Control Systems

Classification of control systems - open loop and closed loop control systems and their differences - transfer function of linear system - differential equations of electrical networks - translational and rotational mechanical systems – block diagram algebra – Feedback characteristics.

UNIT-II

Time Response Analysis

Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants – P, PI, PD & PID Controllers.

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UNIT–III
Stability and Root Locus Technique
The concept of stability – Routh-Hurwitz Criteria – limitations of Routh-Hurwitz criterion-Root locus concept – construction of root loci (simple problems).

UNIT–IV
Frequency Response Analysis
Introduction to frequency domain specifications – Bode diagrams – Transfer function from the Bode diagram – phase margin and gain margin.

UNIT–V
State Space Analysis of Linear Time Invariant (LTI) Systems
Concepts of state - state variables and state model - state space representation of transfer function - State Transition Matrix and it's properties.

Text Books:
1. Modern Control Engineering by Kotsuhiko Ogata - Prentice Hall of India.
2. Automatic control systems by Benjamin C.Kuo - Prentice Hall of India - 2nd Edition.

Reference Books:
1. Control Systems principles and design by M.Gopal - Tata Mc Graw Hill education Pvt Ltd. - 4th Edition.
2. Control Systems by Manik Dhanesh N - Cengage publications.
3. Control Systems Engineering by I.J.Nagarath and M.Gopal - Newage International Publications - 5th Edition.
4. Control Systems Engineering by S.Palani - Tata Mc Graw Hill Publications.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/107/106/107106081
2. https://archive.nptel.ac.in/courses/108/106/108106098
3. https://nptelvideos.com/video.php?id=1423&c=14

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II	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Fundamentals of Electrical Measurements and Instrumentation					

Pre-requisite:

Basics of Electrical and Electronics Engineering.

Course Objectives:

- Interpret the working principles of various analog measuring instruments.
- Understand the concepts behind power and energy measurement procedures.
- Calculate resistance, inductance, and capacitance using various bridges.
- Evaluate the importance of and understand the concepts of various transducers.
- Comprehend the types of digital meters and their functionalities.

Course Outcomes:

After completing the course, the student will be able to:

CO1: Choose the appropriate instrument for the measurement of AC and DC voltage and current.
CO2: Analyse the operation of wattmeters and energy meters.
CO3: Differentiate between the operations of AC and DC bridges.
CO4: Describe the working principles of various transducers.
CO5: Recognize the importance of digital meters and explain their working principles.

UNIT – I: Fundamentals of Analog Instruments

Analog Ammeter and Voltmeter: Classification of instruments – Deflecting, controlling, and damping torques. Types of Instruments: PMMC and Moving Iron type – Construction, working principle, advantages and disadvantages. Applications and simple numerical problems.

UNIT – II: Measurement of Power and Energy

Analog Wattmeter: Electrodynamometer type wattmeters – Low Power Factor (LPF) and Unity Power Factor (UPF) designs, advantages and disadvantages. Energy Meters: Induction type Energy Meter – Construction and working principle Simple numerical problems.

UNIT – III: Measurement of Electrical Parameters

DC Bridges: Measurement of resistance – Low (Kelvin's double bridge), medium (Wheatstone bridge), and high resistance (Loss of charge method), Megger and its uses.
AC Bridges: Measurement of inductance (Maxwell's Bridge) and capacitance (Schering Bridge), Numerical problems.

UNIT – IV: Transducers and Sensors

Classification of Transducers: Basics and applications. Resistive: Strain Gauge. Inductive: Linear Variable Differential Transformer (LVDT). Capacitive: Piezoelectric – Applications

UNIT – V: Introduction to Digital Instruments

Digital Instruments: Digital Voltmeters (Successive approximation type), Digital Frequency Meters and Multimeters, Digital Tachometers and Energy Meters, – Overview and applications.

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Text Books:

1. Electrical & Electronic Measuring Instruments by A.K.Sawhney, Dhanpat Rai & Co. Publications – 19th revised edition - 2011.
2. Electronic Instrumentation by H.S.Kalsi - THM.

Reference Books:

1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis - 5 th Edition - Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper - PHI - 5th Edition - 2002.
3. Electrical and Electronic Measurements and instrumentation by R.K.Rajput - S.Chand - 3rd edition.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105153

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III	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Concepts of Power System Engineering					

Pre-requisite: Basic Electrical Engineering

Course Objectives:

- To understand the types of electric power plants and their working principles.
- To understand the concepts of electric power transmission and distribution.
- To gain the knowledge of protection and grounding of power system components.
- To learn the economic aspects of electrical energy.
- To learn the importance of power factor improvement and voltage control.

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Know the concepts of power generation by various types of power plants.
CO2: Learn about short transmission line parameters and distribution systems schemes.
CO3: Learn about protection equipment and grounding methods of power system.
CO4: Calculate the tariff by applying the economic aspects of electrical energy.
CO5: Know the importance of power factor improvement and voltage control in power systems.

UNIT - I

Electrical power Generation Concepts & Types

Sources for Generation of Electrical Energy – working principle and Schematic diagram approaches of Thermal Power Plant – Hydro Power Plant - Nuclear Power Plant – Gas Power Plants – Comparison between Power Plants. Importance of Renewable energy sources.

UNIT - II

Transmission and Distribution Concepts

Types of Conductors Materials – Parameters of Transmission Line – Classification of Overhead Transmission Lines – Performance of Short Transmission Lines – Simple Problems.
Basic concepts of Sub Station – Distribution Systems – Connection Schemes of Distribution Systems – Structure of Cables – Differences between Overhead & Underground systems.

UNIT - III

Protection and Grounding

Types of Faults – Basic concepts of fuse – Circuit Breakers – Relays – SF_6 Circuit Breakers – Vacuum Circuit Breakers – Operation of Lightning Arrester – Grounding and its advantages - Methods of Neutral Grounding: Resistance - Reactance and Resonant Grounding (elementary approach only).

UNIT - IV

Economic Aspects

Definitions of Load – Load curves & Load Duration Curves - Load Factor - Demand Factor – Utilization Factor – Types of Tariff - Cost of Electrical Energy – Expression for Cost of Electrical Energy – Numerical Problems.

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UNIT - V

Power Factor Improvement and Voltage Control

Power Factor – Effects and Causes of low Power Factor- Shunt & Series Capacitor Compensation - Numerical Problems – Need of Voltage Control – Types of Voltage regulating Devices.

Text Books:

1. Principles of Power System, V K Mehta and Rohit Mehta, S.Chand Publishers, 2022.

Reference Books:

1. Electrical Power Systems, C.L.Wadhwa, New Age International Publishers, 2012.

Online Learning Resources:

1. https://nptel.ac.in/courses/108102047

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IV	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Fundamentals of Power Electronics					

Pre-requisite:
Basic concepts of Electrical and Electronic Circuits and Semiconductor Physics.

Course Objectives:
- To know the characteristics of various power semiconductor devices.
- To learn the operation of single phase full–wave converters.
- To learn the operation of three phase full–wave converters and AC/AC converters.
- To learn the operation of different types of DC-DC converters.
- To learn the operation of PWM inverters for voltage control.

Course Outcomes:
After the completion of the course the student should be able to:
CO1: Illustrate the static and dynamic characteristics of SCR - Power MOSFET and Power IGBT.
CO2: Analyse the operation of phase-controlled rectifiers.
CO3: Analyse the operation of Three-phase full–wave converters - AC Voltage Controllers.
CO4: Examine the operation and design of different types of DC-DC converters.
CO5: Analyse the operation of PWM inverters for voltage control.

UNIT – I
Power Semi-Conductor Devices
Power Diode – Characteristics – Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn-on Methods.
Static and Dynamic Characteristics of Power MOSFET and Power IGBT.

UNIT – II
Single-phase AC-DC Converters
Single-phase half wave-controlled rectifiers - R load and RL load with and without freewheeling diode - Single-phase fully controlled bridge converter with R load and RL load - Continuous conduction - Expression for output voltages – Single-phase Semi-Converter with R load and RL load – Continuous conduction.

UNIT – III
Three-phase AC-DC Converters & AC – AC Converters
Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage.
AC power control by phase control with R and RL loads - Expression for rms output voltage.

UNIT – IV
DC–DC Converters
Basic Chopper Operation with R and RL load – Step-up chopper –Classification of Choppers – Time Ratio Control –Current Limit Control.

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UNIT - V

DC–AC Converters

Introduction - Single-phase half bridge and full bridge inverters with R and RL loads – Voltage control of Single-phase inverters – PWM inverters - Sinusoidal Pulse Width Modulation.

Text Books:

1. Power Electronics – by P.S.Bhimbra - Khanna Publishers.
2. Power Electronics: Essentials & Applications by L.Umanand - Wiley - Pvt. Limited - India - 2009.

Reference Books:

1. Power Electronics: Converters - Applications and Design by Ned Mohan - Tore M Undeland - William P Robbins - John Wiley & Sons.
2. Power Electronics: Circuits - Devices and Applications – by M. H. Rashid - Prentice Hall of India - 2nd edition - 1998
3. Power Electronics: by Daniel W.Hart - Mc Graw Hill.

Online Learning Resources:

1. https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007
2. https://archive.nptel.ac.in/courses/108/101/108101126

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V	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Basics of Electric Drives and applications					

Pre-requisite:
Electrical Machines, Control Systems and Fundamentals of Power Electronics.

Course Objectives:
To make the students learn about:
- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of single-phase converter-controlled dc motors and four quadrant operation of dc motors using dual converters.
- To discuss the DC-DC converter control of dc motors in various quadrants.
- To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- To understand the speed control mechanism of synchronous motors

Course Outcomes:
After the completion of the course the student should be able to:
CO1: Explain the fundamentals of electric drive and different electric braking methods.
CO2: Analyze the operation of single-phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
CO3: Describe the converter control of DC motors in various quadrants of operation
CO4: Know the concept of speed control of induction motors by using AC voltage controllers.
CO5: Explains the speed control mechanism of synchronous motors.

UNIT - I
Fundamentals of Electric Drives
Electric drive and its components– Fundamental torque equation – Load torque components – Classification of load torques –Load equalization– Four quadrant operation of drive (hoist control).

UNIT - II
Controlled Converter Fed DC Motor Drives
1-phase half and fully-controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms and their expressions – Speed-torque characteristics.

UNIT - III
DC–DC Converters Fed DC Motor Drives
Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current operation - Output voltage and current waveforms – Speed–torque characteristics.

UNIT - IV
Control of 3-phase Induction motor Drives
Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control. Static rotor resistance control– Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics.

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UNIT - V

Control of Synchronous Motor Drives

Separate control of synchronous motor – self-control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive (qualitative treatment only).

Text Books:

1. Fundamentals of Electric Drives, G. K. Dubey, Narosa Publications, 2002.
2. Power Semiconductor Drives, S.B.Dewan,G.R.Slemon, A.Straughen, Wiley India, 2009.

Reference Books:

1. Electric Motors and Drives Fundamentals- Types and Apllications - by Austin Hughes and Bill Drury - Newnes.4th edition - 2013.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications-1987.
3. Power Electronic Circuits- Devices and applications by M.H.Rashid - PHI - 3rd edition -2009.
4. Power Electronics handbook by Muhammad H.Rashid- Elsevier - 2nd edition - 2010.

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VI	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Fundamentals of Utilization of Electrical Energy					

Pre Requisites:

Electrical Machines, Power Electronics and Drives and Power Systems –II.

Course Objectives:

To make the students learn about:

- Able to maintain electric drives used in an industries.
- Able to identify a heating/welding scheme for a given application.
- Able to maintain/ Trouble shoot various lamps and fittings in use.
- Able to figure out the different traction schemes and its main components.
- Able to design a suitable scheme of speed control for the traction systems.

Course Outcomes:

After learning the course, the students should be able to

CO1: Get knowledge of electric drives used in industries
CO2: Get knowledge of the principle of electric heating, welding and its applications and design simple resistance furnaces.
CO3: Design residential illumination schemes.
CO4: Get knowledge of electric braking methods, control of traction motors
CO5: Calculate tractive effort, power, acceleration and velocity of traction.

UNIT – I

Electric Drives

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise – cooling and heating time constant, applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

UNIT – II

Electric Heating and Welding

Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating. Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT – III

Fundamentals of Illumination

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

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UNIT – IV

Electric Traction – I

System of electric traction and track electrification, Review of existing electric traction systems in India, Special features of traction motor, methods of electric braking- plugging, rheostatic braking and regenerative braking.

UNIT – V

Electric Traction –II

Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, dead weight, adhesive weight, braking retardation, and coefficient of adhesion.

Text Books:

1. Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. Art & Science of Utilization of electrical Energy, Partab, Dhanpat Rai & Co., 2004.
3. Utilization of Electrical Power including Electric drives and Electric traction – byJ.B.Gupta, S.K. Kataria & Sons.

Reference Books:

1. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited,1993.
2. Electrical Power, S. L. Uppal, Khanna pulishers,1988.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/104/108104140
2. https://nptel.ac.in/courses/108105060

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VII	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Concepts of Renewable Energy Sources					

Pre-requisite:
Electrical Machines, Engineering Physics and Fundamentals of Power Systems.

Course Objectives:
To make the students learn about
- To introduce various energy sources and basic solar energy systems.
- To explain the working and design of photovoltaic systems.
- To understand wind and geothermal energy principles and systems.
- To study ocean energy conversion methods and technologies.
- To learn biomass conversion and basics of fuel cells and hydrogen energy.

Course Outcomes:
At the end of the Course, the student shall be able to
CO1: Identify various energy sources and discuss the applications of solar energy.
CO2: Demonstrate the concepts of photovoltaic systems.
CO3: Outline the wind and geothermal energy sources
CO4: Illustrate ocean and wave energy conversion systems.
CO5: Summarize the biomass, fuel cells and hydrogen energy technologies.

UNIT-I
Introduction to Energy Sources
Energy sources and their availability - non-conventional sources - advantages of renewable energy sources - prospects of renewable energy sources
Solar Energy: Extra-terrestrial solar radiation - terrestrial solar radiation - instruments for measuring solar radiation- Solar energy collectors - flat plate collectors and concentrating collectors - Applications of solar energy - solar pond - solar water heater - solar cooking.

UNIT-II
Photovoltaics
Solar cell - equivalent circuit - characteristics of PV cell - PV array design - PV System components - Sizing and economics - Peak power operation - Fill Factor- MPPT (P&O only)

UNIT-III
Wind Energy
Wind power sources - wind characteristics - site selection - Criterion, momentum theory, WECS and its types - Components of wind energy systems - performance and limitations - classification of wind energy Turbines - Aerodynamic forces acting on blades - applications and environmental impacts.
Geothermal Energy: Origin and types: Hydrothermal, Geo-pressurized & Petro thermal, advantages and disadvantages of geothermal energy.

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UNIT-IV
Ocean Energy
Ocean temperature differences - principles of OTEC plant operations. Open cycle and closed cycle system -Basic principle of tidal power, components of tidal power plants, ocean waves - wave energy conversion systems.

UNIT-V
Energy from Biomass
Biomass conversion technologies, photosynthesis - biogas generation-factors affecting biogas generation - Bio fuels: Classification - direct combustion for heat and electricity generator - anaerobic digestion for biogas - biogas digester – KVIC power generation.
Chemical Energy: Fuel cells - Principle of operation of fuel cell - Types of fuel cells -applications of fuel cells - Hydrogen energy - Green hydrogen production (PV) - Storage and applications.

Text Books:

1. G.D. Rai, Non-Conventional energy sources, 6th Edition, Khanna Publishers, 2011.
2. Renewable Energy in Power Systems by Leon Freris and David Infield, John Wiley & Sons, Ltd

Reference Books:

1. John Twidell & Toney Weir - Renewable Energy Sources, E & F.N. Spon
2. G.S. Sawhney, Non-Conventional Energy Sources, 1st Edition, Prentice India Pvt. Ltd, 2012.
3. G.N. Tiwari and M.K. Ghosal, Renewable Energy Resources: Basic Principles and Applications, 1st Edition, Alpha Science International Ltd, 2004.
4. Chetan Singh Solanki, Fundamentals, Technologies & Applications, Solar Photovoltaic, PHI Publishers, 2019, 3rd Edition.

Web References:

1. Link: https://nptel.ac.in/courses/108/105/108105058/

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VIII	Minor Engineering Courses	L	T	P	C
		3	0	0	3
EV Technologies					

Pre-requisite:
Electrical Machines, Power Electronics and Energy Storage Fundamentals

Course Objectives:
To make the students learn about

- To understand EV powertrain fundamentals, system modeling, and types of electric vehicles.
- To study thermal management methods for EV batteries, motors, and power electronics.
- To explore EV charging technologies, standards, and charging infrastructure in India.
- To understand PEV power flow, charging systems, and grid interaction technologies like V2G.
- To learn about sensors used in EV systems for monitoring temperature, pressure, position, and current.

Course Outcomes:
At the end of the Course, the student shall be able to
CO1: Describe the various principles of power trains of EVs and the wiring layout of EV
CO2: Illustrate the power converters used in EV
CO3: Identify the chargers and their standards for charging station of EV
CO4: Differentiate different types of charging methods
CO5: Identify the sensors used in EV

UNIT-I
Electric Power Train
Introduction, Principles of EV Power Trains and Their Performance, System Modelling Fundamentals - Driving Cycles, Range Modelling; Wiring Layout of Electric Vehicle, Types of EVs.

UNIT-II
Thermal Management
Power Electronics, Battery and Motor - Types of cooling Techniques - De-rating Strategy for Vehicle.

UNIT-III
Chargers and Charging Station in India
Charging Technologies - Types of Chargers - On-Board and Off-Board Charging, Types of Guns - CCS, CHAdeMO, Type-2A, Bharat DC-001, Internal Structure, Specification, Power Requirements for Charging Station, Power Architecture of AC and DC Charging Stations- Basics of information Exchange between EV and station - Wireless Charging

UNIT-IV
Plugin EV and Electrical Infrastructure
Power Electronics for PEV Charging, Grid-Tied Home and Public Systems, V2G, V2V and G2V Technologies, Impact of Charging and V2G Power Flow on the Grid.

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UNIT-V
Sensors
Thermal Runaway Detection sensors - Temperature, Pressure, Gas Concentration; Liquid Cooling - Temperature, Pressure, Level; Inverter Sensors-Temperature, Current sensors, Transmission, Position, Speed, Park Lock Position, Drive Mode Position

Text Books:

1. Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, Haitham Abu-Rub, Mariusz Malinowski and Kamal Al-Haddad, Wiley, IEEE Press. ISBN: 9781118634035
2. Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, By John G. Hayes and G. Abas Goodarzi, Wiley Publication. ISBN:9781119063643

Reference Books:

1. Handbook of Electric Vehicle Charging Infrastructure Implementation, by Government of India
2. Electric Vehicle Technology Explained, By James Larminie, John Wiley & Sons Ltd. ISBN: 978-1119942733
3. Automotive Electrical and Electronic Systems, Tom Denton, Routledge, Taylor and Francis Group, 5th Edition, 2017. ISBN: 9781315856629
4. Power Electronics, Rashid.M.H, Prentice Hall of India, New Delhi, 2008. ISBN: 978-0133125900.

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IX	Minor Engineering Courses	L	T	P	C
		3	0	0	3
Basics of Electrical Machines					

Course objectives:
The objectives of this course is to acquire knowledge on
- To understand the construction and working of DC machines and analyze their performance.
- To study single-phase transformers and assess their efficiency and regulation.
- To learn the working principles of synchronous machines and their applications.
- To understand the performance characteristics of three-phase induction motors.
- To introduce the operational concepts of special machines used in various applications.

Course Outcomes:
At the end of the Course, the student shall be able to
- Explain the working of DC generators and motors and determine their performance using tests.
- Analyze the performance of single-phase transformers through equivalent circuits and testing methods.
- Evaluate the EMF generation and regulation in alternators and understand synchronous motor operations.
- Describe the behaviour of three-phase induction motors under various operating conditions.
- Identify and explain the functionality of various special machines used in industry and domestic applications.

UNIT - I
DC Machines:
Principle of operation of DC generator – EMF equation – types of DC machines – OCC & load characteristics of DC shunt generator - Principle of operation of DC motor - torque equation - speed control methods – losses and efficiency – three-point starter - applications – Swinburne's test - brake test - numerical problems.

UNIT – II
Transformers:
Principle of operation and construction of single-phase transformer – EMF equation – Losses - OC & SC tests - efficiency and voltage regulation of transformer – Numerical Problems.

UNIT - III
Synchronous Machines:
Principle of operation and construction of alternators- types of alternators – EMF equation - regulation of alternator by synchronous impedance method (EMF Method) - principle of operation and construction of synchronous motor – applications.

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UNIT IV
Three-Phase Induction Motors:
Principle of operation – construction – revolving magnetic field - types of three-phase induction motors – slip torque characteristics - maximum, starting and running toques - losses and efficiency - starting methods brake test on 3-phase induction motor.

UNIT V
Special Machines:
Principle of operation of single-phase induction motor - different types of single-phase induction motors (split phase motor, capacitor-start motor, capacitor-start capacitor-run motor, shaded-pole motor) – Linear induction motor – stepper motor - universal motor.

Text Books:

1. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand publications
2. Theory & performance of Electrical Machines by J.B.Guptha, S.K.Kataria & Sons
3. Electrical Machinery by P.S. Bhimbra, Khanna Publishers.

Reference Books:

1. Basic Electrical Engineering by M.S.Naidu & S.Kamakshiah, TMH Publications
2. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition
3. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition