DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Accredited by NBA)

2023

ENGINEERING CURRICULUM

B.Tech Regular

BONAM VENKATA CHALAMAYYA
INSTITUTE OF TECHNOLOGY & SCIENCE
(AUTONOMOUS)
Batlapalem, Amalapuram, Indupalli Post, E. G. Dist, A.P, India – 533 201

BONAM VENKATA CHALAMAYYA INSTITUTE OF TECHNOLOGY & SCIENCE
(AUTONOMOUS)
(Approved by AICTE, Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with 'A' Grade)
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Accredited by NBA)

B.Tech (Regular – Full Time)

(Effective for the students admitted into 1st year from the academic year 2023-2024 onwars)

Academic Regulations (BR23) 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	Course Category	Description

	Classification		
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)	Inter disciplinary/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 /NCC /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.

i) 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.

ii) 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. 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.

viii) For induction programme attendance shall be maintained as per AICTE norms.

18. 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	S (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	≥ 6.5 < 7.5
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 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.

***** *** *****

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).

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ELECTRICAL AND ELECTRONICS ENGINEERING

(Accredited by NBA)

COURSE STRUCTURE
BR23 Regulation

I-B.Tech - I Semester

S.No.	CODES	Title	L/D	T	P	Credits
1	23HM1T01	Communicative English	2	0	0	2
2	23BS1T01	Engineering Physics	3	0	0	3
3	23BS1T02	Linear Algebra and Calculus	3	0	0	3
4	23ES1T01	Basic Electrical & Electronics Engineering	3	0	0	3
5	23ES1T02	Introduction To Programming	3	0	0	3
6	23HM1L01	Communicative English Lab	0	0	2	1
7	23BS1L01	Engineering Physics Lab	0	0	2	1
8	23ES1L01	Electrical & Electronics Engineering Workshop	0	0	3	1.5
9	23ES1L02	Computer Programming Lab	0	0	3	1.5
10	23HM1L02	Health and Wellness, Yoga and Sports	-	-	1	0.5
Total			**14**	**0**	**11**	**19.5**

I-B.Tech –II Semester

S.No.	CODES	Title	L/ D	T	P	Credits
1	23BS2T03	Chemistry	3	0	0	3
2	23BS2T04	Differential Equations & Vector Calculus	3	0	0	3
3	23ES2T03	Basic Civil & Mechanical Engineering	3	0	0	3
4	23ES2T04	Engineering Graphics	1	0	4	3
5	23EE2T01	Electrical Circuit Analysis-I	3	0	0	3
6	23ES2L03	I T Work Shop	0	0	2	1
7	23BS2L02	Chemistry Lab	0	0	2	1
8	23EE2L01	Electrical Circuits Lab	0	0	3	1.5
9	23ES2L04	Engineering Workshop	0	0	3	1.5
10	23HM2L03	NSS/NCC/Scouts & Guides/ Community Service	-	-	1	0.5
Total			**13**		**15**	**20.5**

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COURSE STRUCTURE
BR23 Regulation

II B.Tech. I Semester

S. No	Category	Course Code	Title	L	T	P	C
1	BSC	23BS3T02	Numerical Methods & Complex Variables	3	0	0	3
2	HSMC	23HM3T01	Universal human values – understanding harmony and Ethical human conduct	2	1	0	3
3	ESC	23ES3T02	Electromagnetic Field Theory	3	0	0	3
4	PCC	23EE3T02	Electrical Circuit Analysis-II	3	0	0	3
5	PCC	23EE3T03	DC Machines & Transformers	3	0	0	3
6	PCC	23EE3L02	Electrical Circuit Analysis-II and Simulation Lab	0	0	3	1.5
7	PCC	23EE3L03	DC Machines & Transformers Lab	0	0	3	1.5
8	Skill Enhancement Course	23SC3L02	Data Structures Lab	0	1	2	2
9	Audit Course	23NC3T01	Environmental Science	2	0	0	-
		Total		**16**	**2**	**8**	**20**

II B.Tech. II Semester

S. No	Category	Course Code	Title	L	T	P	C
1	Management Course- I	23HM4T02	Managerial Economics & Financial Analysis	2	0	0	2
2	Engineering Science/Basic Science	23ES4T08	Analog Circuits	3	0	0	3
3	Professional Core	23EE4T04	Power Systems-I	3	0	0	3
4	Professional Core	23EE4T05	Induction and Synchronous Machines	3	0	0	3
5	Professional Core	23EE4T06	Control Systems	3	0	0	3
6	Professional Core	23EE4L04	Induction and Synchronous Machines Lab	0	0	3	1.5
7	Professional Core	23EE4L05	Control Systems Lab	0	0	3	1.5
8	Skill Enhancement course	23SC4L06	Python Programming Lab	0	1	2	2
9	Engineering Science	23ES4L01	Design Thinking & Innovation	1	0	2	2
		Total		**15**	**1**	**10**	**21**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
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III B.Tech. COURSE STRUCTURE:BR-23

B.Tech. III Year I Semester

S.No.	Category	Course Code	Title	L	T	P	C
1	Professional Core	23EE5T07	Power Electronics	3	0	0	3
2	Professional Core	23EE5T08	Digital Circuits	3	0	0	3
3	Professional Core	23EE5T09	Power Systems-II	3	0	0	3
4	Professional Elective- I	23EE5D01 23CS5D05 23EC5D03 23EE5D02	1. Signals and Systems 2. Computer Architecture and Organization 3. Communication systems 4. 12 Week MOOC-Swayam / NPTEL Course	3	0	0	3
5	Open Elective-I	23HM5E01	Any Course from other Department OR Entrepreneurship Development & Venture Creation	3	0	0	3
6	Professional Core	23EE5L06	Power Electronics Lab	0	0	3	1.5
7	Professional Core	23EE5L07	Analog and Digital Circuits Lab	0	0	3	1.5
8	Skill Enhancement course	23SC5L02	Soft skills	0	1	2	2
9	Engineering Science	23ES5L01	Tinkering Lab	0	0	2	1
10	Evaluation of Community Service Internship	23EE5I01		-	-	-	2
			Total	**15**	**1**	**10**	**23**
MC	Minor Course (Student may select from the same specialized minors pool)			3	0	3	4.5
MC	Minor Course through SWAYAM / NPTEL (Minimum 12 Week, 3 credit course)			3	0	0	3
HC	Honors Course (Student may select from the same Honors pool)			3	0	0	3
HC	Honors Course (Student may select from the same Honors Pool)			3	0	0	3

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III B.Tech. COURSE STRUCTURE:BR-23

B. Tech. III Year II Semester

S.No.	Category	Course Code	Title	L	T	P	C
1	Professional Core	23EE6T10	Electrical Measurements and Instrumentation	3	0	0	3
2	Professional Core	23EE6T11	Microprocessors and Microcontrollers	3	0	0	3
3	Professional Core	23EE6T12	Power System Analysis	3	0	0	3
4	Professional Elective-II	23EE6D03 23EE6D04 23EE6D05 23EE6D06	1. Switchgear and Protection 2. Advanced Control Systems 3. Renewable and Distributed Energy Technologies 4. 12 Week MOOC-Swayam / NPTEL Course	3	0	0	3
5	Professional Elective-III	23EE6D07 23EE6D08 23EE6D09 23EE6D10	1. Electric Drives 2. Digital Signal Processing 3. High Voltage Engineering 4. 12 Week MOOC-Swayam / NPTEL Course	3	0	0	3
6	Open Elective - II		Any Course from other Department	3	0	0	3
7	Professional Core	23EE6L08	Electrical Measurements and Instrumentation Lab	0	0	3	1.5
8	Professional Core	23EE6L09	Microprocessors and Microcontrollers Lab	0	0	3	1.5
9	Skill Enhancement course	23SC6L02	IoT Applications of Electrical Engineering Lab	0	1	2	2
10	Audit Course	23NC6T02	Research Methodology	2	0	0	-
			Total	**20**	**1**	**08**	**23**
MC	Student may select from the same minors pool			3	0	3	4.5
MC	Minor Course (Student may select from the same specialized minors pool)			3	0	0	3
HC	Student may select from the same honors pool			3	0	0	3
HC	Honors Course (Student may select from the honors pool)			3	0	0	3

OPEN ELECTIVES

S.No.	Category	Course Code	Title	L	T	P	C
1	Open Elective-I (III-I)	23EE5E01 23EE5E02	1. Renewable Energy Sources 2. Concepts of Energy Auditing & Management	3	0	0	3
2	Open Elective – II (III-II)	23EE6E03 23EE6E04 23EE6E05	1. Fundamentals of Electric Vehicles 2. Electrical Wiring Estimation and Costing 3. Embedded Systems	3	0	0	3
3	Open Elective – III (IV-I)	23EE7E06 23EE7E07	1. Battery Management Systems and Charging Stations 2. Concepts of Smart Grid Technologies	3	0	0	3
4	Open Elective-IV (IV-I)	23EE8E08 23EE8E09	1. Concepts of Power Quality 2. Intelligent Control Systems	3	0	0	3

***Minor Engineering Courses offered by EEE Department for Other Branches (Except EEE Branch)**

S.No.	Course	Title	L	T	P	C
1	I	Concepts of Control Systems	3	0	0	3
2	II	Fundamentals of Electrical Measurements and Instrumentation	3	0	0	3
3	III	Concepts of Power System Engineering	3	0	0	3
4	IV	Fundamentals of Power Electronics	3	0	0	3
5	V	Basics of Electric Drives and applications	3	0	0	3
6	VI	Fundamentals of utilization of Electrical Energy	3	0	0	3
		Total	**18**	**0**	**0**	**18**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

***Honors Engineering Courses offered EEE Branch students**
Need to Acquire 18 credits

Power Systems

S.No.	Course	Title	L	T	P	C
1	I	Electric Power Quality	3	0	0	3
2	II	Smart Grid Technologies	3	0	0	3
3	III	Power System Deregulation	3	0	0	3
4	IV	Real Time Control of Power Systems	3	0	0	3
5	V	Advanced Power Systems Protection	3	0	0	3
6	VI	Flexible ACTransmission Systems	3	0	0	3
7	VII	AI applications in Power Systems	3	0	0	3
8	VIII	Power Systems Lab	0	0	3	1.5
9	IX	Advanced Power Systems Simulation Lab	0	0	3	1.5

Power Electronics

S.No.	Course	Title	L	T	P	C
1	I	Special Electrical Machines	3	0	0	3
2	II	Machine Modeling and Analysis	3	0	0	3
3	III	Power Electronic Converters	3	0	0	3
4	IV	Power Quality and Custom Power Devices	3	0	0	3
5	V	Power Electronics for Renewable Energy systems	3	0	0	3
6	VI	Industrial Applications of Power Electronic Converters	3	0	0	3
7	VII	Advanced Electrical Drives	3	0	0	3
8	VIII	FACTS Controllers	3	0	0	3
9	IX	Power Converters Laboratory	0	0	3	1.5
10	X	Electric Drives Laboratory	0	0	3	1.5
11	XI	Renewable Technologies Laboratory	0	0	3	1.5
12	XII	Electric Vehicles Laboratory	0	0	3	1.5

II Year –I SEMESTER

Course Code: 23ES3T02

L	T	P	C
3	0	0	3

ELECTRO MAGNETIC FIELD THEORY

Pre-requisite: Concepts of Differential Equations, Vector Calculus and Analysis.

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.
- To study the 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 fourth equation for the induced EMF.

Course Outcomes:

At the end of the course, students 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 behavior of conductors in electric fields, electric diploe and the capacitance and energy stored in dielectrics.

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

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

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

UNIT – I

Electrostatics

Rectangular & Cylindrical Coordinate Systems, Del & Curl operators, Divergence and Stoke's theorems (definitions only). Coulomb's law and Electric field intensity (EFI), EFI due to Continuous charge distributions (line and surface charge), Electric flux density, Gauss's law (Maxwell's first equation, $\nabla . D = \rho v$), Applications of Gauss's law, Electric Potential, Work done in moving a point charge in an electrostatic field (second Maxwell's equation for static electric fields,$\nabla \times E = 0$), Potential gradient, Laplace's and Poison's equations.

UNIT - II

Conductors – Dielectrics and Capacitance

Ohm's law in point form, Behavior 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 ($\nabla \times H = J$).

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($\nabla \times \vec{E} = -db/dt$) 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, 7th Editon.2006.

Reference Books:

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

Online Learning Resources:

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

II Year –I SEMESTER
Course Code: 23EE3T02

L	T	P	C
3	0	0	3

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, relation between line and phase quantities, analysis of balanced three phase circuits, and measurement of active and reactive power.

Analysis of three phase unbalanced circuits:

Loop method, Star-Delta transformation technique, two-wattmeter method for measurement of three phase power.

UNIT – II

Laplace transforms & Transient Analysis – Definition and Laplace transforms of standard functions– Shifting theorem – Transforms of derivatives and integrals, Inverse Laplace transforms and applications,Transient response of series 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

Analysis of Electric Circuits with Periodic Excitation: Fourier series and evaluation of Fourier coefficients, Trigonometric and complex Fourier series for periodic waveforms, Application to Electrical Systems – Effective value and average value of non-sinusoidal(square) periodic waveforms.

UNIT - V

Filters: Classification of filters-Low pass, High pass, Band pass and Band Elimination filters, Constant-k filters -Low pass and High Pass. Basic design of low pass and high pass filters.

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, 1st Edition, B. S. Publications, 2012.
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/

II Year – I SEMESTER
Course Code: 23EE3T03

L	T	P	C
3	0	0	3

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.
- Analyze the performance of single-phase transformers and to 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 its 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: Analyse various configurations of three-phase transformers.

UNIT – I: DC Generators:

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 – Armature reaction and commutation.

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

Characteristics of DC motors – losses and efficiency – applications of DC motors. 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 – brake test, Swinburne's test –Hopkinson's 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 factors loads –phasor diagrams– equivalent circuit –regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – 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– auto transformer – equivalent circuit – comparison with two winding transformers.

UNIT – V

Three-Phase Transformers:

Poly-phase connections- Y/Y, Y/Δ, Δ/Y, Δ/Δ, open Δ – third harmonics in phase voltages– Parallel operation–three winding transformers-off load and on load tap changing transformers–Scott connection.

Textbooks:

1. Electrical Machinery by Dr. P S Bimbhra, 7th edition, Khanna Publishers, New Delhi,2021.
2. Performance and analysis of AC machines by M.G. Say, CBS, 2021.

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 Publications 4th edition 2017.
3. Generalized Theory of Electrical Machines by Dr. P S Bimbhra, Khanna Publications 7th Revised Edition, 2021
4. Theory & Performance of Electrical Machines by J.B.Gupta, S.K. Kataria & Sons Publications 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

L	T	P	C
0	0	3	1.5

II Year – I SEMESTER

Course Code: 23EE3L02

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 theorem 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.

II Year I SEMESTER
Course Code: 23EE3L03

L	T	P	C
0	0	3	1.5

DC MACHINES & TRANSFORMERS LAB

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 analyzing the performance characteristics of DCMachines.
CO3: Determine the performance characteristics of DC machines using different testingmethods.
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

II Year – II Semester

Course Code: 23EE4T04

L	T	P	C
3	0	0	3

POWER SYSTEMS-I

Course Objectives:

- To study principle of operation of different components of a hydro and thermal power stations.
- To study principle of operation of different components of a nuclear power stations.
- To study constructional 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, and the operation of power plants.

CO2: Describe the different components of air and gas-insulated substations.

CO3: Discuss the construction of single-core and three-core cables and describe distribution system configurations.

CO4: Analyze 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, superheaters, 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 the 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 a brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

Unit III:

Substations: A**ir 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 systems 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. The capacitance of single and 3-core belted Cables. Grading of cables capacitance grading and intersheath grading.

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-fixe 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, Time of Day(ToD) tariff and Time of Use (ToU) tariff.

Text Books:

1.S. N. Singh, Electric Power Generation, Transmission and Distribution, PHI LearningPvt Ltd, New Delhi, 2nd Edition, 2012
2. J.B.Gupta, Transmission and Distribution of Electrical Power, S.K.Kataria and sons,10th Edition, 2012,Reprint 2021

Reference 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. V. K. Mehta and Rohit Mehta, Principles of Power System 4th Edition. Revised 2022
4. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1985.
5.Handbook of switchgear, BHEL, McGraw-Hill Education, 2008.

Online Learning Resources:

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

II Year – II semester

Course Code: 23EE4T05

L	T	P	C
3	0	0	3

INDUCTION AND SYNCHRONOUS MACHINES

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

Course Objectives:

Students will get exposure to understand the concepts of

- characteristics, starting and testing methods of Induction Motor
- Torque production and performance of Induction Motor.
- In determining the performance parameters of Induction Motor.
- working of synchronous machines

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 and motors.

UNIT-I:

Three-phase induction motors:
Construction of Squirrel cage and Slip ring 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 –No load 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 technique and rotor emf injection technique –crawling and cogging induction generator operation

UNIT – III:
Single Phase Motors:

Single phase induction motors Constructional features, double field revolving theory – equivalent circuit-starting methods: capacitor start ,capacitor start capacitor run induction motor, 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 –voltage regulation by synchronous impedance method, MMF method and Potier triangle method 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, 2021,First Edition.
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, 2007.
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

II Year – II Semester
Course Code: 23EE4T06

L	T	P	C
3	0	0	3

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 - 1
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 – transfer function of Armature voltage controlled DC servo motor - block diagram algebra –representation by signal flow graph – reduction using Mason's gain formula.

UNIT - 2

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)

UNIT - 3

Frequency Response Analysis

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

UNIT - 4

Classical Control Design Techniques

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

UNIT - 5

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,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, 2015.
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd 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, NewagePublications, 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

II Year – II Semester
Course Code: 23EE4L04

L	T	P	C
0	0	3	1.5

INDUCTION AND SYNCHRONOUS MACHINES LAB

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: Aanalyse 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 MotorCO4: 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 methods.
8. Regulation of three-phase alternator by MMF method.
9. V and Inverted V curves of a three-phase synchronous motor.
10. Determination of X_d, X_q& Regulation of a salient pole synchronous generator.
11. Determination of efficiency of three phase alternator by loading with three phase induction motor.
12. Parallel operation of three-phase alternator with infinite bus bar under no-load condition.
13. Determination of efficiency of a single-phase AC series Motor by conducting Brake test.

Online Learning Resources:

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

L	T	P	C
0	0	3	1.5

II Year – II Semester

Course Code: 23EE4L05

CONTROL SYSTEMS LAB

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 Synchros.
- 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: Analyze the performance of Magnetic amplifier, D.C and A.C. servo motors and synchros.

CO2: Design of PID controllers and compensators.

CO3: Evaluate temperature control of an oven using PID controller

CO4: Determine the transfer function of D.C Motor and examine the truth table of logicgates using PLC.

CO5: Judge the stability in time and frequency domain and Kalman's test for controllabilityand observability.

List of Experiments:

Any 10 of the following experiments are to be conducted:

1. Analysis of Second order system in the time domain
2. Characteristics of Synchros
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor
6. Root locus, Bode Plot and Nyquist Plot for the transfer function of systems up to 5^{th}order using MATLAB.
7. Kalman's test of Controllability and Observability using MAT LAB.
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Characteristics of DC servo motor
12. Study and verify the truth table of logic gates and simple Boolean expressions using PLC

L	T	P	C
1	0	2	2

II Year – II Semester

Course Code: 23ES4L01

DESIGN THINKING & INNOVATION

Course Objectives: The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

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 modeling, 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, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles design, 2/e, of Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

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
- https://onlinecourses.nptel.ac.in/noc22_de16/preview

Course Outcomes:

COs	Statements	Blooms Level
CO1	Define the concepts related to design thinking.	L1
CO2	Explain the fundamentals of Design Thinking and innovation.	L2
CO3	Apply the design thinking techniques for solving problems in various sectors.	L3
CO4	Analyse to work in a multidisciplinary environment.	L4
CO5	Evaluate the value of creativity.	L5

Course Code: 23HM1T01

COMMUNICATIVE ENGLISH

(Common to CIVIL, EEE & ECE Branches of Engineering)

I B.Tech Semester: I

L	T	P	C
2	0	0	2

Course Objectives:

The main objective of introducing this course, **Communicative English**, is to facilitate effective Listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

Course Outcomes: After completing this course the student will be able to:

CO1	Understand the context, topic, and pieces of specific information from social or Transactional dialogues and respond to them in the form of conversations along with making Oral Presentations.
CO2	To write sentences, paragraphs and essays with appropriate grammatical structures and other language elements.
CO3	Organize ideas in a logical and coherent manner in both spoken and written forms.
CO4	Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
CO5	Write formal written communication in the forms of Letters, E-Mails, Resume, Cover Letters and Report writing.

UNIT I

Lesson: HUMAN VALUES: Gift of Magi **(Short Story) 1O Hrs**

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. (English Communication Skills Lab software is used for emphasizing more on Listening Skills in the lab)

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. Narrating stories, incidents and processes. (Will be dealt in lab)

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Remedial teaching of writing mechanics - Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Remedial teaching of Parts of Speech, Basic Sentence Structures- forming questions.

Vocabulary: Content based Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts. Listening to various poems on nature on different themes. (English Communication Skills Lab software is used for emphasizing more on Listening Skills in the lab)

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks. Discussions based on nature related topics to sensitize students towards nature related issues in their environment.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to linkthe ideas in a paragraph together.

Writing: Creative writing and reading comprehending and interpreting poems and other creative works. Structure of a paragraph - Paragraph writing (Specific Topics).

Grammar: Cohesive devices - linkers, use of articles and zero article; Prepositions. Contracted forms and other remedial grammar aspects.

Vocabulary: Text Book based Homonyms, Homophones, Homographs, Minimal Pairs, *Rhyming words* and Rhythm.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to. Listening to biographies of eminent persons from science and technology. (English Communication Skills Lab software is used for emphasizing more on Listening Skills in the lab)

Speaking: Discussing specific topics in pairs or small groups and reporting what isdiscussed. Introduction of self and others, introducing Guests and speakers in formal meetings.

Reading: Reading a text in detail by making basic inferences -recognizing and interpretingspecific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing, writing E-Mails

Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations

Vocabulary: Text Book based Compound words and 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/ reading dialogues with intonation.

Writing: Letter Writing: Official Letters, Resumes, and Cover Letters; convert stories in drama and drama into story

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused and Jargons from Text Book.

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 contexts

Reading: Reading comprehension.

Writing: Writing structured essays on specific topics.

Grammar: Editing short texts –identifying and correcting common errors in grammar andusage (articles, prepositions, tenses, subject verb agreement)

Vocabulary: Text Book based Technical Jargons

Textbooks:

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

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 UniversityPress, 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

Course Code: 23BS1T01

ENGINEERING PHYSICS

(Common to EEE,ECE,CIVIL)

I-B.Tech Semester:1

L	T	P	C
3	0	0	3

Course Objectives:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering coursesby 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 magneticmaterials.
CO5: Identify the type of semiconductor using Hall effect.

UNIT I Wave Optics 12 hrs

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 8hrs

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 10 hrs

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 8hrs

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependentwave 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 8 hrs

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).
5. Engineering Physics –P K Palani swamy,winners wisdom ,SCITECH (2018)

Web Resources :

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

Course Code: 23BS1T02

LINEAR ALGEBRA & CALCULUS

(Common to All Branches of Engineering)

I-B.Tech Semester: I

L	T	P	C
3	0	0	3

Course Objectives:

To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

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

CO1:	Find the Rank of a matrix and Solve the system of linear equations.
CO2:	find the inverse and power of a matrix by using Cayley-Hamilton theorem and reduce the Quadratic form into canonical form.
CO3:	Understand the geometrical interpretation of Mean value theorems and expand the given function as a power series
CO4:	Familiarize with functions of several variables, which is useful in optimization.
CO5:	Familiarize with double and triple integrals of functions of several variables in two dimensions using Cartesian and polar coordinates and three dimensions using cylindrical and spherical coordinates.

Unit-I: Linear Transformations (10 Periods):

Rank of a matrix by echelon form, normal form and PAQ 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, Jacobi and Gauss Seidel Iteration Methods.

Unit-II: Eigenvalues, Eigenvectors and Orthogonal Transformation (10 Periods):

Eigenvalues, Eigenvectors and their properties, 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 form by Orthogonal Transformation.

Unit-III: Calculus (10 periods):

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) and related Problems.

Unit-IV: Partial differentiation and Applications (Multi variable calculus) (10 periods):

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Euler's theorem, Taylor's and Maclaurin's series expansion of functions of two variables.

Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit-V:Multiple Integrals (Multi variable Calculus) (10 periods):

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Higher Engineering Mathematics, B.V. Ramana, Mc Graw Hill Education (India) PrivateLimited. Nineteenth edition.

Reference Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9th edition
5. Linear Algebra & Calculus, S. Chand Publications,2023,TKV Iyengar, B Krishna Gandhi, S Ranganatham, MVSSN Prasad.
6. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018,14th Edition.

Course Code: 23ES1T01

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

(Common to EEE,ECE,CIVIL)

I-B.Tech Semester:1

L	T	P	C
3	0	0	3

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

CO1. Describe fundamental laws, operating principles of motors/generators, MC/MI instruments (L2)

CO2. Demonstrate the working of electrical machines, measuring instruments and power generation stations. (L2)

CO3. Apply mathematical tools and fundamental concepts to derive various equations related to electrical circuits and machines. (L3)

CO4. Calculate electrical load and electricity bill of residential and commercial buildings. (L4)

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 Generator, (ii) Single Phase Transformer, (iii) Three Phase Induction Motor and (iv) 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 & Solar 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.

Course Code: 23ES1T02

INTRODUCTION TO PROGRAMMING

(Common to All Branches)

I-B.Tech Semester:1

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce students to the fundamentals of computer programming.
- To provide hands-on experience with coding and debugging.
- To foster logical thinking and problem-solving skills using programming.
- To familiarize students with programming concepts such as data types, controlstructures, functions, and arrays.
- To encourage collaborative learning and teamwork in coding projects.

Course Outcomes: A student after completion of the course will be able to
CO1: Understand basics of computers, the concept of algorithm and algorithmic thinking.
CO2: Analyse a problem and develop an algorithm to solve it.
CO3: Implement various algorithms using the C programming language.
CO4: Understand more advanced features of C language.
CO5: Develop problem-solving skills and the ability to debug and optimize the code.

UNIT I Introduction to Programming and Problem Solving

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program-Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting,Operators.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problemsolving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT II Control Structures

Keywords, Storage Classes, Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do-while) Break and Continue.

UNIT III Arrays and Strings

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings, String manipulation functions.

UNIT IV Pointers & User Defined Data types

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions, Dynamic memory allocation(DMA).

UNIT V Functions & File Handling

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Recursive function and examples, Scopeand Lifetime of Variables, Basics of File Handling

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

Textbooks:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition

Course Code: 23HM1L01

COMMUNICATIVE ENGLISH LAB

(Common to CIVIL, EEE & ECE Branches of Engineering)

I B.Tech Semester: I

L	T	P	C
0	0	2	1

Course Objectives:

The main objective of introducing this course, Communicative English Laboratory, is to exposethe students to a variety of self-instructional, learner friendly modes of language learning. Thestudents 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 Listening and Speaking skills.
CO2	Help the learners to improve their language skills by making small talks/ Role Plays /Short presentations (JAM) and oral presentations.
CO3	Help the students to reduce the Mother Tongue Influence while speaking.
CO4	Evaluate and exhibit professionalism in participating in debates and group discussions.
CO5	Create effective resonate and prepare the students to face interviews in future.

List of Topics:

1. Vowels & Consonants (Remedial)
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing, Narrating techniques for events and stories.
6. Resume Writing, Cover letter, SOP, arguments and floor crossing.
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Suggested Software:

- Walden InfoTech
- Young India Films
- English Communications Skills Lab Software by Softx Technologies.

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

Course Code: 23BS1L01

ENGINEERING PHYSICS LAB

(Common to EEE,ECE,CIVIL)

I-B.Tech Semester:1

L	T	P	C
0	0	2	1

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 magneticmaterials respectively.
CO5: Calculate the band gap of a given semiconductor and also 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

1. www.vlab.co.inhttps://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototyp

Course Code: 23ES1L01

ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP

(Common to EEE,ECE,CIVIL)

I-B.Tech Semester:1

L	T	P	C
0	0	3	1.5

Course Objectives:

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

Course Outcomes:

After competition of this course, the student will be able to

CO1. Measure voltage, current and power in an electrical circuit. (L3)
CO2. Measure of Resistance using Wheat stone bridge (L4)
CO3. Discover critical field resistance and critical speed of DC shunt generators. (L4)
CO4. Investigate the effect of reactive power and power factor in electrical loads. (L5)

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.

Course Code: 23ES1L02

COMPUTER PROGRAMMING LAB

(Common to All branches)

I-B.Tech Semester:1

L	T	P	C
0	0	3	1.5

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 writingthe 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 seriesof 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 IIWEEK 4

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

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 IIIWEEK7:

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 IVWEEK9:

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 alongwith 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 samewithout 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 VWEEK11:

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.

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 functionsthat 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 thedifferences 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

Course Code: 23HM1L02

HEALTH AND WELLNESS, YOGA AND SPORTS

(Common to CIVIL,EEE,ECE)

I-B.Tech Semester:1

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 cardio respiratory fitness, treadmill, run test, 9 min walk, skipping andrunning.

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 manyas 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.

Course Code: 23BS2T03

CHEMISTRY

(Common to EEE,ECE)

I-B.Tech Semester:1I

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry andpolymers

Course Outcomes:

CO1: Apply the principle of Band diagrams in the application of conductors andsemiconductors
CO2: Utilize the theory of Construction of electrodes, batteries and fuel cells in redesigning new engineering products
CO3: Summerize the importance of engineering materials like nano materials.
CO4: Explain the preparation, properties, and applications of thermoplastics & thermosetting & elastomers conducting polymers
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 hetero nucleardiatomic molecules – energy level diagrams of O_2 and CO, etc. π-molecular orbital's of butadiene and benzene, calculation of bond order.

Unit-II Modern Engineering materials

Semiconductors – Introduction, basic concept , applications (N-type& P-type)
Super conductors-Introduction basic concept, applications.(Type I& Type II)
Super capacitors: Introduction, Basic Concept, Classification, Applicatitions .
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 batteriesincluding cell reactions; Fuel cells, hydrogen- oxygen fuel 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 – poly acetylene , poly aniline, – mechanism of conduction and applications. Bio -Degradable polymers - Poly Glycolic Acid (PGA), Poly 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, Dhanpat Rai, 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
4. Prasanta Rath Engineering Chemistry, CENGAGE Learning
5. Shikha Agarwal , Engineering Chemistry Fundamentals and Applications, Cambridge 2nd Edition

Course Code: 23BS2T04

DIFFERENTIAL EQUATIONS & VECTOR CALCULAS

(Common to All Branches of Engineering)

I B.Tech Semester: II

L	T	P	C
3	0	0	3

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 theminto advanced level by handling various real-world applications.

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

CO1:	Solve the linear differential equations and model various situations involving differential equations of first order.
CO2:	Solve linear differential equations of higher order and model various situations involving second order differential equations.
CO3:	Identify the techniques to form and solve the Partial Differential Equations
CO4:	Interpret the physical meaning of different operators such as gradient, curl and divergence.
CO5:	Estimate the work done against a field, circulation and flux using vector calculus.

UNIT I: Differential equations of first order and first degree (10 Periods) :

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

UNIT II: Linear differential equations of higher order with constant coefficients (10 Periods) :

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

UNIT III: Partial Differential Equations (10 Periods):

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. Higher order Homogeneous Linear Partial differential equations with constant coefficients-RHS terms of the type e^{ax+by}, $\sin(ax+by)$, $\cos(ax+by)$ and $x^m y^n$.

UNIT IV: Vector differentiation (10 Periods):

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient,

Directional derivative, del applied to vector point functions-Divergence and Curl, Irrotational vector and its scalar potential, vector identities

UNIT V:Vector integration (10 Periods) :

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

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

Reference Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10thEdition.
2. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
3. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones andBartlett, 2018.
4. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018,5th Edition.
5. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha ScienceInternational Ltd., 2021 5th Edition (9th reprint).

Course Code: 23ES2T03

BASIC CIVIL AND MECHANICAL ENGINEERING

(Common to CIVIL, EEE, ECE)

I-B.Tech Semester:II

L	T	P	C
3	0	0	3

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:

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

Reference Books:

Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
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:

Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.

A text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.

An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

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

Course Code: 23ES2T04

ENGINEERING GRAPHICS

(Common to CIVIL, EEE, ECE)

I-B.Tech Semester :II

L	T	P	C
1	0	4	3

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 drawing of objects 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.

Course Code: 23EE2T01

ELECTRICAL CIRCUIT ANALYSIS-1
(ELECTRICAL & ELECTRONICS ENGINEERING)

I-B.Tech Semester: II

L	T	P	C
3	0	0	3

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.

Course Code: 23ES2L03

IT WORKSHOP

(Common to CIVIL, EEE, ECE)

I B.Tech Semester: II

L	T	P	C
0	0	2	1

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 throughthe 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 bothWindows 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 configuredas 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. Finallystudents

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 TeX and 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:

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

Course Code: 23BS2L02

CHEMISTRY LAB

(Common to EEE,ECE)

I-B.Tech Semester:II

L	T	P	C
0	0	2	1

Course Objectives:

Verify the fundamental concepts with experiments.

Course Outcomes: At the end of the course, student 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 spectro photometric 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. Potentiometer - 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 nonmaterial's by precipitation method
12. Estimation of Ferrous Iron by Dichrometry
13. Determination of Hardness of a ground water sample
14. Estimation of dissolved oxygen in given water sample
15. Estimation of Vitamin –C in ascorbic acid
16. Estimation of mohrs salt solution by using standard $KMnO_4$ solution
17. Estimation of HCL solutions by using standard Na_2CO_3 solution

References:

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

Course Code: 23EE2L01

ELECTRICAL CIRCUITS LAB
(ELECTRICAL & ELECTRONICS ENGINEERING)

I B.Tech Semester: II

L	T	P	C
0	0	3	1.5

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

Course Code: 23ES2L04

ENGINEERING WORKSHOP

(Common to CIVIL, EEE, ECE)

I B.Tech Semester: II

L	T	P	C
0	0	3	1.5

Course Objectives:
To familiarize students with wood working, sheet metal operations, fitting, electrical house wiring skills, and basic repairs of two-wheeler vehicle.

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.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.
9.Basic repairs of Two-wheeler vehicle – Demonstration of working of two-wheeler vehicle and its repairs.

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

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

Course Code: 23HM2L03

NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE

(Common to CIVL, EEE, ECE)

I-B.Tech Semester:II

L	T	P	C
0	0	1	0.5

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-releasingroad map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societalissues 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- Surveyin 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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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
(Accredited by NBA)

III Year –I Semester Course Code: 23EE5T07	POWER ELECTRONICS (PROFESSIONAL CORE)	L	T	P	C
		3	0	0	3

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 Cyclo converters.
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

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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.

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, 3rd Edition-2009.
2. Power Electronics: Devices, Circuits and Applications – by M. H. Rashid, Prentice Hall of India, 4th 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.

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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 Course Code: 23EE5T08	DIGITAL CIRCUITS (PROFESSIONAL CORE)	L	T	P	C
		3	0	0	3

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 – 3,4,5 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

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PROM, PAL, PLA, realization of Boolean functions.

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.

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 Course Code: 23EE5T09	POWER SYSTEMS-II (PROFESSIONAL CORE)	L	T	P	C
		3	0	0	3

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 – 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.

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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.

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.

UNIT–IV

Corona& Effects of transmission lines

Description of the phenomenon – Types of Corona - critical voltages and power loss – 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, 8th Edition-2022.
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 Course Code: 23EE5D01	SIGNALS AND SYSTEMS (PROFESSIONAL ELECTIVE- I)	L	T	P	C
		3	0	0	3

Course Outcomes:

- Differentiate the various classifications of signals and systems
- Analyze the frequency domain representation of signals using Fourier concepts
- Classify the systems based on their properties and determine the response of LTI Systems.
- Know the sampling process and various types of sampling techniques.
- 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.

UNIT–II: FOURIER SERIES AND FOURIER TRANSFORM:
Fourier series representation of continuous time periodic signals, 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 standard signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Related problems

UNIT-III:
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.

SAMPLING THEOREM: Graphical and analytical proof or Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Aliasing, Related problems.

UNIT–IV:
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.

UNIT–V:
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.

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TEXT BOOKS:

1. Signals, Systems & Communications-B.P.Lathi,BSPublications,2003.
2. Signals and Systems-A.V. Oppenheim, A.S. Willsky and S.H. Nawab,PHI,2ndEdn,1997
3. Signals & Systems-SimonHaykinandVanVeen,Wiley,2ndEdition,2007

REFERENCE BOOKS:

1. Principles of LinearSystemsandSignals–BPLathi,OxfordUniversityPress,2015
2. Signals and Systems–TK Rawat, Oxford University press,2011.

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		L	T	P	C
III Year – I Semester **Course Code: 23CS5D05**	**COMPUTER ARCHITECTURE AND ORGANIZATION** **(PROFESSIONAL ELECTIVE- I)**	**3**	**0**	**0**	**3**

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 pipe lining.

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

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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.

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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		L	T	P	C
III Year I Semester **Course Code: `23EC5D03**	**COMMUNICATION SYSTEMS (PROFESSIONAL ELECTIVE- I)**	**3**	**0**	**0**	**3**

Course Outcomes:

Analyze the performance of analog modulation schemes in time and frequency domains.

Analyze the performance of angle modulated signals.

Characterize analog signals in time domain as random processes and noise

Characterize the influence of channel on analog modulated signals

Determine the performance of analog communication systems in terms of SNR

Analyze pulse amplitude modulation, pulse position modulation, pulse code modulation and TDM systems.

UNIT – I

Basic tools for communication, Fourier Series/Transform, Properties, Autocorrelation, Energy Spectral Density, Parsevals Relation, Amplitude Modulation (AM), Spectrum of AM, Envelope Detection, Power, Efficiency, Modulation Index

UNIT2 : Double Sideband Suppressed Carrier (DSB-SC) Modulation, Demodulation, Costas Receiver,Single Sideband Modulation (SSB), Hilbert Transform, Complex Pre-envelope/ Envelope, Demodulation of SSB, Vestigial Sideband Modulation (VSB)

UNIT 3 : Angle Modulation, Frequency Modulation (FM), Phase Modulation (PM), Modulation Index, Instantaneous Frequency, Spectrum of FM Signals, Carsons Rule for FM Bandwidth, Narrowband FM Generation, Wideband FM Generation via Indirect Method, FM Demodulation

UNIT 4 : Introduction to Sampling, Spectrum of Sampled Signal, Aliasing, Nyquist Criterion, Signal Reconstruction from Sampled Signal, Pulse Amplitude Modulation, Quantization, Uniform Quantizers – Midrise and Midtread, Quantization noise, , Non uniform Quantizers, Delta Modulation, Differential Pulse Code Modulation (DPCM)

UNIT 5: : Basics of Probability, Conditional Probability, MAP Principle, Random Variables, Probability Density Functions, Applications in Wireless Channels, Basics of Random Processes ,Gaussian Random Process, Noise.

TEXTBOOKS:

1. Simon Haykin, Communications Systems, 4th Edition. John Wiley and Sons, Inc

2.Fundamentals of Wireless Communication by David Tse

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III Year I Semester Course Code: 23EE5E01	RENEWABLE ENERGY SOURCES (OPEN ELECTIVE- I)	L	T	P	C
		3	0	0	3

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.

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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 Course Code: 23EE5E02	CONCEPTS OF ENERGY AUDITING & MANAGEMENT (OPEN ELECTIVE- I)	L	T	P	C
		3	0	0	3

Pre-requisite:

Basics of Conservation of Electrical Energy

Course Objectives:

- To understand basic concepts of Energy Audit & various Energy conservation schemes.
- To design energy an energy management program.
- To understand concept of Energy Efficient Motors and lighting control efficiencies.
- To estimate/calculate power factor of systems and propose suitable compensation techniques.
- To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Course Outcomes:

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

CO1: Understand the principles of energy audit along with various Energy related terminologies.

CO2: Asses the role of Energy Manager and Energy Management program. CO3: Design a energy efficient motors and good lighting system.

CO4: Analyse the methods to improve the power factor and identify the energy instruments for various real time applications.

CO5: Evaluate the computational techniques with regard to economic aspects.

UNIT–I

Basic Principles of Energy Audit

Energy audit- definitions - concept - types of **Energy** audit - energy index - cost index - pie charts - Sankey diagrams and load profiles - Energy conservation schemes- Energy audit of industries- energy saving potential - energy audit of process industry, thermal power station - building energy audit - Conservation of Energy Building Codes (ECBC-2017)

UNIT–II:

Energy Management

Principles of energy management - organizing energy management program - initiating - planning - controlling - promoting - monitoring - reporting. Energy manager - qualities and functions - language - Questionnaire – check list for top management.

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UNIT–III:

Energy Efficient Motors and Lighting

Energy efficient motors - factors affecting efficiency - loss distribution - constructional details - characteristics – variable speed - RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design and practice - lighting control - lighting energy audit.

UNIT–IV

Power Factor Improvement and Energy Instruments

Power factor – methods of improvement - location of capacitors - Power factor with non-linear loads - effect of harmonics on power factor - power factor motor controllers – Energy Instruments- watt meter - data loggers - thermocouples - pyrometers - lux meters - tongue testers.

UNIT–V

Economic Aspects and their Computation

Economics Analysis depreciation Methods - time value of money - rate of return - present worth method - replacement analysis - lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method - net present value 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 - Heinemann publications - 1982.
2. Energy management hand book by W.CTurner - John wiley and sons - 1982.

Reference Books:

1. Energy efficient electric motors by John.C.Andreas - Marcel Dekker Inc Ltd-2nd edition - 1995
2. Energy management by Paul o’ Callaghan - Mc-graw Hill Book company-1st edition - 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12- EEO

Online Learning Resources:

1. https://nptel.ac.in/courses/108106022
2. https://archive.nptel.ac.in/courses/108/106/108106022

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III Year I Semester Course Code: 23EE5L06	POWER ELECTRONICS LAB (PROFESSIONAL CORE)	L	T	P	C
		0	0	3	1.5

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 Cyclo converter 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.
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.

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11. Single -Phase square wave bridge inverter with R & RL Loads.
12. Single - Phase PWM inverter.
13. Three-phase bridge inverter with 120^0 and 180^0 conduction mode.
14. SPWM control of Three-phase bridge inverter

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III Year I Semester Course Code: 23EE5L07	ANALOG AND DIGITAL CIRCUITS LAB (PROFESSIONAL CORE)	L	T	P	C
		0	0	3	1.5

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 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 ofMod-10 ripples 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 Course Code: 23SC5L02	SKILL ENHANCEMENT COURSE SOFT SKILLS	L	T	P	C
		0	1	2	2

Course Objectives:

- To prepare to face global competition for employment and excellence in profession.
- To help the students understand and build interpersonal and interpersonal skills that will enable them to lead meaningful professional life.

UNIT – 1: INTRODUCTION

Introduction- Emergence of life skills, Definition & Meaning, Importance& need, reasons for skill gap, Analysis--Soft Skills vs Hard skills, Linkage between industry and soft skills, Challenges, Personality Developments. Soft Skills, Soft Skills vs English - Improving Techniques.

UNIT – II: Intra-Personal:

Definition-Meaning – Importance-SWOT analysis, Johari windows - Goal Setting-quotient skills - Emotional Intelligence- Attitudinal skills - Right thinking- Problem Solving-Time management, stress management.

UNIT – III: Inter-Personal:

Definition – Meaning – Importance-Communications skills- Team Work, managerial skills
-Negotiation skills- Leadership skills, corporate etiquettes.

UNIT – IV: Verbal Skills:

Definition and Meaning-Listening skills, need- types, advantages, Importance-Improving Tips for Listening, Speaking, need- types, advantages, Importance- Improving Tips, Reading- Writing Skills, Report, Resume, statement of purpose, need- types, advantages, Importance-Improving Tips .

UNIT – V: Non Verbal Skills& Interview skills

Definition and Meaning – Importance- Facial Expressions- Eye Contact – Proxemics-Haptics -Posture, cross cultural body language, body language in interview room, appearance and dress code – Kinetics- Para Language - tone, pitch, pause, neutralization of accent, use of appropriate language, Interview skills, interview methods and questions.

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Text Books:

1. Sherfield, M. Robert at al, Cornerstone Developing Soft Skills, 4/e, Pearson Publication, New Delhi, 2014.

2. Alka Wadkar, Life Skills for Success, 1/e, Sage Publications India Private Limited, 2016.

Reference Books:

•Sambaiah.M. Technical English, Wiley publishers India. New Delhi. 2014.
•Gangadhar Joshi, From Campus to Corporate, SAGE TEXT.
•Alex.K, Soft Skills, 3rd ed. S. Chand Publication, New Delhi, 2014.
•Meenakshi Raman and Sangita Sharma, Technical Communication: Principle and Practice, Oxford University Press, 2009.
•Shalini Varma, Body Language for Your Success Mantra, 4/e, S. Chand Publication, New Delhi, 2014.
•Stephen Covey, Seven Habits of Highly Effective People, JMD Book, 2013.

Online Learning Resources:

•https://onlinecourses.nptel.ac.in/noc20_hs60/preview
•http://www.youtube.com/@softskillsdevelopment6210
•https://youtube.com/playlist?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q&si=Fs05Xh8ZrOPsR8F4
•https://www.coursera.org/learn/people-soft-skills-assessment?language=English
•https://www.edx.org/learn/soft-skills

Course Outcomes:

COs	Statements	Blooms Level
CO1	Assimilate and understood the meaning and importance of soft skills and learn how to develop them.	L1
CO2	Understand the significance of soft skills in the working environment for professional excellence.	L2
CO3	Prepare to undergo the placement process with confidence and clarity.	L3
CO4	Ready to face any situation in life and equip themselves to handle them effectively.	L6
CO5	Understand and learn the importance of etiquette in both professional and personal life	L2

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III Year I Semester Course Code: 23ES5L01	TINKERING LAB (ENGINEERING SCIENCE)	L	T	P	C
		0	0	2	1

(This Tinkering Lab will be Offered to other Departments also)

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Objectives : To

1. **Encourage Innovation and Creativity**
2. **Provide Hands-on Learning**
3. **Impart Skill Development**
4. **Foster Collaboration and Teamwork**
5. **Enable Interdisciplinary Learning**
6. **Impart Problem-Solving mind-set**
7. **Prepare for Industry and Entrepreneurship**

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

List of experiments:

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) Demonstrate a traffic light circuit using breadboard.
3) Build and demonstrate automatic Street Light using LDR.
4) Simulate the Arduino LED blinking activity in Tinkercad.
5) Build and demonstrate an Arduino LED blinking activity using Arduino IDE.
6) Interfacing IR Sensor and Servo Motor with Arduino.
7) Blink LED using ESP32.
8) LDR Interfacing with ESP32.
9) Control an LED using Mobile App.
10) Design and 3D print a Walking Robot
11) Design and 3D Print a Rocket.
12) Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.
13) Demonstrate all the steps in design thinking to redesign a motor bike.

Students need to refer to the following links:

1) https://aim.gov.in/pdf/equipment-manual-pdf.pdf

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2) https://atl.aim.gov.in/ATL-Equipment-Manual/
3) https://aim.gov.in/pdf/Level-1.pdf
4) https://aim.gov.in/pdf/Level-2.pdf
5) https://aim.gov.in/pdf/Level-3.pdf

Course Outcomes: The students will be able to experiment, innovate, and solve real-world challenges.

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III Year I Semester **Course Code: 23E5I01**	**EVALUATION OF COMMUNITY SERVICE INTERNSHIP**	**L**	**T**	**P**	**C**
		-	**-**	**-**	**2**

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		L	T	P	C
III Year II Semester **Course Code: 23EE6T10**	**ELECTRICAL MEASUREMENTS AND INSTRUMENTATION (PROFESSIONAL CORE)**	**3**	**0**	**0**	**3**

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.

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UNIT - II

Analog Wattmeters and Power Factor Meters

Electrodynamics 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.

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

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- S.Chand - 3rd edition.
3. Electrical Measurements by Buckingham and Price - Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons
5. A Course in Electrical and Electronic Measurements & Instrumentaion- J.B Gupta-14th Edition

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105153

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III Year II Semester **Course Code: 23EE6T11**	**MICROPROCESSORS AND MICROCONTROLLERS (PROFESSIONAL CORE)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite:

Basic knowledge in digital electronics, fundamentals of computers.

Course objectives:

- To understand the organization and architecture of Microprocessor
- To understand addressing modes to access memory
- To understand 8051 micro controller architecture
- To understand the programming principles for 8086 and 8051
- To understand the interfacing of Microprocessor with I/O as well as other devices
- To understand how to develop cyber physical systems

Course Outcomes:

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

CO1: Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.

CO2: Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors

CO3: Analyse the Microcontroller and interfacing capability CO4: Describe the architecture and interfacing of 8051 controller

CO5: Know the concepts of PIC micro controller and its programming.

UNIT - I

Introduction to Microprocessor Architecture

Introduction and evolution of Microprocessors – Architecture of 8086 – Memory Organization of 8086 – Register Organization of 8086– Introduction to 80286 - 80386 - 80486 and Pentium (brief description about architectural advancements only).

UNIT - II

Minimum and Maximum Mode Operations

Instruction sets of 8086 - Addressing modes – Assembler directives –Simple Programs-General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

UNIT - III

Microprocessors I/O interfacing

8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using

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8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086 – Architecture and interfacing of DMA controller (8257).

UNIT - IV

8051 Microcontroller

Overview of 8051 Microcontroller – Architecture– Memory Organization – Register set – Instruction set – Simple Programs - I/O ports and Interrupts – Timers and Counters – Serial Communication – Interfacing of peripherals.

UNIT - V

PIC Architecture

Block diagram of basic PIC 18 micro controller – registers I/O ports – Programming in C for PIC: Data types - I/O programming - logical operations - data conversion.

Text Books:

1. Ray and Burchandi - "Advanced Microprocessors and Interfacing"- Tata McGraw–Hill - 3rd edition - 2006.
2. Kenneth J Ayala - "The 8051 Microcontroller Architecture- Programming and Applications" - Thomson Publishers - 2nd Edition.
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18 - - Muhammad Ali Mazidi - RolindD.Mckinay - Danny causey -Pearson Publisher 21st Impression.

Reference Books:

1. Microprocessors and Interfacing - Douglas V Hall - Mc–Graw Hill - 2nd Edition.
2. R.S. Kaler - "A Text book of Microprocessors and Micro Controllers" - I.K. International Publishing House Pvt. Ltd.
3. Ajay V. Deshmukh - "Microcontrollers – Theory and Applications" - Tata McGraw–Hill Companies –2005.
4. Ajit Pal - "Microcontrollers – Principles and Applications" - PHI Learning Pvt Ltd - 2011.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105102
2. https://archive.nptel.ac.in/courses/108/103/108103157
3. https://nptel.ac.in/courses/106108100

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III Year II Semester Course Code: 23EE6T12	POWER SYSTEM ANALYSIS (PROFESSIONAL CORE)	L	T	P	C
		3	0	0	3

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 method 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 networks 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.

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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.

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 - 2007.
4. Power System Analysis and Design by J.Duncan Glover - M.S.Sarma - T.J.Overbye – Cengage Learning publications - 6th Edition - 2015.

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 Course Code: 23EE6D03	SWITCHGEAR AND PROTECTION (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

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

Components of a Protection System– 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, SF_6 circuit breakers and RCCB– Circuit Breaker ratings and specifications– Concept of Auto reclosing.

UNIT – II

Electromagnetic Protection

Relay connection – Balanced beam type attracted armature relay - induction disc and

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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.

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 - 3rd edition - 2022.
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 Course Code: 23EE6D04	ADVANCED CONTROL SYSTEMS (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

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.

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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.

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 Course Code: 23EE6D05	RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

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.

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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.

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 andtheir 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.

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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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		L	T	P	C
III Year II Semester	**ELECTRIC DRIVES**	**3**	**0**	**0**	**3**
Course Code: 23EE6D07	**(PROFESSIONAL ELECTIVE-III)**				

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

3-phase half and fully-controlled converter fed separately and self-excited DC

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motor drive – 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.

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

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)– PMSM: Basic operation and advantages – 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 - 2002.

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 Course Code: 23EE6D08	DIGITAL SIGNAL PROCESSING (PROFESSIONAL ELECTIVE-III)	L	T	P	C
		3	0	0	3

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.

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UNIT - III

Design and Realizations of IIR Digital Filters

Analog filter approximations – Butterworth and Chebyshev filters - Design of IIR Digital filters from analog filters withexamples. 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.

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 Course Code: 23EE6D09	HIGH VOLTAGE ENGINEERING (PROFESSIONAL ELECTIVE-III)	L	T	P	C
		3	0	0	3

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:

CO 1: Recognise the dielectric properties of gaseous materials used in HV equipment.
CO 2: Differentiate the break down phenomenon in liquid and solid dielectric materials.
CO 3: Acquaint with the techniques of generation of high AC and DC voltages
CO 4: Acquaint with the techniques of generation of high Impulse voltages and currents.
CO 5: 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:

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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.

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 – 4th Edition-2020.
3. High Voltage Insulation Engineering by RavindraArora - Wolfgang Mosch - New Age International (P) Limited - 2nd Edition-2022.

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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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
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III Year II Semester Course Code: 23EE6E03	FUNDAMENTALS OF ELECTRIC VEHICLES (OPEN ELECTIVE-II)	L	T	P	C
		3	0	0	3

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 MotorandController – Power Converters – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.

UNIT – III

Motors for Electric Vehicles

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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).

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 Course Code: 23EE6E04	ELECTRICAL WIRING ESTIMATION AND COSTING (OPEN ELECTIVE-II)	L	T	P	C
		3	0	0	3

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.

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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.

UNIT - IV

Substations

Introduction - types of substations - outdoor substations-pole mounted type - indoor substations-floor mounted type - simple examples on quantity estimation- case study.

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.

Online Learning Resources:

1. https://onlinecourses.swayam2.ac.in/nou25_ec07/preview

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III Year II Semester **Course Code: 23EE6E05**	**EMBEDDED SYSTEMS** **(OPEN ELECTIVE-II)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

CO1	Illustrate the building blocks, Core, characteristics, quality attributes of typical embedded system.	L2
CO2	Identify various electronic devices to design an embedded hardware.	L3
CO3	Identify different approaches and concepts for embedded Firmware design.	L3
CO4	Choose an Operating System for a Real – Time system and Identify fundamental issues in system co-design.	L3
CO5	Illustrate the process of embedded system development, implementation and testing using different utility tools..	L2

Unit-I: Introduction: Embedded System-Definition, History, Classification, application areas and purpose of embedded systems, The typical embedded system-Core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, PCB and passive components. Characteristics, Quality attributes of an Embedded systems, Application-specific and Domain-Specific examples of an embedded system.

Unit-II: Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

Unit-III: Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

Unit-IV: Real Time Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Threads, Processes and Scheduling, Task Scheduling, Communication, Synchronization, Device Drivers, How to choose an RTOS.
Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware, ICE.

Unit-V: Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools.
Embedded System Implementation and Testing: The main software utility tool, CAD and the hardware, Translation Tools-Pre-processors, Interpreters, Compilers and Linkers, debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

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Text Books:

1. Embedded Systems Architecture by Tammy Noergaard, Elsevier Publications, 2005
2. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications.

References:

1. Embedded Systems, Raj Kamal-Tata McGraw Hill Education Private Limited, Second Edition, 2008
2. Embedding system building blocks By Labrosse, CMP publishers.

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III Year II Semester Course Code: 23EE6L08	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB (PROFESSIONAL CORE)	L	T	P	C
		0	0	3	1.5

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 brides 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 – V.G as Null detector – Measurement of % ratio error and phase angle 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 and single-phase power using three

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voltmeter and three ammeter methods.

14. Calibration of single-phase Induction Type Energy Meter.
15. Calibration of DC ammeter and voltmeter using Crompton DC Potentiometer.
16. AC Potentiometer: Polar Form / Cartesian Form - Calibration of AC voltmeter - Parameters of choke.

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III Year II Semester	**MICROPROCESSORS AND MICROCONTROLLERS LAB**	**L**	**T**	**P**	**C**
Course Code: 23EE6L09	**(PROFESSIONAL CORE)**	**0**	**0**	**3**	**1.5**

Pre-requisite:
Concepts of Microprocessors and Microcontrollers

Course Objectives:

- To study programming based on 8086 microprocessor and 8051 microcontroller.
- To study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
- To study to interface 8086 with I/O and other devices.
- To study parallel and serial communication using 8051& PIC 18 micro controllers.

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

CO1: Write assembly language program using 8086 microprocessor based on arithmetic - logical number systems and shift operations.

CO2: Write assembly language programs for numeric operations and array handling problems.

CO3: Write a assembly program on string operations. CO4: Interface 8086 with I/O and other devices.

CO5: Do parallel and serial communication using 8051 & PIC 18 micro controllers. CO6: Program microprocessors and microcontrollers for real world applications.

List of experiments
Any 10 of the following experiments are to be conducted:

8086 Microprocessor Programs

1. Arithmetic operations – Two 16-bit numbers and multibyte numbers :addition - subtraction - multiplication and division – Signed and unsigned arithmetic operations - ASCII – Arithmetic operations.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD - BCD to ASCII conversion – BCD numbers addition.
3. Arrange the given array in ascending and descending order
4. Determine the factorial of a given number
5. By using string operation and Instruction prefix**:** Move block - Reverse string Sorting - Inserting - Deleting - Length of the string - String comparison.
6. Find the first and n^{th} number of ‘n’ natural numbers of a Fibonacci series.
7. Find the number and sum of even and odd numbers of a given array
8. Find the sum of ‘n’ natural numbers and squares of ‘n’ natural numbers
9. Arithmetic operations on 8051

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10. Conversion of decimal number to hexa equivalent and hexa equivalent to decimal number
11. Find the Sum of elements in an array and also identify the largest & smallest number of a given array using 8051

Programs on Interfacing

12. Interfacing 8255–PPI with 8086.
13. Stepper motor control using 8253/8255.
14. Reading and Writing on a parallel port using 8051
15. Timer in different modes using 8051
16. Serial communication implementation using 8051
17. Understanding three memory areas of 00 – FF Using 8051 external interrupts.
18. Traffic Light Controller using 8051.

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III Year II Semester Course Code: 23SC6L02	IOT APPLICATIONS OF ELECTRICAL ENGINEERING LAB (SKILL ENHANCEMENT COURSE)	L	T	P	C
		0	1	2	2

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:Interconnect with wireless communication technologies.

Topics to be covered in Tutorials

Module–1: Programming Arduino: (3 hrs)

Arduino - Classification of Arduino Boards - Pin diagrams – Arduino Integrated Development Environment (IDE) – Programming 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 thingspeak 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 RESEARCH METHODOLOGY	L	T	P	C
		2	0	0	-

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Minor Engineering Courses offered by EEE Department for Other Branches (Except EEE Branch)

		L	T	P	C
I	CONCEPTS OF CONTROL SYSTEMS	3	0	0	3

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.

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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.

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 Measurement

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).

AC Bridges:Measurement of inductance (Maxwell's Bridge) and capacitance (Schering Bridge), Numerical problems.

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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 Measurement

Digital Instruments:Digital Voltmeters (Successive approximation type),Digital Frequency Meters and Multimeters, Digital Tachometers and Energy Meters, – Overview and applications.

Text Books:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney, DhanpatRai & 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 - 3rdedition.

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.

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UNIT - III

Protection and Grounding

List 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 – Numerical Problems.

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.

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, NewAge 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 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

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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.

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

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 schemes of 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 an industries
CO2: Get knowledge of 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

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between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

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, 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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VI	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 motor by using AC voltage controllers.
CO5: Explains the speed control mechanism of synchronous motors.

UNIT - 1
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 - 2
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.

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UNIT - 3

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 - 4

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.

UNIT - 5

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, WileyIndia, 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.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/104/108104140
2. https://nptel.ac.in/courses/108104011

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***Honors Engineering Courses offered 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:

CO 1: Differentiate between different types of power quality problems.
CO 2: Explain the sources transient over voltages and over voltage protection.
CO 3: Explain the principles long duration over voltages and voltage regulation improvement methods.
CO 4: Analyse voltage distortion and current distortion and their indices.
CO 5: 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.

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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.

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

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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.

Online Learning Resources:

1. https://nptel.ac.in/courses/108102179
2. https://nptel.ac.in/courses/108107157

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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

CO 1: Understand the structure and benefits of smart grids.

CO 2: Analyze communication technologies and protocols in smart grids.

CO 3: Evaluate smart grid components like smart meters, energy storage, and distributed generation.

CO 4: Apply concepts in demand response and load management.

CO 5: Identify and address cyber security challenges in smart grids

UNIT – 1

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 – 2

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 – 3

Smart Grid Components and Technologies

Smart Meters: Role, Functionality, and Types-Energy Storage Systems: Batteries,

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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 – 4

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

UNIT – 5

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

CO 1: Illustrate the operation of deregulated electricity market systems and typical issues in electricity markets

CO 2: Analyze various types of electricity market operational and control issues using new mathematical models.

CO 3: Summarize power wheeling transactions and congestion management.

CO 4: Analyze impact of ancillary services.

CO 5: Understand the Power market scenarios and Electric Energy Trading in the World.

UNIT – 1

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 – 2

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

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Markets, Bilateral Markets; Market participation issues; Unit Commitment in Deregulated Environment; Competitive Bidding.

UNIT – 3

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 – 4

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.

UNIT – 5

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 andJ.E. Daalder, Springer(For Units – 1,2.3, and 4)
2. Market operations in electric power systems – M. Shahidehpour, H. YaminandZ. 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&SonsLtd., 2012.

Online Learning Resources:

1. https://nptel.ac.in/courses/108101005

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IV	HONORS ENGINEERING COURSES (POWER SYSTEMS)	L	T	P	C
		3	0	0	3
REAL TIME CONTROL OF POWER SYSTEMS					

Pre-requisite: Power systems, Power System Analysis and Protection

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:

CO 1: Illustrate different types of state estimations

CO 2: Describe security and contingency evaluation

CO 3: Demonstrate the computer control of power systems CO 4: To classify and compare the voltage stability issues. CO 5: 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

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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.

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.

Online Learning Resources:

1. https://nptel.ac.in/courses/108104191

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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 – 1

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 – 2

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.

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Phase Comparison: Block Spike and phase Splitting Techniques – Transistor Integrating type, phase comparison, Rectifier Bridge Type Comparison – Vector product devices.

UNIT – 3

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.

UNIT – 4

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 – 5

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

Online Learning Resources:

1. https://nptel.ac.in/courses/108104191

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VI	HONORS ENGINEERING COURSES (POWER SYSTEMS)	L	T	P	C
		3	0	0	3
FLEXIBLE AC TRANSMISSION SYSTEMS					

Pre-requisite: Fundamentals of Electrical Engineering, Power systems, Power Electronics

Course Objectives:

- To understand the role of FACTS controllers and their impact on improving the performance, stability, and efficiency of transmission systems.
- To analyze Compensation Techniques to explore the effects of static shunt and series compensation techniques on voltage regulation, power flow control, and system stability.
- To study Shunt Compensation Devices for Investigating the working principles and applications of Static Var Compensator (SVC) and Static Synchronous Compensator (STATCOM) for reactive power compensation.
- To select FACTS Devices by assess various power system scenarios and determine the most suitable FACTS device for specific applications to enhance power transfer capability.
- To examine Advanced Controllers by understanding the principles of operation, control strategies, and applications of Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC) for comprehensive power flow management.

Course Outcomes:
After the completion of the course the student should be able to:
CO1: Know the performance improvement of transmission system with FACTS. CO2: Demonstrate the effect of static shunt and series compensation.
CO3: Illustrate the use of SVC and STATCOM for Shunt Compensations
CO4: Determine an appropriate FACTS device for different types of applications. CO5: Know the principle of operation and various controls of UPFC& IPFC

UNIT – I:
FACTS concepts, Transmission interconnections, 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.
UNIT – II:
Static shunt compensation: Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable VAr generation, variable impedance type static VAr generation, switching converter type VAr generation, hybrid VAr generation.Basic concept of voltage and current source converters, comparison of current source converters with voltage source

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converters.

UNIT – III:

SVC and STATCOM: The regulation slope, Transfer function and dynamic performance, Transient stability enhancement and power oscillation damping, Operating point control and summary of compensation control.

UNIT – IV:

Static series compensation: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

UNIT – V:

Unified Power Flow Controller: Basic operating principle, Conventional transmission control capabilities, Independent real and reactive power flow control, Comparison of the UPFC to series compensators and phase angle regulators. Inter line Power Flow Controller (IPFC) - Introduction, operation and applications.

Text Books:

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available:--Standard Publications

Reference Books:

1. Sang.Y.Hand John.A.T, "Flexible AC Transmission systems" IEEE Press (2006).
2. HVDC & FACTS Controllers: applications of static converters in power systems- Vijay K.Sood- Springer publishers.

Online Learning Resources:

1. https://nptel.ac.in/courses/108107114
2. https://nptel.ac.in/courses/117103488

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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

CO 1: Describe the fundamental concepts and components involved in the functioning of ANN and Fuzzy Logic systems.

CO 2: Explain the functionality of different ANN models (e.g., perceptron, back propagation) and fuzzy set operations.

CO 3: Apply ANN algorithms and fuzzy logic techniques to solve practical problems like load forecasting and control systems.

CO 4: Analyze the performance and limitations of various ANN models and fuzzy controllers in different applications.

CO 5: Design and implement ANN-based solutions and fuzzy logic controllers for engineering applications, such as power system control and frequency regulation.

UNIT– 1

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

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and non-separability with examples.

UNIT– 2
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.

UNIT– 3
Classical and Fuzzy Sets
Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT– 4
Fuzzy Logic Controller (FLC)
Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision-making system), Defuzzification to crisp sets- Defuzzification methods.

UNIT– 5
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.

Online Learning Resources:
1. https://nptel.ac.in/courses/127105006

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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.

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7. Measurement of ABCD parameters on transmission line.
8. Performance of long transmission line without compensation.
9. To determine and verify the reactor compensation of transmission line.
10. Performance of long transmission line with shunt compensation.
11. To study the differential and percentage bias integrated relay operations.
12. Performance characteristics of Over current relay
13. 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

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Power Electronics

I	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:

CO 1: Demonstrate the merits of PM motors.
CO 2: Choose best control scheme for stepper motors.
CO 3: Construct the various converter circuits for Switched Reluctance Motors.
CO 4: Analyse the characteristics of Brushless dc Motor.
CO 5: 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

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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.

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.

Reference Books:

1. E. G. Janardhanan, ‘Special Electrical Machines’ PHI Learning Private Limited.
2. Krishnan, Ramu. Switched reluctance motor drives: modeling, simulation, analysis, design, and applications. CRC press, 2017.

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3. Krishnan, Ramu. Permanent magnet synchronous and brushless DC motor drives. CRC press, 2017.

Online Learning Resources:

1. https://nptel.ac.in/courses/108102156

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II	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:

- Analyze the performance of electrical machines under both steady-state and transient conditions
- Apply the transformation and derive the mathematical model of three phase Induction/synchronous motors
- Learn the dynamic modeling of special machines for the performance analysis

Course Outcomes:

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

CO1: Develop mathematical modeling of DC machines for steady state & transient analysis.
CO2: Illustrate the phase/reference frame transformations and Develop mathematical modeling of three phase induction motor.
CO3: Interpret the knowledge of reference frame theory and obtain d-q axis modeling of induction Motorsin different reference frames.
CO4: Distinguish different inductances of a synchronous motor and obtain synchronous motor modeling inthe rotor's dq_0 reference frame.
CO5: Develop the mathematical models of special electrical machines.

UNIT– 1

DC Motor Modeling :

Importance of mathematical modeling of electrical machines, 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– 2

Reference Frame Theory & 3-phase Induction Motor dq model:

Linear transformation – Phase transformation (abc to αβ0) – Power equivalence, Active transformation (αβ0 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– 3

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– 4

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– 5

Special Machines:

Modeling of Permanent Magnet Synchronous motors – 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

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. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press-Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013..

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106023/

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III	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

CO 1: Illustrate the characteristics of Switching devices and use gate drive circuits. Illustrate the operation of multilevel inverters and compare their features.
CO 2: Analyze the performance of isolated switch mode converters.
CO 3: Investigate the PWM Control of single-phase and three-phase inverters and compare various PWM techniques.
CO 4: Investigate the PWM Control of CHB and diode clamped multilevel inverters.

UNIT– 1
Overview of Switching Devices
Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.

UNIT– 2
Isolated DC-DC Converters
Need for isolated converters, Forwarded 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– 3
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-

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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– 4

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.

UNIT– 5

PWM Multilevel Inverters

CHB Multilevel Inverter: Stair case modulation-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.

Online Learning Resources:

1. https://nptel.ac.in/courses/108105066
2. https://nptel.ac.in/courses/108102584
3. https://nptel.ac.in/courses/108101126

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IV	HONORS ENGINEERING COURSES (POWER ELECTRONICS)	L	T	P	C
		3	0	0	3
POWER QUALITY AND CUSTOM POWER DEVICES					

Pre-requisite:

Basic knowledge in power systems and power electronics.

Course Objectives:

- To be familiar with the causes and effects of power quality issues.
- To know the techniques for mitigation of power quality issues.
- To study the effect of harmonics and to design filters
- To understand the working of custom power devices.
- To use a suitable device for power quality improvement

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

CO 1: Identify the issues related to power quality in power systems.
CO 2: Categorize short and long duration voltage variations in power systems.
CO 3: Analyze the effects of harmonics and study of different mitigation techniques.
CO 4: Illustrate the importance of custom power devices and their applications.
CO 5: Compare different compensation techniques to minimize power quality disturbances.

UNIT– 1

Introduction to power quality

Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.

UNIT– 2

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, Utility Lightning Protection, Load Switching Transient Problems.

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 generation.

UNIT– 3

Harmonic Distortion and solutions

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
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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.

UNIT– 4

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– 5

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, Distribution Static Compensator (D-STATCOM). Operation and control of Unified Power Quality Conditioner (UPQC).

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. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000
4. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, Arindam Ghosh, Kluwer Academic Publishers, 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).

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6. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S. Masoum-Elsevier
7. Instantaneous Power Theory and Application to Power Conditioning, H. Akagiet.al., IEEE Press, 2007.
8. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002.
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.

Online Learning Resources:

1. https://nptel.ac.in/courses/108107157
2. https://nptel.ac.in/courses/108102179
3. https://nptel.ac.in/courses/108106025

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V	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

CO 1: Illustrate the I-V characteristics of solar PV modules and use of blocking diodes and bypass diodes for shade mitigation
CO 2: Understand MPPT, usage of power converters for PV and battery charging
CO 3: Understand different Wind turbine technologies and converters for wind energy generation
CO 4: Analyze PV and wind energy integrated systems

UNIT – 1
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 – 2
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 – 3
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

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turbines, Doubly Fed Induction Generator, Permanent Magnet Synchronous Generators and their characteristics.

UNIT – 4

Converters for wind generators: AC-DC-AC converters, matrix converters, multilevel converter, Maximum power point tracking for wind turbines, fault ride through capabilities.

UNIT-5

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
2. https://nptel.ac.in/courses/103103206

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VI	HONORS ENGINEERING COURSES (POWER ELECTRONICS)	L	T	P	C
		3	0	0	3
INDUSTRIAL APPLICATIONS OF POWER ELECTRONIC CONVERTERS					

Course Educational Objective: This course enables the student understanding different power converters and their operation in LED lighting, UPS, drives and micro-grid applications.

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

		Knowledge Level (K)#
CO1	Design and analyze drivers for efficient LED lighting.	
CO2	Illustrate UPS, SMPS, Bi-directional DC-DC (BDC) converters operation and applications.	
CO3	Explain the applications of inverters and rectifiers for high power and low power applications	
CO4	Examine the operation and performance of various power converters.	
CO5	Design and implement power converters for grid integration.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	--	--	--	--	--
CO2	--	--	--	--	--
CO3	--	--	--	--	--
CO4	--	--	--	--	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT–1	**Power Converters for LED Driving:** LED Characteristics, Driving LEDs, Converters (Buck, Boost & Buck-Boost) for LED lightning systems, PFC based LED drivers, Selecting Components for LED Drives, Applications of LEDs.	
UNIT–2	**UPS and SMPS:** Components of UPS, operation and applications of UPS, Basic operation and applications of SMPS, Difference between UPS and SMPS. **Bi-directional DC-DC (BDC) converters:** Electric traction, Automotive Electronics, Battery charging converters, Line Conditioners and Solar	

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	Charge Controllers.	
UNIT–3	**High Voltage Power Supplies** - Power supplies for X-ray applications, Power supplies for radar applications, Power supplies for space applications. **Low Voltage High Current Power Supplies:** Power converters for modern Microprocessor and Computer loads.	
UNIT–4	**Power converters for AC Drives:** Two-Level VSI-Based Medium Voltage (MV) drives, NPC/H-Bridge inverter fed drive, ANPC inverter fed drive, Modular Multi level inverter fed drive, and Multi-Module Cascaded Matrix Converter fed MV drive, power converters for PMSM & BLDC motors.	
UNIT–5	**Power converters for micro-grid and grid connection of renewable energy sources:** Design, control of converters, grid synchronization and filtering requirements, Solid State Transformers technologies in Distribution system.	

Text Books:

1. Steve Winder, Power Supplies for LED Driving, Newnes, 2016, 2nd Edition.
2. Abraham I. Pressman, Keith Billings &Taylor Morey, Switching Power Supply Design, McGraw HillInternational, 2009, 3rd Edition.
3. Ali Emadi, A. Nasiri, and S. B. Bekiarov, Uninterruptible Power Supplies and Active Filters, CRCPress, 2004, 1stEdition.
4. Ali Keyhani Mohammad Marwali ,Min Dai, Integration and Control of Renewable Energy in Electric Power System, , John Wiley publishing company, 2010, 2ndEdition.

Reference Books:

1. Muhammad H. Rashid ,Power Electronics Handbook, Butterworth-Heinemann, 2023, 5th Edition
2. M Singh, K Khanchandani, Power Electronics, McGraw-Hill Education, 2006, 2nd Edition.
3. B.L. Theraja, A Textbook of Electrical Technology - Volume III, 2007,1st Edition.
4. William Ribbens, Understanding Automotive Electronics: An Engineering Perspective, ButterworthHeinemann, 2017, 8th Edition.
5. Paul C. Krause, Oleg W, Scott D. Sudhoff,Analysis of Electric Machinery & Drive systems, IEEE Press, 2013, 3rd Edition.
6. High-power Converters and AC Drives, Bin-Wu, Wiley-Blackwell, 2017, 2nd Edition.

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VII	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 comprehensive understanding of advanced control schemes for induction motor drives.
- To familiarize students with control strategies for PMSM, BLDC, and SRM drives.
- To impart knowledge on minimizing torque ripple and improving performance in motor drives.

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.

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

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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.

Online Learning Resources:

1. https://nptel.ac.in/courses/108104011
2. https://nptel.ac.in/courses/108102046

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VIII	HONORS ENGINEERING COURSES (POWER ELECTRONICS)	L	T	P	C
		3	0	0	3
FACTS CONTROLLERS					

Pre-requisite: Fundamentals of Electrical Engineering, Power systems, Power Electronics

Course Objectives:

- To understand the role of FACTS controllers and their impact on improving the performance, stability, and efficiency of transmission systems.
- To analyze Compensation Techniques to explore the effects of static shunt and series compensation techniques on voltage regulation, power flow control, and system stability.
- To study Shunt Compensation Devices for Investigating the working principles and applications of Static Var Compensator (SVC) and Static Synchronous Compensator (STATCOM) for reactive power compensation.
- To select FACTS Devices by assess various power system scenarios and determine the most suitable FACTS device for specific applications to enhance power transfer capability.
- To examine Advanced Controllers by understanding the principles of operation, control strategies, and applications of Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC) for comprehensive power flow management.

Course Outcomes:

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

CO1: Know the performance improvement of transmission system with FACTS.
CO2: Demonstrate the effect of static shunt and series compensation.
CO3: Illustrate the use of SVC and STATCOM for Shunt Compensations
CO4: Determine an appropriate FACTS device for different types of applications.
CO5: Know the principle of operation and various controls of UPFC& IPFC

UNIT – I:

FACTS concepts, Transmission interconnections, 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.

UNIT – II:

Static shunt compensation: Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable VAr generation, variable impedance type static VAr generation, switching converter type VAr generation, hybrid VAr generation.Basic concept of voltage

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and current source converters, comparison of current source converters with voltage source converters.

UNIT – III:

SVC and STATCOM: The regulation slope, Transfer function and dynamic performance, Transient stability enhancement and power oscillation damping, Operating point control and summary of compensation control.

UNIT – IV:

Static series compensation: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

UNIT – V:

Unified Power Flow Controller: Basic operating principle, Conventional transmission control capabilities, Independent real and reactive power flow control, Comparison of the UPFC to series compensators and phase angle regulators. Inter line Power Flow Controller (IPFC) - Introduction, operation and applications.

Text Books:

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available:--Standard Publications

Reference Books:

1. Sang.Y.Hand John.A.T, "Flexible AC Transmission systems" IEEE Press (2006).
2. HVDC & FACTS Controllers: applications of static converters in power systems- Vijay K.Sood- Springer publishers.

Online Learning Resources:

1. https://nptel.ac.in/courses/108107114
2. https://nptel.ac.in/courses/117103488

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IX	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 120ºmode of conduction.
5. Analysis of three-phase inverter for 180º mode of conduction.
6. Analysis of single-phase inverter with uni polar 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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X	HONORS ENGINEERING COURSES (POWER ELECTRONICS)	L	T	P	C
		0	0	3	1.5
ELECTRIC DRIVES LABORATORY					

Course Objectives:
This course enables the student to get hands on experience in understanding different control methods of DC drives and advanced electric drives through experimentation.

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

CO1: Analyze the speed control of DC drive with converter circuits.
CO2: Examine the regenerative braking of DC drives.
CO3: Examine the performance of V/f and vector control methods of AC drives

List of experiments

Any 10 of the following experiments are to be conducted:

1. Armature control based speed control of separately excited DC drive with single-phase full converter.
2. Armature control based speed control of excited DC drive with three-phase full converter.
3. Study of regenerative braking of DC drive
4. Soft starting of three-phase induction motor.
5. Performance characteristics of a three-phase induction motor using V/f control.
6. Vector control based speed control of three-phase induction motor drive
7. Study of direct torque control of three-phase induction motor
8. Speed control of PMSM motor by voltage control method.
9. Speed control of BLDC motor by voltage control method.
10. Vector control based speed control of PMSM drive.
11. Vector control based speed control of BLDC motor drive.
12. Speed control of Switched Reluctance Motor with eddy current loads

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XI	HONORS ENGINEERING COURSES (POWER ELECTRONICS)	L	T	P	C
		0	0	3	1.5
RENEWABLE 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 analyze 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.

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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.
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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XII	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:

CO 1: Simulate and analyze the performance of isolated and non-isolated DC-DC converters for electric vehicle applications.

CO 2: Implement and evaluate field-oriented and direct torque control (DTC) strategies for induction motor drives in EVs.

CO 3: Design and simulate a closed-loop control system for switched reluctance motor (SRM) and BLDC motor drives for EV applications.

CO 4: Construct and analyze a Li-ion battery pack (48V/72V, 3/5 kWh) and study its charging and discharging characteristics.

CO 5: Perform real-time analysis of propulsion motor speed, voltage, current, and power using throttle control.

CO 6: Demonstrate V/F control of induction motors and study the four-quadrant operation of propulsion motors, including motoring and braking modes.

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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.

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