DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC REGULATIONS (R23)

FOR

B. Tech Four Year Degree Programme

(Applicable for the batches admitted from the A.Y. 2023-24)

PACE INSTITUTE OF TECHNOLOGY AND SCIENCES
(Autonomous)
Approved by AICTE and Govt. of Andhra Pradesh, Accredited by NAAC (A Grade)
Recognized under 2(f) & 12(B) of UGC, Permanently Affiliated to JNTUK, Kakinada
NH-16, Near Valluramma Temple, Ongole-523272
Andhra Pradesh, India.

Academic Regulations (R23) for B. Tech (Regular-Full time)
(Effective for the students admitted into I year from the Academic Year 2023-24 onwards)

1. **Award of the Degree**

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

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

      ii. Registers for 160 credits and secures all 160 credits.

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

      i. Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 160 credits.

      ii. Registering for Honors is optional.

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

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

3. **Courses of study:**
   The following courses of study are offered at Pace Institute of Technology and Sciences,Ongole

Sl No	Branch	Short name	Code
1	Civil Engineering	CE	01
2	Electrical and Electronics Engineering	EEE	02
3	Mechanical Engineering	ME	03
4	Electronics & Communication Engineering	ECE	04
5	Computer Science and Engineering	CSE	05
6	Computer Science and Information Technology	CSIT	07
7	Information Technology	IT	12
8	Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)	CSE(IoT&CSBT)	47
9	Artificial Intelligence and Data Science	AIDS	54
10	Artificial Intelligence and Machine Learning	AIML	61
11	Computer Science and Engineering (Indian Language)	CSE-R	63
12	Electronics Engineering (VLSI Design & Technology)	EE(VLSID&T)	66

4. **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.

5. **Program related terms**

   (a) **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.

   (b) **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

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

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

6. **Semester/Credits:**

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

   (b) 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.

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

7. **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	-

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

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

9. **Programme Pattern**

(a) Total duration of the of B. Tech (Regular) Programme is four academic years.

(b) Each academic year of study is divided into two semesters.

(c) Minimum number of instruction days in each semester is 90 days.

(d) 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.

(e) Health/wellness/yoga/sports and NSS /NCC /Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduate students.

(f) Courses like Environmental Sciences, Indian Constitution, Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.

(g) Design Thinking for Innovation & Tinkering Labs are made mandatory as credit courses for all the undergraduate students.

(h) Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.

(i) 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.

(j) 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.

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

(l) 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.

(m) 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.

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

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

(p) 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.

(q) 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.

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

10. **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.

(A) **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) **Semester 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 20 marks such that each question carries 2 marks.

iii. There shall be 2 short answer questions from each unit.

◇ 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.

(B) **Practical Courses**

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

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

(b) 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.

(c) 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.

i. Procedure: 20 marks

ii. Experimental work & Results: 30 marks

iii. 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.

(d) 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. Day-to-day work shall be evaluated for 15 marks

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

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.

(e) 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.

(f) 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.

11. **Skill oriented Courses**

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

(b) 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.

(c) 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.

(d) 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.

(e) 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.

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

(g) 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 principal.

12. **Massive Open Online Courses (MOOCs):**

A Student has to pursue and complete one course compulsorily through MOOCs approved by the principal. 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 college.

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

13. **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 institute 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.

(a) The institute shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online

learning courses.

(b) 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.

(c) Credit transfer policy will be applicable to the Professional & Open Elective courses only.

(d) The concerned department shall identify the courses permitted for credit transfer.

(e) The institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.

(f) The department shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

(g) The institution shall ensure no overlap of MOOC exams with that of the semester end examination schedule. In case of delay in results, the institution will re-issue the marks sheet for such students.

(h) 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.

(i) The department shall submit the following to the examination cell & systems:

  i. List of students who have passed MOOC courses in the current semester along with the certificate of completion.

  ii. Undertaking form filled by the students for credit transfer.

(j) The institution 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.

14. **Academic Bank of Credits (ABC)**

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

(a) provide option of mobility for learners across the universities of their choice

(b) provide option to gain the credits through MOOCs from approved digital platforms.

(c) facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC

(d) execute Multiple Entry and Exit system with credit count, credit transfer and credit acceptance from students' account.

15. **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 institution.

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 Exami-

nation conducted in the presence of internal examiner and external examiner appointed by the principal 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.

16. **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.

(a) The Minor program requires the completion of 12 credits in Minor stream chosen.

(b) 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.

(c) 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.

17. **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.

(a) 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.

(b) 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).

(c) 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.

(d) The concerned Head of The Department shall arrange separate class work and timetable of the courses offered under Honors program.

(e) 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.

(f) 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.

(g) The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.

(h) A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.

(i) **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.

(j) 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.

(k) 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:

(a) Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline

(b) 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.

(c) If a student is detained due to lack of attendance either in Major or in Honors, registration shall be cancelled.

(d) Transfer of credits from Honors to regular B. Tech degree and vice-versa shall not be permitted.

(e) Honors is to be completed simultaneously with a Major degree program.

Registration for Honors:

(a) 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.

(b) 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.

(c) 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.

(d) There is no fee for registration of subjects for Honors program offered in offline at the respective institutions.

18. **Attendance Requirements:**

(a) A student shall be eligible to appear for the semester end 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.

(b) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.

(c) A stipulated fee shall be payable towards condonation of shortage of attendance to the University.

(d) 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.

(e) 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.

(f) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

(g) 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.

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

19. **Promotion Rules:**

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

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

(b) 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.

(c) 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.

(d) 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.

20. **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

(a) 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.

(b) 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 Grade Point 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.,

$$SGPA = \frac{\sum(C_i \times G_i)}{\sum(C_i)}$$

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.,

$$CGPA = \frac{\sum(C_i \times S_i)}{\sum(C_i)}$$

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	$\geq$ 7.5
First Class	$\geq$ 6.5 <7.5
Second Class	$\geq$ 5.5 <6.5
Pass Class	$\geq$ 5.0 <5.5

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

21. **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.

22. **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.

23. **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 Head of The Department shall forward such proposals submitted by the students to the principal. An evaluation committee constituted by the principal 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

24. **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.

25. **Minimum Instruction Days for a Semester:**

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

26. **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. Similarly, the medium of instruction and examinations in AICTE approved Indian language B.Tech programme are in Telugu and English.

27. **Student Transfers:**

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

28. **General Instructions:**

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

(b) Malpractices rules-nature and punishments are appended.

(c) Where the words “he”, “him”, “his”, occur in the regulations, they also include “she”, “her”, “hers”, respectively.

(d) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the competent authorities of institution is final.

(e) The institution 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 institute.

(f) In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the 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

   (a) 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.

   (b) 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**

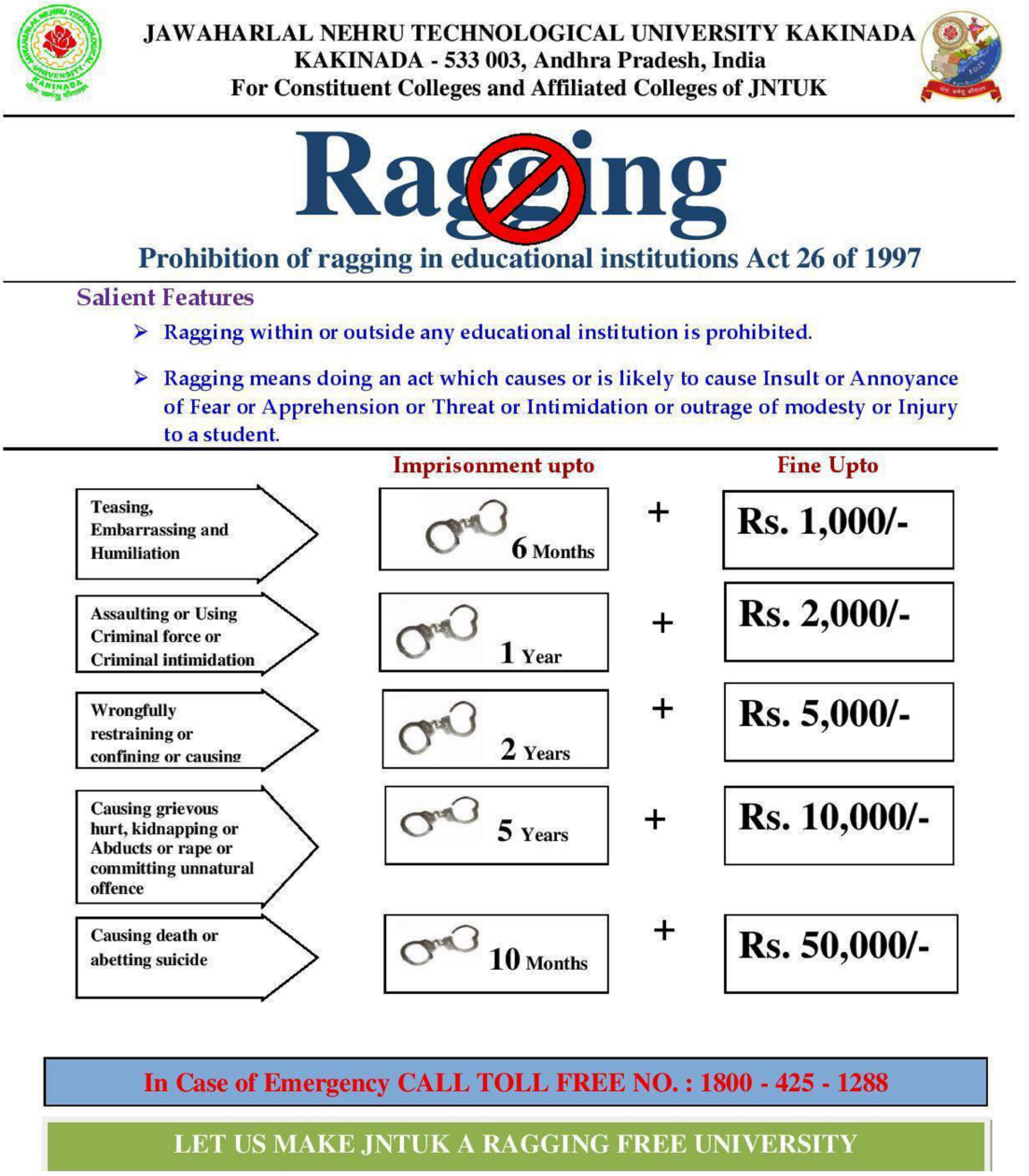
   (a) The entire course of study is three academic years on semester pattern.

(b) 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.

(c) 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).

Annexure-I


JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India
For Constituent Colleges and Affiliated Colleges of JNTUK
Ragging
Prohibition of ragging in educational institutions Act 26 of 1997
Salient Features
Ragging within or outside any educational institution is prohibited.
Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student.
Imprisonment upto
Fine Upto
Teasing, Embarrassing and Humiliation
6 Months
+
Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation
1 Year
+
Rs. 2,000/-
Wrongfully restraining or confining or causing
2 Years
+
Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence
5 Years
+
Rs. 10,000/-
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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India
For Constituent Colleges and Affiliated Colleges of JNTUK

Ragging

ABSOLUTELY NO TO RAGGING

1. **Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.**
2. **Ragging entails heavy fines and/or imprisonment.**
3. **Ragging invokes suspension and dismissal from the College.**
4. **Outsiders are prohibited from entering the College and Hostel without permission.**
5. **Girl students must be in their hostel rooms by 7.00 p.m.**
6. **All the students must carry their Identity Cards and show them when demanded**
7. **The Principal and the Wardens may visit the Hostels and inspect the rooms any time.**

Jawaharlal Nehru Technological University Kakinada
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
R-23 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

R-23 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

I Year I Semester

S.No	Course Code	Course Title	L	T	P	C
1	P23BST04	Engineering Physics	3	0	0	3
2	P23BST02	Linear Algebra & Calculus	3	0	0	3
3	P23EST03	Basic Electrical and Electronics Engineering	3	0	0	3
4	P23EST04	Engineering Graphics	1	0	4	3
5	P23EST02	Introduction to Programming	3	0	0	3
6	P23ESL04	IT Workshop	0	0	2	1
7	P23BSL02	Engineering Physics Lab	0	0	2	1
8	P23ESL03	Electrical and Electronics Engineering Workshop	0	0	3	1.5
9	P23ESL02	Computer Programming Lab	0	0	3	1.5
10	P23BST08	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5
Total Credits						20.5

I Year II Semester

S.No	Course Code	Course Title	L	T	P	C
1	P23BST01	Communicative English	2	0	0	2
2	P23BST06	Chemistry	3	0	0	3
3	P23BST03	Differential Equations & Vector Calculus	3	0	0	3
4	P23EST01	Basic Civil & Mechanical Engineering	3	0	0	3
5	P23EET02	Network Analysis	3	0	0	3
6	P23BSL01	Communicative English Lab	0	0	2	1
7	P23BSL04	Chemistry Lab	0	0	2	1
8	P23ESL01	Engineering Workshop	0	0	3	1.5
9	P23EEL02	Network Analysis and Simulation Lab	0	0	3	1.5
10	P23BSL05	Health and wellness, Yoga and sports	-	-	1	0.5
Total Credits						19.5

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

R-23 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

II Year I Semester

S.No	Course Code	Course Title	L	T	P	C
1	P23BST08	Complex Variables and Numerical Methods	3	0	0	3
2	P23BST12	Universal Human Values – Understanding Harmony	2	1	0	3
3	P23EST06	Electromagnetic Field Theory	3	0	0	3
4	P23EET03	Electrical Circuit Analysis-II	3	0	0	3
5	P23EET04	DC Machines & Transformers	3	0	0	3
6	P23EEL03	Electrical Circuit Analysis-II and Simulation Lab	0	0	3	1.5
7	P23EEL04	DC Machines & Transformers Lab	0	0	3	1.5
8	P23EES01	Data Structures	0	1	2	2
9	P23ACT01	Environmental Science	2	0	0	-
Total Credits						20

II Year II Semester

S.No	Course Code	Course Title	L	T	P	C
1	P23MBT01	Managerial Economics & Financial Analysis	3	0	0	3
2	P23EST11	Analog Circuits	3	0	0	3
3	P23EET05	Power Systems-I	3	0	0	3
4	P23EET06	Induction and Synchronous	3	0	0	3
5	P23EET07	Control Systems	3	0	0	3
6	P23EEL05	Induction and Synchronous Machines Lab	0	0	3	1.5
7	P23EEL06	Control Systems Lab	0	0	3	1.5
8	P23EES02	Python Programming	0	1	2	2
9	P23BST17	Design Thinking & Innovation	1	0	2	2
Total Credits						23
Note: Mandatory Community Service Project Internship of 08 weeks duration during summer vacation						

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

R-23 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

III Year I Semester

S.No	Course Code	Course Title	L	T	P	C
1	P23EET08	Power Electronics	3	0	0	3
2	P23EET09	Digital Circuits	3	0	0	3
3	P23EET10	POWER SYSTEMS II	3	0	0	3
4	P23EEE01	(Professional Elective-I) Signals and Systems	3	0	0	3
5	P23EEE02	(Professional Elective-I) Computer Architecture and Organization - I	3	0	0	3
6	P23EEE03	(Professional Elective-I) Communication systems	3	0	0	3
7		(Open Elective-I) The Joy of Computing using Python	0	0	3	1.5
8		(Open Elective-I) Introduction to Internet of Things	0	0	3	1.5
9		(Open Elective-I) Introduction to Industry 4.0 and Industrial Internet of Things	0	1	2	2
10	P23EEL07	Power Electronics Lab	0	0	2	1
11	P23EEL08	Analog and Digital Circuits Lab	-	-	-	2
12	P23EESO3	Soft skills	-	-	-	2
13		Tinkering Lab	-	-	-	2
Total Credits						23

III Year II Semester

S.No	Course Code	Course Title	L	T	P	C
1	P23EET11	Electrical Measurements and Instrumentation	3	0	0	3
2	P23EET12	Microprocessors and Microcontrollers	3	0	0	3
3	P23EET13	Power System Analysis	3	0	0	3
4	P23EEE04	(Professional Elective- II) Switchgear and Protection	3	0	0	3
5	P23EEE05	(Professional Elective- II) Advanced Control Systems	3	0	0	3
6	P23EEE06	(Professional Elective- II) Renewable and Distributed Energy Technologies	3	0	0	3
7	P23EEE07	(Professional Elective- III) Electric Drives	3	0	0	3
8	P23EEE08	(Professional Elective- III) Digital Signal Processing	3	0	0	3
9	P23EEE09	(Professional Elective- III) High Voltage Engineering	3	0	0	3
10		(Open Elective - II) Fundamentals of Artificial Intelligence	3	0	0	3
11		(Open Elective - II) Introduction to Machine Learning	3	0	0	3
12		(Open Elective - II) Principles of Data Base Management systems	3	0	0	3
13	P23EEL09	Electrical Measurements and Instrumentation Lab	3	0	0	1.5
14	P23EEL10	Microprocessors and Microcontrollers Lab	0	0	3	1.5
15	P23EESO4	IoT Applications of Electrical Engineering Lab	0	1	2	2
16		Research Methodology	2	0	0	-
Total Credits						23
Note: Mandatory Industry Internship of 08 weeks duration during summer vacation						

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
R-23 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

IV Year I Semester						
S.No.	**Category**	**Title**	**L**	**T**	**P**	**C**
1	Professional Core		3	0	0	3
2	Professional Core		3	0	0	3
3	Management Course - II		2	0	0	2
4	Professional Elective - IV		3	0	0	3
5	Professional Elective - V		3	0	0	3
6	Open Elective - IV		3	0	0	3
7	Professional Core		0	0	2	1
8	Professional Core		0	0	2	1
9	Skill Enhancement Course		0	1	2	2
10	Audit Course	Constitution of India	2	0	0	-
11	Internship	Evaluation of Industry Internship	-	-	-	2
Total Credits			19	1	6	23

IV Year II Semester						
S.No.	**Category**	**Title**	**L**	**T**	**P**	**C**
1	Internship & Project Work	Full semester Internship & Project Work	0	0	24	12

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST04	Engineering Physics (Common to All Branches of Engineering)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Analyze the intensity variation of light due to interference, diffraction and polarization.

CO2: Familiarize with the basics of crystals and their structures.

CO3: Summarize various types of polarization of dielectrics and classify the magnetic materials.

CO4: Explain the basic concepts of Quantum Mechanics, free electron theory.

CO5: Apply the band theory of solids and Hall Effect to study the semiconductors.

UNIT–I: Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT–II: Crystallography and X-ray diffraction

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

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

UNIT–III: Dielectric and Magnetic Materials

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

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

loss

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

UNIT–IV: Quantum Mechanics and Free electron Theory

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

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

UNIT–V: Semiconductors

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

Text Books:

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

Reference Books:

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

Web Resources:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST02	Linear Algebra & Calculus (Common to All Branches of Engineering)	3	0	0	3

Internal Marks: 30 External Marks: 70

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, the student will be able to

CO1: Demonstrate the understanding of rank of a matrix. Analyze the solutions of the system of linear equations.

CO2: Find the Eigen values and Eigen vectors of a matrix, apply Cayley-Hamilton theorem to determine inverse and power of a matrix and identify the nature of quadratic form.

CO3: Utilize mean value theorems to real life problems.

CO4: Familiarize with functions of several variables which are useful in optimization.

CO5: Familiarize with double and triple integrals of functions of several variables in two dimensions using Cartesian and polar coordinates and in three dimensions using cylindrical and spherical coordinates.

UNIT–I: Matrices

Rank of a matrix by echelon form, normal form. Cauchy–Binet formulae (without proof). Inverse of Non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

UNIT–II: Eigenvalues, Eigenvectors and Orthogonal Transformation

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

UNIT–III: Calculus

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

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

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, 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)

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, 44^{th} Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10^{th} Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14^{th} Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha ScienceInternational Ltd., 2021 5^{th} Edition (9^{th} reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5^{th} Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, , Pearson publishers, 9^{th} edition.
5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, Third Edition (Reprint 2021)

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EST03	Basic Electrical & Electronics Engineering (Common to All branches of Engineering)	3	0	0	3

Internal Marks: 30 External Marks: 70

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: At the end of the course, the student 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 Motor, (ii) DC Generator, (iii) Single Phase Transformer, Applications.

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 & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical

energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

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

Text 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

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.

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

CO1: Compare the operation and characteristics of various semiconductor devices and their utilization.

CO2: Implement various power supply circuits using diodes and amplifier circuits using BJT.

CO3: Categorize various types of Logic gates and implement simple combinational logic circuits.

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.

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.

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.

Text Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4^{th} 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.

Semester end examination pattern:

1. Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35 marks each.
2. In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1 mark.
3. 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.
4. The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EST04	Engineering Graphics (Common to All branches of Engineering)	1	0	4	3

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Understand the principles of engineering drawing, including polygons, engineering curves, scales.

CO2: Draw and interpret orthographic projections of points, lines, planes.

CO3: Understand and draw projection of solids in various positions in first quadrant.

CO4: Explain principles behind sections of solids and development of surfaces.

CO5: Convert the isometric view into orthographic view and vice versa.

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: Semiconductors

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

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

Text Books:

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	Course Name	Course Structure			
		L	T	P	C
P23EST02	Introduction To Programming (Common to All branches of Engineering)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Understand basics of computers, the concept of algorithm, flowcharts and algorithmic thinking.

CO2: Analyse a problem and develop programs involving decision structures and loops.

CO3: Implement different operations on arrays and solve problems using Strings.

CO4: Design the programs by applying the features of pointers, structures and unions.

CO5: Develop problem-solving skills and the ability to debug and optimize the code by using functions and files.

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.

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

UNIT–II: Control Structures

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.

UNIT–IV: Pointers & User Defined Data types

Pointers, dereferencing (Pointer to Pointer) and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions.

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. Scope and Lifetime of Variables, Basics of File Handling

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

Text Books:

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, 2^{nd} edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition

Course Code	Course Name	Course Structure			
		L	T	P	C
P23ESL04	IT Workshop (Common to All branches of Engineering)	0	0	2	1

Internal Marks: 30 External Marks: 70

Course Objectives:

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

Course Outcomes:

CO1: Understand the fundamental principles of computer hardware components and their interconnections.

CO2: Analyze the historical development of the Internet and its impact on global communication.

CO3: Analyze the underlying principles and structure of LaTeX and Word documents.

CO4: Implement essential toolbars and ribbons for common spreadsheet tasks.

CO5: Understand the principles of effective content organization in presentations.

CO6: Implement AI tools like ChatGPT into their professional workflows for content creation and translation.

PC Hardware & Software Installation

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

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

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

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot

(VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

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

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

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

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

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

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of LaTeX 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 LaTeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using LaTeX 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 LaTeX 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, 3^{rd} edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2^{nd} 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, 3^{rd} edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3^{rd} edition

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BSL02	Engineering Physics Lab (Common to All Branches of Engineering)	0	0	2	1

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Apply the concepts of wave optics to get wavelength of light.

CO2: Apply the concept of resonance in sonometer and melde's experiments for getting frequency.

CO3: Study the earth's gravity and rigidity modulus of material.

CO4: Study electrostatics and magnetism to determine its dependent properties.

CO5: Determine the properties of semiconductors and Planks constant.

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:

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

Web Resources:

1. www.vlab.co.in
2. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

Course Code	Course Name	Course Structure			
		L	T	P	C
P23ESL03	Electrical & Electronics Engineering Workshop (Common to All branches of Engineering)	0	0	3	1.5

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Measure voltage, current and power in an electrical circuit. (L3)

CO2: **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.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

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

References:

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

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23ESL02	Computer Programming Lab (Common to All branches of Engineering)	0	0	3	1.5

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Understand and trace the execution of programs written in C language.

CO2: Analyze the right control structure for solving the problem.

CO3: Develop C programs which utilize memory efficiently using programming constructs like pointers and structures

CO4: Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.

UNIT–I:

WEEK 1

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

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

1. Basic Linux environment and its editors like Vi, Vim & Emacs etc.
2. Exposure to Turbo C, gcc
3. Writing simple programs using printf(), scanf()

WEEK 2

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

Suggested Experiments/Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab2: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

1. Sum and average of 3 numbers
2. Conversion of Fahrenheit to Celsius and vice versa
3. 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:
Lab3: Simple computational problems using arithmetic expressions.

1. Finding the square root of a given number
2. Finding compound interest
3. Area of a triangle using heron's formulae
4. Distance travelled by an object

UNIT II
WEEK 4

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

Suggested Experiments/Activities:
Tutorial4: Operators and the precedence and as associativity:
Lab4: Simple computational problems using the operator' precedence and associativity

1. 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)
2. Find the maximum of three numbers using conditional operator
3. 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:
Lab5: Problems involving if-then-else structures.

1. Write a C program to find the max and min of four numbers using if-else.

2. Write a C program to generate electricity bill.
3. TFind the roots of the quadratic equation.
4. Write a C program to simulate a calculator using switch case.
5. 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 each of these statements is more appropriate to use.

Suggested Experiments/Activities:
Tutorial 6: Loops, while and for loops
Lab6: Iterative problems e.g., the sum of series

1. Find the factorial of given number using any loop.
2. Find the given number is a prime or not.
3. Compute sine and cos series
4. Checking a number palindrome
5. Construct a pyramid of numbers.

UNIT III
WEEK 7

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

Suggested Experiments/Activities:
Tutorial 7: 1 D Arrays: searching.
Lab7: 1D Array manipulation, linear search

1. Find the min and max of a 1-D integer array.
2. Perform linear search on1D array.
3. The reverse of a 1D integer array
4. Find 2's complement of the given binary number.
5. 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

1. Addition of two matrices
2. Multiplication two matrices
3. Sort array elements using bubble sort
4. Concatenate two strings without built-in functions
5. Reverse a string using built-in and without built-in string functions

UNIT IV
WEEK 9

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

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

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

WEEK 10

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

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

1. Create and display a singly linked list using self-referential structure.
2. Demonstrate the differences between structures and unions using a C program.
3. Write a C program to shift/rotate using bitfields.
4. Write a C program to copy one structure variable to another structure of the same type.

UNIT V
WEEK 11

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

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

1. Write a C function to calculate NCR value.
2. Write a C function to find the length of a string.
3. Write a C function to transpose of a matrix.
4. Write a C function to demonstrate numerical integration of differential equations using Euler's method

WEEK 12

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

Suggested Experiments/Activities:
Tutorial 12: Recursion, the structure of recursive calls
Lab 12: Recursive functions

1. Write a recursive function to generate Fibonacci series.
2. Write a recursive function to find the lcm of two numbers.
3. Write a recursive function to find the factorial of a number.
4. Write a C Program to implement Ackermann function using recursion.
5. 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.

1. Write a C program to swap two numbers using call by reference.
2. Demonstrate Dangling pointer problem using a C program.
3. Write a C program to copy one string into another using pointer.
4. Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK 14

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

Suggested Experiments/Activities:
Tutorial 12: Recursion, the structure of recursive calls
Lab 14: File operations

1. Write a C program to write and read text into a file.
2. Write a C program to write and read text into a binary file using fread() and fwrite()
3. Copy the contents of one file to another file.
4. Write a C program to merge two files into the third file using command-line arguments.
5. Find no. of lines, words and characters in a file
6. Write a C program to print last n characters of a given file.

Text Books:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum & 39; 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	Course Name	Course Structure			
		L	T	P	C
P23BST08	NSS/NCC/SCOUTS & Guides/Community Service (Common to All branches of Engineering)	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: At the end of the course, the student 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:

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

UNIT–II: Nature & Care :

Activities:

1. Best out of waste competition.
2. Poster and signs making competition to spread environmental awareness.
3. Recycling and environmental pollution article writing competition.
4. Organising Zero-waste day.
5. Digital Environmental awareness activity via various social media platforms.
6. Virtual demonstration of different eco-friendly approaches for sustainable living.

7. Write a summary on any book related to environmental issues.

UNIT–III: Community Service
Activities:

1. Conducting One Day Special Camp in a village contacting village-area leaders-Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc.
2. Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
3. Conducting consumer Awareness. Explaining various legal provisions etc.
4. Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
5. 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:

1. Evaluated for a total of 100 marks.
2. 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.
3. A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST01	Communicative English (Common to All Branches of Engineering)	2	0	0	2

Internal Marks: 30 External Marks: 70

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:

CO1: Understand the context, topic, and pieces of specific information from social or Transactional dialogues.

CO2: Apply grammatical structures to formulate sentences and correct word forms.

CO3: Analyze discourse markers to speak clearly on a specific topic in informal discussions.

CO4: Evaluate reading / listening texts and to write summaries based on global comprehension of these texts.

CO5: Create a coherent paragraph, essay, and resume

UNIT I

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

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

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

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

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

Vocabulary: 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

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.

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

Writing: Structure of a paragraph - Paragraph writing (specific topics)
Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.
Vocabulary: Homonyms, Homophones, Homographs.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed
Reading: Readinga text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.
Writing: Summarizing, Note-making, paraphrasing
Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations
Vocabulary: Compound words, Collocations

UNIT IV

Lesson: INSPIRATION: The Toys of Peace by Saki

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

UNIT V

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

Text Books:

1. Pathfinder: Communicative English for Undergraduate Students, 1^{st} Edition, Orient Black 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 University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources:

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
7. https://www.youtube.com/c/DailyVideoVocabulary/videos

VOCABULARY

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST06	Chemistry (Common to EEE, ECE, CSE, IT & allied branches)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives: At the end of the course the student can be able

1. To predict the Fundamentals of Quantum mechanics, energy level diagrams in homo, hetero nuclear molecules.
2. To Illustrate the commonly used industrial materials.
3. To train the students on the principles and applications of electrochemistry.
4. To train the students on the principles and applications of polymers.
5. To introduce instrumental methods, molecular machines and switches.

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

CO1: Explain the Fundamentals of Quantum mechanics, energy level diagrams in homo, hetero nuclear molecules.
CO2: Explain the. commonly used industrial materials.
CO3: Explain the principles and applications of electrochemistry.
CO4: Explain the principles and applications of polymers.
CO5: Explain the instrumental methods and applications.

UNIT–I: Structure and Bonding Models

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of ψ and $\psi 2$, particle in one dimensional box, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2, N_2 and CO, etc. π-molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT–II: Modern Engineering materials

Semiconductors – Introduction, basic concept, application

Super conductors-Introduction basic concept, applications.

Supercapacitors: Introduction, Basic Concept-Classification – Applications.

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

UNIT–III: Electrochemistry and Applications

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

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

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

UNIT–IV: Polymer Chemistry

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

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

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

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

UNIT–V: Instrumental Methods and Applications

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

Text Books:

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

Reference Books:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST03	Differential Equations and Vector Calculus (Common to All Branches of Engineering)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Solve the differential equations related to various engineering fields.

CO2: Find the complete solution to the higher order linear differential equations and apply these methods to find the current in complex electrical circuits.

CO3: Identify solution methods for partial differential equations that model physical processes.

CO3: Interpret the physical meaning of different operators such as gradient, curl and divergence.

CO4: Estimate the work done against a field, circulation and flux using vector calculus.

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

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

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

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

UNIT–III: Partial Differential Equations

Introduction, Formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method and non-linear(standard types) equations, Second order PDE: solution of linear PDE with constant coefficients- RHS term of the type $e^{ax+by}, sin(ax+by), cos(ax+by), x^m y^n$

UNIT–IV: Vector differentiation

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, Scalar potential functions, Vector identities.

UNIT–V: Vector integration

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

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44^{th} Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10^{th} Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14^{th} Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha ScienceInternational Ltd., 2021 5^{th} Edition(9^{th} reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5^{th} Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, , Pearson publishers, 9^{th} edition
5. Higher Engineering Mathematics, B. V. Ramana, McGraw Hill Education, 2017

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EST01	Basic Civil and Mechanical Engineering (Common to All branches of Engineering)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

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

CO2: Identity 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.

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: Polymers and Fuel Chemistry

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).

Text Books:

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

Reference Books:

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

PART B: BASIC MECHANICAL ENGINEERING

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

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

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

CO1: Understand the role of mechnical engineering and different engineering materials.

CO2: Explain the basics of manufacturing processes, thermal engineering and its applications.

CO3: Describe the working of different mechanical power transmission systems,power plants, 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.)

Text Books:

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

Reference Books:

1. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt.
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	Course Name	Course Structure			
		L	T	P	C
P23EET01	Electrical Circuit Analysis - I (EEE & allied branches)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Remember the basic electrical elements and different fundamental laws.

CO2: Understand network reduction techniques, transformations, concepts of self- 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: Evaluate network theorems in electrical, magnetic, and single-phase circuits.

UNIT–I: Introduction to Electrical Circuits

Basic Concepts of passive elements R, L, C and their V-I relations. Sources (dependent and independent). Network reduction techniques: series, parallel, series-parallel, star–delta and delta–star transformation, source transformation technique. Nodal analysis and mesh analysis for DC networks with dependent and independent voltage/current sources.

UNIT–II: Magnetic Circuits

Basic definitions — 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. Analysis of series and parallel magnetic circuits.

UNIT–III: Single Phase Circuits

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

UNIT–IV: Resonance

Series Resonance: Characteristics of series resonant circuit, Q-factor, selectivity, bandwidth, half-power frequencies.
Parallel Resonance: Q-factor, selectivity, bandwidth.

UNIT–V: Network Theorems (DC & AC excitations)
Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem, Compensation theorem.

Text Books:

1. William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, *Engineering Circuit Analysis*, 9th Edition, 2020.
2. M. E. Van Valkenburg, *Network Analysis*, Revised 3rd Edition, Pearson Education, 2019.

Reference Books:

1. Charles K. Alexander, Mathew N. O. Sadiku, *Fundamentals of Electrical Circuits*, 5th Edition, McGraw Hill Education (India), 2013.
2. Mahmood Nahvi, Joseph Edminister, K. Rao, *Electric Circuits* (Schaum's Outline Series), 5th Edition, McGraw Hill Education, 2017.
3. David A. Bell, *Electric Circuits*, 7th Edition, Oxford University Press, 2009.
4. Robert L. Boylestad, *Introductory Circuit Analysis*, 14th Edition, Pearson Publications, 2023.
5. A. Chakrabarti, *Circuit Theory: Analysis and Synthesis*, 7th Revised Edition, Dhanpat Rai & Co., 2018.

Web Resources:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BSL01	Communicative English Lab (Common to All Branches of Engineering)	0	0	2	1

Internal Marks: 30 External Marks: 70

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

Course Outcomes:

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills.

CO2: Apply communication skills through various language learning activities.

CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.

CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.

CO5: Create effective Course Objectives

List of Topics:

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

Suggested Software:

1. Walden Infotech
2. Young India Films

Reference Books:

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

Web Resources:

Spoken English:

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

Voice & Accent:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BSL04	Chemistry Lab (Common to EEE, ECE, CSE, IT & allied branches)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

- To verify the fundamental concepts with experiments

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

References:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23ESL01	Engineering Workshop (Common to All branches of Engineering)	0	0	3	1.5

Internal Marks: 30 External Marks: 70

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

CO1: Identify workshop tools and their operational capabilities.

CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry, welding and plumbing.

CO3: Apply sheet metal working operations in various applications and basic repairs of two weeler vehicle.

CO4: Apply basic electrical engineering knowledge for House Wiring Practice.

SYLLABUS

1. **Demonstration:** Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.

   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. **Sheet Metal Working:** Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.

   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.

   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring:** Familiarity with different types of basic electrical circuits and make the following connections.

   a) Parallel and series b) Two-way switch c) Godown lighting d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.

7. **Welding Shop:** Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.

8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

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

Text Books:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published, 2019.

2. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5^{th} Edn. 2015.

3. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.

2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.

3. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14^{th} edition

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL01	Electrical Circuits Lab (EEE & allied branches)	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Objectives:

1. To impart hands-on experience in verification of circuit laws and theorems, measurement of circuit parameters, and study of circuit characteristics.
2. To provide practical exposure to different circuits under various conditions.

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

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- and mutual-inductance, coefficient of coupling, and parameters of a choke coil.

CO4: Analyse different circuit characteristics using 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.

Hardware Requirements: Regulated Power Supplies, Analog/Digital Function Generators, Digital Multimeters, Decade Resistance Boxes/Rheostats, Decade Capacitance Boxes, Ammeters (Analog/Digital), Voltmeters (Analog/Digital), Active & Passive Electronic Components.

References:

1. Jack Kemmerly, William Hayt, Steven Durbin, *Engineering Circuit Analysis*, 6th Edition, Tata McGraw Hill Education, 2005.

2. M. E. Van Valkenburg, *Network Analysis*, Revised 3rd Edition, Pearson Education, 2019.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BSL05	Health and Wellness, Yoga and Sports (Common to All branches of Engineering)	0	0	1	0.5

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: At the end 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:

1. Organizing health awareness programmes in community
2. Preparation of health profile
3. 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:

1. 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
2. Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14^{th} 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. – 3^{rd} ed. Human Kinetics, Inc.2014

General Guidelines:

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

Evaluation Guidelines:

1. Evaluated for a total of 100 marks.
2. 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.
3. A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST08	Complex Variables & Numerical Methods (Professional Core)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

1. To elucidate the different numerical methods to solve non-linear algebraic equations.
2. To disseminate the use of different numerical techniques for carrying out numerical integration.
3. To familiarize the complex variables.
4. To equip the students to solve application problems in their disciplines.

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

CO 1: Execute the approximate roots of polynomial and transcendental equations by different algorithms. Apply Newton's forward and backward and Lagrange's formulae for equal and unequal intervals.

CO 2: Apply numerical integral techniques to different Engineering problems. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations.

CO 3: Apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic.

CO 4: Calculate the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculating residues. Make use of Cauchy Residue theorem to evaluate certain integrals.

CO 5: Analyze properties of various types of conformal mappings.

UNIT–I: Iterative Methods

Introduction, Solutions of algebraic and transcendental equations: Bisection method, Secant method, Method of false position, General Iteration method, Newton-Raphson method.

Interpolation: Newton's forward and backward formulae for interpolation with equal and unequal intervals, Lagrange's interpolation formula.

UNIT–II: Numerical Integration and Solution of Ordinary Differential Equations with Initial Conditions

Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule, Solution of initial value problems by Taylor's series, Picard's method of successive approximations, Euler's method, Runge–Kutta method (second and fourth order), Milne's Predictor and Corrector Method.

UNIT–III: Functions of a Complex Variable and Complex Integration

Introduction: Continuity, Differentiability, Analyticity, Cauchy-Riemann equations in Cartesian and polar coordinates, Harmonic and conjugate harmonic functions, Milne–Thompson method.
Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, Generalized integral formula (all without proofs) and problems on above theorems.

UNIT–IV: Series Expansions and Residue Theorem
Radius of convergence, Expansion of function in Taylor's series, Maclaurin's series, and Laurent series. Types of Singularities: Isolated, Essential singularities, Pole of order m, Residues, Residue theorem (without proof), Evaluation of real integrals of the types $\int_{-\infty}^{\infty} f(x)\,dx$ and $\int_C f(\sin\theta, \cos\theta)\,d\theta$.

UNIT–V: Conformal Mapping
Transformation by z^n, e^z, $\ln z$, $z + a$, $\sin z$, $\cos z$ (n positive integer).
Translation, rotation, inversion and bilinear transformation, fixed point, cross ratio, properties, invariance of circles and cross ratio, determination of bilinear transformation mapping given 3 points.

Text Books:

1. B. S. Grewal, *Higher Engineering Mathematics*, 44th Edition, Khanna Publishers.
2. Micheael Greenberg, *Advanced Engineering Mathematics*, 2nd edition, Pearson Publishers.

Reference Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley India.
2. B. V. Ramana, *Higher Engineering Mathematics*, 2007 Edition, Tata McGraw Hill Education.
3. Steven C. Chapra, *Applied Numerical Methods with MATLAB for Engineering and Science*, Tata McGraw Hill Education.
4. M. K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, New Age International Publications.
5. J.W. Brown and R. V. Churchill, *Complex Variables and Applications*, 9th edition, Mc-Graw Hill, 2013.

Web Resources:

1. `http://tutorial.math.lamar.edu/Classes/DE/DE.aspx`
2. `http://mathworld.wolfram.com/topics`
3. `http://www.nptel.ac.in/course.php`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST12	Universal Human Values Understanding Harmony	2	1	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO1: Define the terms like Natural Acceptance, Happiness and Prosperity.
CO2: Identify one's self, and one's surroundings (Family, Society, Nature).
CO3: Apply what they have learnt to their own self in different day-to-day real life situations.
CO4: Relate human values with human relationship and human society.
CO5: Justify the need for universal human values and harmonious existence.
CO6: Develop as socially and ecologically responsible engineers.

UNIT–I: Introduction to Value Education

- Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
- Understanding Value Education
- *Practice Session PS1:* Sharing about Oneself
- Self-exploration as the Process for Value Education
- Continuous Happiness and Prosperity – the Basic Human Aspirations
- *Practice Session PS2:* Exploring Human Consciousness
- Happiness and Prosperity – Current Scenario
- Method to Fulfill the Basic Human Aspirations

- *Practice Session PS3:* Exploring Natural Acceptance

UNIT–II: Harmony in the Human Being

- Understanding Human Being as the Co-existence of the self and the body.
- Distinguishing between the Needs of the self and the body
- *Practice Session PS4:* Exploring the difference of Needs of self and body
- The body as an instrument of the self
- Understanding Harmony in the self
- *Practice Session PS5:* Exploring Sources of Imagination in the self
- Harmony of the self with the body
- Programme to ensure self-regulation and Health
- *Practice Session PS6:* Exploring Harmony of self with the body

UNIT–III: Harmony in the Family and Society

- Harmony in the Family – the Basic Unit of Human Interaction
- 'Trust' – the Foundational Value in Relationship
- *Practice Session PS7:* Exploring the Feeling of Trust
- 'Respect' – as the Right Evaluation
- *Practice Session PS8:* Exploring the Feeling of Respect
- Other Feelings, Justice in Human-to-Human Relationship
- Understanding Harmony in the Society
- Vision for the Universal Human Order
- *Practice Session PS9:* Exploring Systems to fulfil Human Goal

UNIT–IV: Harmony in the Nature/Existence

- Understanding Harmony in the Nature
- Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
- *Practice Session PS10:* Exploring the Four Orders of Nature
- Realizing Existence as Co-existence at All Levels
- The Holistic Perception of Harmony in Existence
- *Practice Session PS11:* Exploring Co-existence in Existence

UNIT–V: Implications of Holistic Understanding – A Look at Professional Ethics

- Natural Acceptance of Human Values
- Definitiveness of (Ethical) Human Conduct
- *Practice Session PS12:* Exploring Ethical Human Conduct
- A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
- Competence in Professional Ethics
- *Practice Session PS13:* Exploring Humanistic Models in Education
- Holistic Technologies, Production Systems and Management Models – Typical Case Studies
- Strategies for Transition towards Value-based Life and Profession
- *Practice Session PS14:* Exploring Steps of Transition towards Universal Human Order

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN: 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, *Teacher's Manual for A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN: 978-93-87034-53-2

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A. N. Tripathi, New Age International Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth – by Mohandas Karamchand Gandhi
5. Small is Beautiful – E.F. Schumacher
6. Slow is Beautiful – Cecile Andrews
7. Economy of Permanence – J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India – Dharampal
10. Hind Swaraj or Indian Home Rule – by Mohandas K. Gandhi
11. India Wins Freedom – Maulana Abdul Kalam Azad

12. Vivekananda – Romain Rolland (English)
13. Gandhi – Romain Rolland (English)

Web References:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EST06	Electromagnetic Field Theory (Professional Core)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

1. To study the production of electric field and potentials due to different configurations of static charges.
2. To study the properties of conductors and dielectrics, calculate the capacitance of various configurations and understand the concept of conduction and convection current densities.
3. To study the magnetic fields produced by currents in different configurations, application of Ampere's law and Maxwell's equations.
4. To study the magnetic force and torque through Lorentz force equation in magnetic field environments.
5. To develop the concept of self and mutual inductances and the energy stored.

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

CO 1: Solve the production of electric field and potentials due to different configurations of static charges.

CO 2: Build the capacitance for various configurations and understand the concept of conduction and convection current densities.

CO 3: Calculate the magnetic fields produced by currents in different configurations and apply Ampere's and Maxwell's laws.

CO 4: Analyze the magnetic force and torque through Lorentz force equation and develop the concepts of inductance and stored energy.

CO 5: Analyze time-varying fields using Maxwell's equations and apply them to induced EMF situations.

UNIT–I: Electrostatics – I

Coordinate systems: Rectangular, cylindrical, and spherical coordinate systems. Coulomb's Law – Electric Field Intensity (EFI) – Electric fields due to volume, line, and surface charge distributions – Electric flux density – Gauss's Law and its applications – Maxwell equations.

UNIT–II: Electrostatics – II

Electric Potential – Properties of potential function – Potential gradient – Work done in an electrostatic field – Current density – Equation of continuity – Conduction and convection current densities – Ohm's law in point form – Conductors and dielectrics – Polarization – Electric dipole – Torque on dipole – Boundary conditions – Capacitance of various configurations – Energy stored and energy density – Laplace's and Poisson's equations.

UNIT–III: Magnetostatics – I

Static magnetic fields – Biot-Savart's law – Magnetic field intensity (MFI) due to different conductor shapes – Relation between magnetic flux, flux density, and MFI – Maxwell's second equation – Ampere's circuital law – Point form – Fields due to loops – Maxwell's third equation.

UNIT–IV: Magnetostatics – II

Magnetic force – Lorentz force – Force on conductors – Force between parallel conductors – Magnetic dipole and moment – Torque on loop – Scalar and vector magnetic potentials – Self and mutual inductance – Neumann's formula – Energy stored and energy density in magnetic field.

UNIT–V: Electro Dynamic Fields

Faraday's laws of electromagnetic induction – Induced EMF (statically and dynamically) – Modification of Maxwell's equations for time-varying fields – Displacement current – Poynting theorem and Poynting vector.

Text Books:

1. William H. Hayt & John A. Buck, *Engineering Electromagnetics*, 8th Edition, McGraw-Hill, 2017.
2. K.A. Gangadhar, *Field Theory*, 15th Edition, Khanna Publishers, 2004.
3. M.N.O. Sadiku, *Elements of Electromagnetics*, 4th Edition, OUP USA, 2007.

Reference Books:

1. M.N.O. Sadiku, *Principles of Electromagnetics*, 6th Edition, Oxford Publications, 2015.
2. D.J. Griffiths, *Introduction to Electrodynamics*, 4th Edition, Pearson Education, 2015.

Web Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106073/
2. https://archive.nptel.ac.in/courses/108/104/108104087/

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET03	Electrical Circuits Analysis – II (Professional Core)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Circuits Analysis – I

Course Objectives:

1. To analyze the network theorems and understand the applications of network topology to electrical circuits.
2. To analyze the concepts of balanced and unbalanced three-phase circuits.
3. To understand the behavior of RLC networks for DC and sinusoidal excitations.
4. To calculate the various two-port network parameters and to understand interconnections.
5. To understand the application of Fourier series and Fourier transforms for analysis of electrical circuits.

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

CO 1: Analyze the balanced and unbalanced 3-phase circuits for power calculations.
CO 2: Analyze the transient behavior of electrical networks in different domains.
CO 3: Estimate various network parameters.
CO 4: Apply the concept of Fourier series to electrical systems.
CO 5: Analyze the filter circuit for electrical circuits.

UNIT–I: Analysis of Three-Phase Circuits

Balanced Circuits: Phase sequence, star and delta connections of sources and loads, relation between line and phase quantities, analysis of balanced three-phase circuits, measurement of active and reactive power.

Unbalanced Circuits: Loop method, Star-Delta transformation technique, two-wattmeter method for power measurement.

UNIT–II: Laplace Transforms and Transient Analysis

Laplace transforms of standard functions, shifting theorem, transforms of derivatives and integrals, inverse Laplace transforms and applications.

Transient Response: R-L, R-C, R-L-C circuits (series and parallel), for D.C. and sinusoidal excitations – initial conditions – solution using differential equations and Laplace transforms.

UNIT–III: Two-Port Network Parameters

Impedance, admittance, hybrid, and transmission (ABCD) parameters – conversion between parameters – conditions for reciprocity and symmetry – interconnection of two-port networks: series, parallel, and cascade.

UNIT–IV: Fourier Series Applications

Fourier series and evaluation of coefficients – trigonometric and complex forms – application to electrical systems – effective value, average value of non-sinusoidal waveforms, power factor, effect of harmonics.

UNIT–V: Filters

Classification of filters: Low-pass, high-pass, band-pass, band-elimination – constant-k filters – low-pass and high-pass – filter design.

Text Books:

1. William Hayt and Jack E. Kemmerly, *Engineering Circuit Analysis*, 8th Edition, McGraw-Hill, 2013.
2. Charles K. Alexander and Mathew N. O. Sadiku, *Fundamentals of Electric Circuits*, 3rd Edition, Tata McGraw-Hill, 2019.

Reference Books:

1. M. E. Van Valkenburg, *Network Analysis*, 3rd Edition, Pearson Education, 2019.
2. N. C. Jagan and C. Lakshminarayana, *Network Theory*, 3rd Edition, B. S. Publications, 2015.
3. A. Sudhakar and Shyam Mohan S. Palli, *Circuits and Networks: Analysis and Synthesis*, 5th Edition, Tata McGraw-Hill, 2017.

Web Resources:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET04	DC Machines & Transformers (Professional Core)	3	0	0	3

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Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Circuits

Preamble: This is a basic course on rotating electrical machines. This course covers the topics related to principles, performance, applications and design considerations of DC machines and transformers.

Course Objectives:

1. To understand the construction, principle of operation and performance of DC machines.
2. To learn the characteristics, performance, methods of speed control and testing methods of DC motors.
3. To predetermine the performance of single-phase transformers with equivalent circuit models.
4. To understand the methods of testing of single-phase transformer.
5. To analyze the three-phase transformers and achieve three-phase to two-phase conversion.

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

CO 1: Explain the construction and principal operation of DC generators.

CO 2: Calculate the torque production and performance of DC machines.

CO 3: Explain the construction and principle of operation of single-phase transformers.

CO 4: Apply various testing methods for transformer testing.

CO 5: Analyze various configurations of three-phase transformers.

UNIT–I: DC Generators

Construction and principle of operation of DC machines – EMF equation for generator – Types of DC Generators – Excitation techniques – Characteristics of DC generators – Applications of DC generators – Load test on DC machines.

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

Construction and principle of operation of DC motor – Torque equations – Back EMF – Characteristics of DC motors – Losses and efficiency – Applications of DC motors – Necessity of a starter – 3-point and 4-point starters – Speed control methods – Testing of DC machines: brake test, Swinburne's test, Hopkinson's test, Field test.

UNIT–III: Single-phase Transformers

Construction and principle of operation – EMF equation – Operation on no-load and load – Loads with lagging, leading and unity power factors – Phasor diagrams – Equivalent circuit – Regulation – Losses and efficiency – Effect of variation of frequency and supply voltage – All-day efficiency – Applications.

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 – Autotransformer – Equivalent circuit – Comparison with two-winding transformers.

UNIT–V: Three-Phase Transformers

Polyphase connections: Y-Y, Y-Δ, Δ-Y, Δ-Δ, Open-Δ and Vector groups – Third harmonics in phase voltages – Parallel operation – Three-winding transformers – Transients in switching – Off-load and on-load tap changers – Scott connection.

Text Books:

1. P. S. Bimbhra, *Electrical Machinery*, 7th Edition, Khanna Publishers.
2. M.G. Say, *The Performance and Design of Alternating Current Machines*, 1st Edition, CBS Publishers.

Reference Books:

1. D. P. Kothari, I. J. Nagrath, *Electrical Machines*, 5th Edition, McGraw Hill.
2. Stephen J. Chapman, *Electrical Machinery Fundamentals*, 4th Edition, McGraw Hill.
3. P. S. Bimbhra, *Generalized Theory of Electrical Machines*, 7th Edition, Khanna Publishers.
4. J. B. Gupta, *Theory & Performance of Electrical Machines*, 13th Edition, S.K. Kataria & Sons.
5. Fitzgerald, Kingsley, Umans, *Electric Machinery*, 6th Edition, McGraw-Hill.

Web Resources:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL03	Electrical Circuit Analysis-II & Simulation Lab (Professional Core)	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Physics, Electrical Circuit Analysis-I

Course Objectives:

1. To verify and demonstrate various theorems and resonance.
2. To draw the locus diagram of series circuits.
3. To determine the various parameters of a two-port network.
4. To determine self and mutual inductance of a magnetic circuit, parameters of a given coil.
5. To measure the power of a three-phase unbalanced circuit.

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

CO 1: Calculate the power in three-phase circuits.
CO 2: Analyze the time response of given networks.
CO 3: Analyze two-port network parameters.
CO 4: Analyze electrical circuits using software tools.
CO 5: Apply various theorems to solve different electrical networks using simulation tools.

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 superposition 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 using simulation tools.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL04	DC Machines & Transformers Lab (Professional Core)	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Electrical Machines

Course Objectives:

1. To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
2. To control the speed of DC motors.
3. To determine and predetermine the performance of DC machines.
4. To predetermine the efficiency and regulation of transformers and assess their performance.

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

CO 1: Demonstrate starting and speed control methods of DC Machines.
CO 2: Apply theoretical concepts to determine the performance characteristics of DC Machines.
CO 3: Analyze the parallel operation of single-phase transformers.
CO 4: Determine the performance parameters of single-phase transformers.
CO 5: Analyze the performance of transformers using various tests.

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. Field 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.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EES01	Data Structures (Professional Core)	0	1	2	2

Internal Marks: 15 External Marks: 35

Course Prerequisite: Programming in C

Course Objectives:

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

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

CO 1: Identify the role of data structures in organizing and accessing data.
CO 2: Design, implement, and apply linked lists for dynamic data storage.
CO 3: Develop applications using stacks and queues.
CO 4: Design and implement algorithms for operations on binary trees and binary search trees.
CO 5: Devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, and trees.

UNIT–I: Introduction to Data Structures

Data types (ADTs) and its specifications, elements of arrays, Row Major and Column Major storage of Arrays, Linear and Binary Search, Sorting Techniques.

Sample Experiments:

- Program to find min & max element in an array.
- Program to implement matrix multiplication.
- Find an element in a sorted array using Binary Search.
- Implement Selection and Quick sort techniques.

UNIT–II: Linked Lists

Singly linked lists: representation and operations, Doubly linked lists and Circular linked lists, Comparing arrays and linked lists, Applications of linked lists.

Sample Experiments:

- Implement insert, delete, and traversal operations.
- Store name, roll number, and marks of students using circular double linked list.

- Perform addition of two polynomial expressions using linked list.

UNIT–III: Stacks

Introduction to stacks: properties and operations, Implementing stacks using arrays and linked lists, Applications in expression evaluation, backtracking, reversing lists.

Sample Experiments:

- Implement stack using arrays and linked list.
- Convert infix to postfix expression.
- Evaluate postfix expression.
- Reverse linked list using stack.

UNIT–IV: Queues & Deques

Queues: Introduction, properties, operations; Circular queues; Implementing queues using arrays and linked lists; Applications like job scheduling.

Deques: Introduction, operations, and applications.

Sample Experiments:

- Implement queue operations using arrays and linked lists.
- Implement circular queue using arrays and linked lists.
- Implement dequeue using linked list.

UNIT–V: Trees

Introduction to Trees, Binary Trees and Tree Traversals, Binary Search Tree – Insertion, Deletion & Traversal.

Sample Experiments:

- Implement binary tree traversals using linked list.
- Create binary search tree for given list of integers and perform in-order traversal, insertion, and deletion.

Text Books:

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

Reference Books:

1. Kurt Mehlhorn and Peter Sanders, *Algorithms and Data Structures: The Basic Toolbox*.

2. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, *C Data Structures and Algorithms*.

3. Brad Miller and David Ranum, *Problem Solving with Algorithms and Data Structures*.

4. Thomas H. Cormen et al., *Introduction to Algorithms*.

5. Robert Sedgewick, *Algorithms in C, Parts 1–5 (Bundle)*.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23ACT01	Environmental Science (Professional Core)	2	0	0	0

Internal Marks: 30 External Marks: 70

Course Objectives:

1. To make the students aware of the environment and provide an overall understanding of natural resources.
2. To understand the concept of ecosystems and their importance.
3. To create awareness on the importance of biodiversity and the need for its conservation.
4. To explain the adverse effects of environmental pollution and the measures to control it.
5. To familiarize students with various environmental challenges, social issues, legislation, and global treaties.

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

CO 1: Explain the concepts of ecosystems, their function, and the need for protecting the food web.
CO 2: Analyze the natural resources essential for life and the need for conservation.
CO 3: Explain the biodiversity of India, threats, and conservation practices.
CO 4: Distinguish various types of pollution, their impacts, and control measures including waste management.
CO 5: Interpret environmental policies, legislation, and processes like EIA and audits.

UNIT–I: Multidisciplinary Nature of Environmental Studies

Definition, Scope and Importance – Need for Public Awareness.
Renewable energy resources: solar energy, wind, ocean, tidal energy.
Non-renewable energy resources: LPG, water gas, producer gas.
World food problems, degradation and soil erosion – overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging and salinity.

UNIT–II: Ecosystems

Concept, structure and function – Producers, consumers, decomposers – Energy flow – Ecological succession – Pyramids, food chains, food webs.
Types and features of ecosystems: Forest, Grassland, Desert, Aquatic (River and Lake).

UNIT–III: Biodiversity and its Conservation

Definition – Genetic, species and ecosystem diversity – Biogeographical classification of India – Biodiversity value: consumptive, productive, social, ethical, aesthetic – Levels: global, national, local – Hotspots – Threats: habitat loss, poaching – Endangered and endemic species – In-situ and Ex-situ conservation.

UNIT–IV: Environmental Pollution

Definition, causes, effects, control measures of: Air, Water, Soil, Marine, Noise, Nuclear hazards.

Solid Waste Management – Urban and industrial waste impacts – Disaster management: floods, earthquakes, cyclones, landslides.

UNIT–V: Social Issues and the Environment

Sustainable development – Urban energy problems – Water conservation, rainwater harvesting, watershed management – Environmental ethics – Climate change, global warming, acid rain, ozone depletion, nuclear accidents – Population growth and impacts – Environmental Impact Assessment (EIA) – Environmental Protection Acts.

Text Books:

1. Erach Bharucha, *Textbook of Environmental Studies for Undergraduate Courses*, Universities Press, 2005.
2. Benny Joseph, *Environmental Studies*, Tata McGraw Hill, 2008.

Reference Books:

1. Dr. A. Ravikrishnan, *Environmental Science & Engineering*, Hitech Publishing, 2013.
2. Anubha Koushik and C.P. Koushik, *Perspectives in Environmental Studies*, New Age International, 2004.

Online References:

1. `https://oxfordre.com/environmentalscience`
2. `https://www.msichicago.org/science/environmental-science`
3. `http://collegesat.du.ac.in/UG/Envinromental%20Studies%20ebook.pdf`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23MBT01	Managerial Economics and Financial Analysis	2	0	0	2

Internal Marks: 30 External Marks: 70

Course Prerequisite: None

Course Objectives:

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

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

CO 1: Define the concepts related to Managerial Economics, financial accounting and management.

CO 2: Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets.

CO 3: Apply the concept of Production, cost and revenues for effective business decision.

CO 4: Analyze how to invest their capital and maximize returns.

CO 5: Evaluate the capital budgeting techniques.

CO 6: Develop the accounting statements and evaluate the financial performance of business entity.

UNIT–I: Managerial Economics

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

UNIT–II: Production and Cost Analysis

Introduction – Nature, meaning, significance, functions and advantages.
Production Function – Least-cost combination – Short run and long run Production

Function – Isoquants and Isocosts, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems).

UNIT–III: Business Organizations and Markets

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

UNIT–IV: Capital Budgeting

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

UNIT–V: Financial Accounting and Analysis

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

Text Books:

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

Reference Books:

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

Web References:

1. https://www.slideshare.net/123ps/managerial-economics-ppt

2. https://www.slideshare.net/rossanz/production-and-cost-45827016
3. https://www.slideshare.net/darkyla/business-organizations-19917607
4. https://www.slideshare.net/balarajbl/market-and-classification-of-market
5. https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396
6. https://www.slideshare.net/ashu1983/financial-accounting

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EST11	Analog Circuits	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

1. Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of pn diode.
2. Acquire knowledge about diode applications and the operation of Bipolar Junction Transistors.
3. Understand the operation of feedback amplifiers and oscillators.
4. Learn the concepts and applications of operational amplifiers.
5. Understand the principles of A/D and D/A converters.

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

CO 1: Understand the various concepts of pn junction diode.
CO 2: Design diode applications and explain transistor concepts.
CO 3: Design feedback amplifiers and oscillators.
CO 4: Design various circuits using operational amplifiers.
CO 5: Explain the concepts of A/D and D/A converters.
CO 6: Understand the characteristics of special semiconductor devices.

UNIT–I: Junction Diode Characteristics

Energy band diagram of PN junction diode, open-circuited p-n junction, biased p-n junction, V-I characteristics, temperature dependence, diode resistance, and capacitance.

UNIT–II: Special Semiconductor Devices and Transistor Characteristics

The diode as a circuit element, clipping circuits (single and dual level), clamping circuits. Junction transistor characteristics in CB, CE, and CC configurations; punch through and reach through effects.

UNIT–III: Feedback Amplifiers and Oscillators

Classification of amplifiers, feedback concept, characteristics of negative-feedback amplifiers, voltage-series, current-series, and voltage-shunt feedback. Barkhausen criterion, R-C phase shift oscillator, Wien bridge oscillator, crystal oscillator.

UNIT–IV: Operational Amplifiers

Basic op-amp concepts, ideal and practical characteristics, block diagram, DC and AC characteristics. Applications: instrumentation amplifier, log and antilog amplifiers, differentiator, integrator.

UNIT–V: Digital to Analog and Analog to Digital Converters

Basic DAC techniques: weighted resistor, R-2R ladder, inverted R-2R. ADC types: parallel comparator, counter type, successive approximation, dual slope ADC. DAC and ADC specifications.

Text Books:

1. J. Millman, C. C. Halkias, Satyabrata Jit, *Electronic Devices and Circuits*, McGraw Hill, 4th Edition, 2015.
2. J. Millman, C. Halkias, Ch. D. Parikh, *Integrated Electronics*, McGraw Hill, 2nd Edition, 2009.
3. D. Roy Choudhury, *Linear Integrated Circuits*, New Age International, 2nd Edition, 2003.

Reference Books:

1. Chinmoy Saha et al., *Basic Electronics – Principles and Applications*, Cambridge University Press.
2. Robert L. Boylestad, Louis Nashelsky, *Electronic Devices & Circuit Theory*, Pearson, 11th Edition, 2015.
3. R.A. Gayakwad, *Operational Amplifiers and Linear Integrated Circuits*, Prentice Hall India, 2002.
4. Sanjay Sharma, *Operational Amplifiers and Linear Integrated Circuits*, Kataria & Sons, 2nd Edition, 2010.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET05	Power Systems-I	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

1. To study the principle of operation of thermal and hydroelectric power plants.
2. To study the working principle of nuclear power plants.
3. To study the construction and operation of air and gas insulated substations.
4. To study the constructional details of cables and understand power factor aspects.
5. To study different types of load curves and tariff methods.

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

CO 1: Demonstrate the layout and components of hydroelectric and thermal power plants.
CO 2: Explain the working principle of nuclear power plants.
CO 3: Explain the construction and operation of air and gas insulated substations.
CO 4: Explain the construction and working of underground cables.
CO 5: Calculate load and demand factors, and analyze different tariff methods.

UNIT–I: Hydroelectric and Thermal Power Stations
Selection of site and layout of hydroelectric power plants – Major components and principle of operation. Thermal power plants – Selection of site, layout, boilers, economizers, superheaters, steam turbines, condensers, cooling towers, and chimneys.

UNIT–II: Nuclear Power Stations
Working principle – Nuclear fission, fuels, chain reaction, reactor components (moderators, control rods, reflectors, coolants), types of reactors (PWR, BWR, FBR), radiation hazards and shielding, nuclear waste disposal.

UNIT–III: Substations
Classification – Air Insulated Substations (indoor outdoor), 33/11kV layout, bus bar arrangements: single, sectionalized, double, main and transfer bus systems. Gas Insulated Substations – Advantages, construction, installation, comparison with AIS.

UNIT–IV: Underground Cables and Distribution Systems
Cable types, construction, insulation materials, resistance, stress, capacitance (single and 3-core), grading techniques. Distribution systems – AC distribution, overhead vs underground, connection schemes, and design considerations.

UNIT–V: Economic Aspects and Tariffs

Load curve, load duration curve, demand and load factors, diversity, plant capacity and use factors, base/peak load plants. Tariff types – simple, flat, block, two-part, three-part, power factor tariffs.

Text Books:

1. M.L. Soni et al., *Power System Engineering*, Dhanpat Rai, 6th Ed., 2008.
2. C.L. Wadhwa, *Generation, Distribution and Utilization of Electric Energy*, New Age, 3rd Ed., 2015.

Reference Books:

1. *"Power System Engineering."* I.J. Nagarath & D.P. Kothari, McGraw-Hill Education, 3rd Edition, 2019.
2. *"Generation, Distribution and Utilization of Electrical Energy."* C.L. Wadhwa, New Age International Publishers, 6th Edition, 2018.
3. *"Principles of Power Systems."* V.K. Mehta and Rohit Mehta, S. Chand, 4th Edition, 2005.

Web Resources:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET06	Induction and Synchronous Machines	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

1. To understand the principle of operation and performance of 3-phase induction motor.
2. To quantify the performance of induction motor and induction generator in terms of torque and slip.
3. To understand the torque producing mechanism of a single-phase induction motor.
4. To understand the principle of emf generation, the effect of armature reaction and redetermination of voltage regulation in synchronous generators.
5. To study parallel operation and load sharing of synchronous generators.

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

CO 1: Explain the construction and principle of operation of three-phase induction motor.

CO 2: Analyze the torque-speed relation, performance of induction motor and induction generator.

CO 3: Analyze the single-phase induction motors and three-phase induction motor and starting methods.

CO 4: Explain winding design and predetermine the regulation of synchronous generators.

CO 5: Demonstrate the hunting phenomenon, correction methods of power factor with synchronous motor.

UNIT–I: 3-Phase Induction Motors

Construction of Squirrel cage and Slipring induction motors – production of rotating magnetic field – principle of operation – rotor emf and rotor frequency – rotor current and power factor at standstill and during running conditions – rotor power input, rotor copper loss and mechanical power developed and their interrelationship – equivalent circuit – phasor diagram.

UNIT–II: Performance of 3-Phase induction motors :

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

UNIT–III: Single Phase Induction Motors

Constructional features – problem of starting – double revolving field theory – cross field theory – equivalent circuit – Methods of starting: Capacitor start capacitor run, capacitor start induction run, split phase and shaded pole – AC series motors.

UNIT–IV: Synchronous Generator

Constructional features of non-salient and salient pole machines – types of armature windings – distribution and pitch factors – EMF equation – armature reaction – voltage regulation by synchronous impedance method, MMF method, and Potier triangle method – two-reaction analysis of salient pole machines – methods of synchronization – Slip test – Parallel operation of alternators.

UNIT–V: Synchronous Motor

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

Text Books:

1. *"Electrical Machines"*, P.S. Bhimbra, Khanna Publishers, 7th Edition, 1977.
2. *"Electric Machinery"*, A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, McGraw Hill Education, 6th Edition, 2017.

Reference Books:

1. *"Performance and Design of AC Machines"*, M.G. Say, CBS Publishers and Distributors, 1st Edition, 2005.
2. *"Alternating Current Machines"*, A.F. Puchstein, T.C. Lloyd, A.G. Conrad, ASIA Publishing House, 3rd Edition, 1972.
3. *"Electrical Machinery Fundamentals"*, Stephen J. Chapman, McGraw Hill Education, 4th Edition, 2017.
4. *"Electrical Machines"*, R.K. Rajput, Lakshmi Publications, 5th Edition, 2016.

Web Resources:

1. `https://onlinecourses.nptel.ac.in/noc21_ee13/preview`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET07	Control Systems	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Objectives:

1. To obtain the mathematical models of physical systems and derive transfer function.
2. To determine the time response of systems and analyse system stability.
3. To analyse system stability using frequency response methods.
4. To design compensators using Bode diagrams.
5. 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:

CO 1: Illustrate the transfer function of physical systems and determine overall transfer function using block diagram algebra and signal flow graphs.

CO 2: 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.

CO 3: Analyze the stability of LTI systems using frequency response methods.

CO 4: Explain Lag, Lead, Lag-Lead compensators to improve system performance using Bode Diagrams.

CO 5: Apply state space analysis concepts to represent physical systems as state models, derive transfer function and determine the response. Understand the concepts of controllability and observability.

UNIT–I: Mathematical Modelling of Control Systems

Classification of control systems—open loop and closed loop control systems and their differences – Feedback characteristics – transfer function of linear systems, differential equations of electrical networks—translational and rotational mechanical systems – transfer function of Armature voltage-controlled DC servo motor – block diagram algebra – signal flow graph – reduction using Mason's gain formula.

UNIT–II: Time Response Analysis

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

Stability and Root Locus Techniques

The concept of stability – Routh's stability criterion – limitations of Routh's stability

– root locus concept – construction of root loci (simple problems) – effect of addition of poles and zeros to the transfer function.

UNIT–III: Frequency Response Analysis

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

UNIT–IV: Classical Control Design Techniques

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

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 – Controllable Canonical Form – Observable Canonical Form – Diagonal Canonical Form – diagonalization using linear transformation – solving the time invariant state equations – State Transition Matrix and its properties – concepts of controllability and observability.

Text Books:

1. *Modern Control Engineering*, Kotsuhiko Ogata, Prentice Hall of India, 2010.
2. *Automatic Control Systems*, Benjamin C. Kuo, Prentice Hall of India, 2nd Edition.

Reference Books:

1. *Control Systems: Principles and Design*, M. Gopal, Tata McGraw Hill Education Pvt Ltd., 4th Edition.
2. *Control Systems Engineering*, Norman S. Nise, Wiley Publications, 7th Edition.
3. *Control Systems*, Manik Dhanesh N., Cengage Publications.
4. *Control Systems Engineering*, I.J. Nagarath and M. Gopal, New Age Publications, 5th Edition.
5. *Control Systems Engineering*, S. Palani, Tata McGraw Hill Publications.

Web 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`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL05	Induction and Synchronous Machines Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Objectives:

1. To control the speed of three phase induction motors.
2. To determine /predetermine the performance of three phase and single-phase induction motors.
3. To improve the power factor of single-phase induction motor.
4. To improve the power factor of single-phase induction motor.

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

CO 1: Assess the performance of single phase and three phase induction motors.
CO 2: Measure and control the speed of three phase induction motor.
CO 3: Predetermine the regulation of three–phase alternator by various methods.
CO 4: Calculate the Xd/ Xq ratio of alternator and assess the performance of three–phase synchronous motor.
CO 5: Determine the performance of a single-phase AC series motor.

List of Experiments

1. Brake test on three phase Induction Motor.
2. No–load & Blocked rotor tests on three phase Induction motor.
3. Regulation of a three–phase alternator by synchronous impedance & m.m.f. Methods.
4. Regulation of three–phase alternator by Potier triangle method.
5. V and Inverted V curves of a three–phase synchronous motor.
6. Determination of Xd and Xq of a salient pole synchronous machine.
7. Equivalent circuit of single phase induction motor.
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three-phase alternator by loading with three phase induction motor.
10. Power factor improvement of single-phase induction motor by using capacitors and load test on single-phase induction motor.
11. Parallel operation of three-phase alternator.

12. Brake test on single-phase AC series Motor.
13. Starting methods of a capacitor start and capacitor start run single-phase Induction motor.
14. Brake test on single-phase Induction Motor.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL06	Control Systems Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Objectives:

1. To determine/predetermine the performance of three-phase and single-phase induction motors.
2. To improve the power factor of single-phase induction motor.
3. To improve the power factor of single-phase induction motor.

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

CO 1: Analyze the performance of Magnetic amplifier, D.C and A.C. servo motors and Synchros.
CO 2: Design PID Controllers and Compensators.
CO 3: Evaluate temperature control of an oven using PID controller.
CO 4: Determine the transfer function of D.C Motor and examine the truth table of logic gates using PLC.
CO 5: Judge the stability in time and frequency domain and apply Kalman's test for controllability and observability.

List of Experiments

1. Analysis of Second order system in 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 5th order using MATLAB
7. Kalman's test of Controllability and Observability using MATLAB
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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EES02	Python Programming (Skill Enhancement Course)	1	0	2	2

Internal Marks: 30 External Marks: 70

Course Objectives:

1. Introduce core programming concepts of Python programming language.
2. Demonstrate Python data structures like Lists, Tuples, Sets and Dictionaries.
3. Implement Functions, Modules and Regular Expressions in Python.
4. Create practical and contemporary applications using Python.

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

CO 1: Understand the fundamentals of Python and control flow structures.
CO 2: Implement functions, strings, and list operations in Python.
CO 3: Utilize dictionaries, tuples and sets for real-life applications.
CO 4: Perform file operations and apply object-oriented concepts in Python.
CO 5: Apply Python for data science tasks using NumPy and Pandas.

UNIT–I: Introduction and Control Flow

History, installation (Anaconda, Jupyter). Identifiers, Keywords, Variables, Data types, Operators, Input/Output, Type Conversion. Control statements: if, if-else, loops, break, continue, try-except.

Sample Experiments:

- Max of 3 numbers
- Prime numbers in interval
- Swap variables
- Operator demonstration
- Complex number operations
- Multiplication table

UNIT–II: Functions, Strings and Lists

Functions, Built-in modules, Scope, args/kwargs, Command-line arguments. Strings: slicing, formatting, methods. Lists: indexing, slicing, built-ins, methods.

Sample Experiments:

- Functions with return/default args
- String operations (length, substring)

- List manipulations (add, slice, built-ins)

UNIT–III: Dictionaries, Tuples and Sets

Create, access, update dictionaries. Tuple creation, operations, relations. Sets, operations, frozenset.

Sample Experiments:

- Tuple creation and concatenation
- Vowel count without control flow
- Dictionary key existence, sum

UNIT–IV: Files and Object-Oriented Programming

File types, reading/writing text and binary, CSV, Pickle, os module. Classes, objects, constructors, attributes, encapsulation, inheritance, polymorphism.

Sample Experiments:

- Sort and write words to file
- Reverse lines in file
- File character/word/line count
- Arrays and matrix operations
- Shape class hierarchy

UNIT–V: Python for Data Science

Functional programming, JSON/XML parsing. NumPy arrays, slicing, stats. Pandas DataFrames: creation, selection, plotting with matplotlib.

Sample Experiments:

- JSON structure check
- NumPy array operations
- DataFrame manipulation and visualization

Reference Books:

1. Gowrishankar S, Veena A., *Introduction to Python Programming*, CRC Press.
2. S Sridhar et al., *Python Programming*, Pearson, 2nd Ed., 2024.
3. Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson.

Online Learning Resources:

1. `https://www.coursera.org/learn/python-for-applied-data-science-ai`
2. `https://www.coursera.org/learn/python?specialization=python#syllabus`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23BST17	Design Thinking & Innovation	1	0	2	2

Internal Marks: 30 External Marks: 70

Course Objectives:

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

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

CO 1: Define the concepts related to design thinking.
CO 2: Explain the fundamentals of Design Thinking and innovation.
CO 3: Apply the design thinking techniques for solving problems in various sectors.
CO 4: Analyse to work in a multidisciplinary environment.
CO 5: Evaluate the value of creativity.

UNIT–I: Introduction to Design Thinking
Elements and principles of Design – Fundamentals: dot, line, shape, form – Principles of design – Introduction to design thinking – History – Role of new materials in industry.

UNIT–II: Design Thinking Process
Process steps: empathize, analyze, ideate, prototype – Applications in inventions and social innovation – Tools: persona, customer journey map, brainstorming, product development.
Activity: Present idea in 3 minutes, explain product development and process diagram.

UNIT–III: Innovation
Art of innovation – Innovation vs Creativity – Role in organizations – Teams – Impact and value of creativity.
Activity: Debate on innovation vs creativity, idea to innovation planning.

UNIT–IV: Product Design
Problem formation – Strategies – Value – Planning – Specifications – Case studies.
Activity: Explain personal product design, importance of modeling and setting specifications.

UNIT–V: Design Thinking in Business
Applications in business strategy – Challenges: growth, change, relevance, com-

petition – Startups – Business model and case testing – Prototype development.
Activity: Marketing, maintenance, reliability, startup planning.

Text Books:

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, Kritina Holden, Jill Butler, *Universal Principles of Design*, 2/e, Rockport Publishers, 2010.
4. Chesbrough H., *The Era of Open Innovation*, 2003.

Web References:

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/preview
4. https://onlinecourses.nptel.ac.in/noc22_de16/preview

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET08	Power Electronics	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisites: Semiconductor Devices, Mathematics, Control Systems

Course Objectives:

1. To study the characteristics of various power semiconductor devices and firing circuits for SCR.
2. To understand the operation of single-phase AC-DC half wave and full–wave converters and perform harmonic analysis of input current.
3. To understand the operation of three-phase AC-DC half wave and full–wave converters and single-phase AC/AC converters.
4. To understand the operation of different types of DC-DC converters.
5. To learn the operation of PWM inverters for voltage control and harmonic mitigation.

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

CO 1: Explain the characteristics of various power semiconductor devices and analyze the static and dynamic characteristics of SCR, and design firing circuits of SCR. Also explain characteristics of power MOSFET and IGBT.
CO 2: Explain the operation of phase-controlled rectifiers.
CO 3: Analyze the operation of three-phase full–wave converters and AC Voltage Controllers.
CO 4: Analyze the operation and design of different types of DC-DC converters.
CO 5: Explain the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.

UNIT–I: Power Semi-Conductor Devices (8 Lectures)

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.

UNIT–II: Single-phase AC-DC Converters (10 Lectures)

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 – Continuous conduction – Effect of source inductance in single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase semi-converter with R load and RL load – Continuous conduction – Harmonic Analysis – Numerical Problems.

UNIT–III: Three-phase AC-DC Converters & AC–AC Converters (10 Lectures)

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 – Harmonic Analysis – Numerical Problems. Single-phase AC–AC power control by phase control with R and RL loads – Expression for rms output voltage – Numerical Problems.

UNIT–IV: DC–DC Converters (8 Lectures)

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 (9 Lectures)

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° conduction and 180° conduction modes of operation – Sinusoidal Pulse Width Modulation – Current Source Inverter (CSI) – Numerical Problems.

Text Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, *Power Electronics: Converters, Applications and Design*, John Wiley & Sons.
2. M. H. Rashid, *Power Electronics: Circuits, Devices and Applications*, Prentice Hall of India, 2nd edition, 1998.
3. L. Umanand, *Power Electronics: Essentials and Applications*, Wiley Pvt. Limited, India, 2009.

Reference Books:

1. Philip T. Krein, *Elements of Power Electronics*, Oxford University Press, 2nd Edition.
2. P. S. Bhimbra, *Power Electronics*, Khanna Publishers.
3. G. K. Dubey, S. R. Doradla, A. Joshi, R. M. K. Sinha, *Thyristorised Power Controllers*, New Age International Publishers, 1996.
4. Daniel W. Hart, *Power Electronics*, McGraw Hill.

Web References:

1. `https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm`
2. `https://www.electrical4u.com`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET09	Digital Circuits	3	0	0	3

Internal Marks: 30 External Marks: 70

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

Course Objectives:

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

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

CO 1: Use the concepts of Boolean algebra, K-map, tabulation method in minimization of switching functions and design arithmetic combinational circuits. L2
CO 2: Realize different types of data routing combinational circuits and PLDs. L2
CO 3: Apply knowledge of flip-flops in designing of registers and counters. L3
CO 4: Analyze synchronous sequential circuits and apply different methods for their design. L4
CO 5: Understand the logic families in the form of digital integrated circuits. L5

UNIT–I: Combinational Logic Circuits – I (10 Lectures)
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 (10 Lectures)
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 - basic structures, programming tables of PROM, PAL, PLA, realization of Boolean functions.

UNIT–III: Sequential Logic Circuits (9 Lectures)

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, 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 (8 Lectures)

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 (8 Lectures)

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.

Text Books:

1. Zvi Kohavi, *Switching and Finite Automata Theory*, 3rd Edition, Cambridge University Press, 2010.
2. M. Morris Mano and M. D. Ciletti, *Digital Design*, 4th Edition, Pearson Education, 2006.

Reference Books:

1. Charles H. Roth Jr, *Fundamentals of Logic Design*, Jaico Publishers, 5th Edition, 1992.
2. A. Anand Kumar, *Switching Theory and Logic Design*, Prentice Hall India, 3rd Edition, 2016.

Web References:

1. `https://nptel.ac.in/courses/117106086`
2. `https://nptel.ac.in/courses/108105113`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET10	Power Systems-II	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisites: Power Systems-I, Electrical Circuit Analysis

Course Objectives:

1. To understand the concepts of GMD and GMR to compute inductance and capacitance of transmission lines.
2. To distinguish the models of short, medium and long transmission lines and analyze their performance.
3. To learn the effect of travelling waves on transmission lines with different terminal conditions.
4. To learn the concepts of corona, the factors affecting corona, and effects of transmission lines.
5. To design the sag and tension of transmission lines as well as to learn the performance of line insulators.

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

CO 1: Calculate parameters of transmission lines for different circuit configurations. L2

CO 2: Analyze the performance of short, medium and long transmission lines. L2

CO 3: Analyze the effect of travelling waves on transmission lines. L3

CO 4: Estimate the effects of corona in transmission lines. L4

CO 5: Calculate sag and tension of transmission lines and design the line insulators. L5

UNIT–I: Transmission Line Parameters Calculations (11 Lectures)

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. Numerical problems.

UNIT–II: Performance Analysis of Transmission Lines (10 Lectures)

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 (8 Lectures)

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 (7 Lectures)

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 (9 Lectures)

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. C.L. Wadhwa, *Electrical Power Systems*, New Age International, 1998.
2. I.J. Nagrath, D.P. Kothari, *Power System Engineering*, Tata McGraw Hill, 3rd Edition, 2019.

Reference Books:

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

Web References:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE01	Signals and Systems (Professional Elective-I)	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Outcomes:

CO1: Recall and list various classifications of signals and systems.

CO2: Analyze signals in the frequency domain using Fourier series and Fourier transform techniques.

CO3: Understand the properties of systems and determine the response of Linear Time-Invariant (LTI) systems.

CO4: Explain the sampling process and distinguish between various types of sampling techniques.

CO5: Apply Laplace and Z-transform techniques to analyze continuous-time and discrete-time signals and systems.

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 and Sampling Theorem

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 for 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 Laplace Transforms,

Inverse Laplace transform, Relation between Laplace Transforms and Fourier Transforms 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.

Text Books:

1. B.P. Lathi, *Signals, Systems and Communications*, BS Publications, 2003.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, *Signals and Systems*, PHI, 2nd Edition, 1997.
3. Simon Haykin and Barry Van Veen, *Signals and Systems*, Wiley, 2nd Edition, 2007.

Reference Books:

1. B.P. Lathi, *Principles of Linear Systems and Signals*, Oxford University Press, 2015.
2. T.K. Rawat, *Signals and Systems*, Oxford University Press, 2011.

Online References:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011
2. https://www.tutorialspoint.com/signals_and_systems/index.htm

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE02	Professional Elective-I Computer Architecture and Organization	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basic knowledge in digital electronics, fundamentals of computers.

Course Objectives:

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

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

CO 1: Demonstrate the instruction cycle of a computer. L2
CO 2: Understand various micro operations and register transfer language. L2
CO 3: Describe parallel processing and pipelining. L3
CO 4: Interface different peripherals with processors. L4
CO 5: Know the advantages of cache and virtual memory. L5

UNIT–I: Basic Computer Organization and Design (9 Lectures)
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 (9 Lectures)
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 and Pipelining (10 Lectures)
General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, RISC.
Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

UNIT–IV: Input/Output Organization (9 Lectures)

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 (8 Lectures)

Memory Hierarchy, Main memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual memory, Memory Management Hardware.

Text Books:

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

Reference Books:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE03	Professional Elective-I COMMUNICATION SYSTEMS	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basic knowledge in digital electronics, fundamentals of computers.

Course Objectives:

1. Understand the fundamental concepts of analog modulation techniques and their applications.
2. Analyze the performance of AM and FM systems in the presence of noise.
3. Illustrate the principles of pulse modulation and digital modulation techniques.
4. Examine the performance of digital communication systems, including PCM, ASK, FSK, PSK, and QAM.
5. Explore error control coding, multiplexing, and communication system applications in real-world scenarios.

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

CO 1: Understand the fundamental concepts of analog modulation techniques and their applications. L1

CO 2: Analyze the performance of AM and FM systems in the presence of noise. L3

CO 3: Illustrate the principles of pulse modulation and digital modulation techniques. L3

CO 4: Examine the performance of digital communication systems, including PCM, ASK, FSK, PSK, and QAM. L3

CO 5: Explore error control coding, multiplexing, and communication system applications in real-world scenarios. L2

UNIT–I: Amplitude Modulation (9 Lectures)

Introduction to Communication Systems, Elements of a communication system: Transmitter, channel, receiver, Types of communication: Analog and Digital, Classification: Simplex, half-duplex, full-duplex, Electromagnetic spectrum and frequency bands. Need for Modulation, Baseband signals and their limitations, Advantages of modulation, Amplitude Modulation (AM), Basic principle and waveform representation, Modulation index, power relations, bandwidth, Generation of AM: Square-law modulator, switching modulator, Detection of AM: Envelope detector, DSB-SC & SSB-SC, Generation and comparison of DSB-SC and SSB-SC.

UNIT–II: Angle Modulation (9 Lectures)

Concept of frequency and phase modulation, Mathematical representation of FM and PM, Narrowband and Wideband FM, Bandwidth calculations using Carson's Rule, Generation of FM: Direct and indirect methods, Detection of FM: Slope detector, Foster-Seeley, Ratio detector, PLL-based demodulator. Noise performance in AM/FM, Pre-emphasis and de-emphasis techniques.

UNIT–III: Pulse Modulation (10 Lectures)

Sampling theorem, Natural and Flat-top sampling, Aliasing and anti-aliasing filters, Pulse Amplitude Modulation (PAM), PWM, PPM, Comparison of PAM, PWM, PPM. Time Division Multiplexing (TDM), PCM: Quantization, encoding, decoding, and SNR.

UNIT–IV: Digital Modulation Techniques (9 Lectures)

Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Binary and M-ary, PSK: BPSK, DPSK, QPSK, QAM: signal representation and trade-offs. Applications in communication systems.

UNIT–V: Error Control Coding and Communication Systems (8 Lectures)

Error types, Need for coding, Hamming codes, CRC, Convolutional Codes, Viterbi decoding, Applications in cellular networks, data transmission, internet, industrial communication.

Text Books:

1. Simon Haykin, *Communication Systems*, 5th Edition, Wiley, 2013.
2. B.P. Lathi, *Modern Digital and Analog Communication Systems*, 4th Edition, Oxford University Press, 2011.

Reference Books:

1. George Kennedy, *Electronic Communication Systems*, 3rd Edition, McGraw-Hill, 2011.
2. Taub and Schilling, *Principles of Communication Systems*, 3rd Edition, McGraw-Hill, 2008.
3. R.P. Singh & S.D. Sapre, *Communication Systems: Analog and Digital*, 3rd Edition, McGraw-Hill, 2017.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL07	POWER ELECTRONICS LABORATORY	0	0	3	1.5

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electronic Devices and Circuits

Course Objectives:

1. To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
2. To analyze the performance of single-phase and three-phase full-wave bridge converters with both resistive and inductive loads.
3. To understand the operation of AC voltage regulator with resistive and inductive loads.
4. To understand the working of Buck converter and Boost converter.
5. To understand the working of series, parallel, and PWM inverters.

List of Experiments:

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.
11. Single-phase square wave bridge inverter with R & RL loads.
12. Single-phase PWM inverter.
13. Three-phase bridge inverter with 120° and 180° conduction modes.
14. SPWM control of Three-phase bridge inverter.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL08	ANALOG AND DIGITAL CIRCUITS LAB	0	0	3	1.5

Internal Marks: 30 External Marks: 70

Course Objectives:

- Analysis of transistor amplifiers.
- Analysis of feedback amplifiers and oscillators.
- Realization of digital circuits such as data routing, registers and counters.

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

CO 1: Analyse diode clipper/clamper circuits and transistor biasing. L2
CO 2: Illustrate the operation of feedback amplifiers and oscillator circuits. L2
CO 3: Analyze the applications of linear IC's. L3
CO 4: Demonstrate the operation of digital circuits such as arithmetic, data routing, registers and counters. L4

Any 5 of the Following Experiments are to be conducted from each PART

PART-A

1. Analysis of clipper and clamper circuits.
2. Analysis of self-bias to a transistor.
3. Analysis of voltage series and current series feedback amplifiers.
4. Analysis of Wien Bridge oscillator and RC-phase shift oscillator.
5. Analysis of Integrator and Differentiator Circuits using IC 741.
6. Analysis of Monostable and Astable multivibrator operation using IC 555 Timer.
7. Analysis of Schmitt Trigger Circuits using IC 741 and IC 555.
8. Verify the PLL characteristics using IC 565.
9. Analysis of 8-bit A to D and D to A circuits.

PART-B

1. Design of Full Adder and Full Subtractor using logic gates.
2. Realization of parallel adder/subtractor using IC 7483.
3. Implementation of 3 to 8 line decoder using logic gates and IC 7445.
4. Implementation of 8 to 1 multiplexer using logic gates and IC 74151.
5. Verify the operation of master-slave JK flip-flop using IC 7476.
6. Realization of the following shift registers using IC 7495:

- SISO
- SIPO
- PISO
- PIPO

7. Implementation of Mod-N Counters.
8. Implementation of 4-bit Ring Counter and Johnson Counter using D flip-flop.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EES03	SOFT SKILLS	0	1	2	2

Course Objectives:

- To equip the students with the skills to effectively communicate in English.
- To train the students in interview skills, group discussions and presentation skills.
- To motivate the students to develop confidence.
- To enhance the students' interpersonal skills.
- To improve the students' writing skills.

UNIT–I: Analytical Thinking & Listening Skills

Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self–Analysis, Developing Positive Attitude, Perception.

Communication Skills: Verbal Communication; Non-Verbal Communication (Body Language)

UNIT–II: Self-Management Skills

Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities

Etiquette: Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT–III: Standard Operation Methods

Basic Grammar, Tenses, Prepositions, Pronunciation, Letter Writing; Note Making, Note Taking, Minutes Preparation, Email & Letter Writing

UNIT–IV: Job-Oriented Skills

Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

UNIT–V: Interpersonal Relationships

Introduction, Importance, Types, Uses, Factors affecting interpersonal relationships, Accommodating different styles, Consequences of interpersonal relationships

Text Books:

1. Barun K. Mitra, *Personality Development and Soft Skills*, Oxford University Press, 2011.
2. S.P. Dhanavel, *English and Soft Skills*, Orient Blackswan, 2010.

Reference Books:

1. R.S. Aggarwal, *A Modern Approach to Verbal & Non-Verbal Reasoning*, S. Chand & Company Ltd., 2018.

2. Raman, Meenakshi & Sharma, Sangeeta, *Technical Communication Principles and Practice*, Oxford University Press, 2011.

E-resources:

- https://swayam-plus.swayam2.ac.in/courses/course-details?id=P_CAMBR_01

Course Code	Course Name	Course Structure			
		L	T	P	C
—	Engineering Science: Tinkering Lab	0	0	2	1

Internal Marks: 30 External Marks: 70

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:

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 practical experience. Some students may also develop entrepreneurial skills, potentially leading to startups 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 plant on your computer dashboard.
13. Demonstrate all the steps in design thinking to redesign a motorbike.

Online References:

1. https://aim.gov.in/pdf/equipment-manual-pdf.pdf
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 Code	Course Name	Course Structure			
		L	T	P	C
P23EET11	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basics of Electrical and Electronics Engineering.

Course Objectives:

- To understand and analyze the factors that affect the various measuring units.
- To choose the appropriate meters for measuring voltage, current, power, power factor, and energy, 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 transducers and their effectiveness in conversion for ease of measurement.
- To understand the operating principles of basic digital systems, record, and display units.

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

CO 1: Know the construction and working of various types of analog instruments. L2

CO 2: Describe the construction and working of wattmeter and power factor meters. L2

CO 3: Know the construction and working of various bridges for the measurement of resistance, inductance, and capacitance. L3

CO 4: Know the operational concepts of various transducers. L4

CO 5: Know the construction and operation of digital meters. L5

UNIT–I: Analog Ammeters and Voltmeters (9 Lectures)

Classification – deflecting, control and damping torques – PMMC, moving iron type and electrostatic instruments – Construction – Torque equation – Range extension – Errors and compensations – advantages and disadvantages. Instrument transformers: Current Transformer and Potential Transformer – theory –Ratio and phase angle errors–Numerical Problems.

UNIT–II: Analog Wattmeters and Power Factor Meters (9 Lectures)

Electrodynamometer type wattmeter (LPF and UPF) – Power factor meters: Dynamometer and M.I type (Single phase and Three phase) – Construction – torque equation – advantages and disadvantages. Potentiometers: Principle and operation of D.C Crompton's potentiometer – Standardization –Applications –AC

Potentiometer (Polar and coordinate types) –Standardization – Applications – Numerical Problems.

UNIT–III: Measurements of Electrical parameters (11 Lectures)

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 (7 Lectures)

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 (9 Lectures)

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
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K. Sawhney, Dhanpat Rai & Co.
2. Electrical and Electronic Measurements and Instrumentation by R.K. Rajput
3. Electrical Measurements by Buckingham and Price
4. Electrical Measurements by Forest K. Harris, John Wiley and Sons

Web References:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET12	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basic knowledge in digital electronics, fundamentals of computers.

Course Objectives:

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

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

CO 1: Know the concepts of microprocessor capabilities and explore the evolution of microprocessors. L2
CO 2: Analyse the instruction sets, addressing modes, and operations of 8086 in minimum and maximum modes. L2
CO 3: Analyse the microcontroller and interfacing capabilities. L3
CO 4: Describe the architecture and interfacing of the 8051 controller. L4
CO 5: Know the concepts of PIC microcontroller and its programming. L5

UNIT–I: Introduction to Microprocessor Architecture (10 Lectures)
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: AMinimum and Maximum Mode Operations (9 Lectures)
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 (10 Lectures)
8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 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 (8 Lectures)

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 (8 Lectures)

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
2. Kenneth J. Ayala
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC18

Reference Books:

1. Microprocessors and Interfacing
2. R.S. Kaler
3. Ajay V. Deshmukh
4. Ajit Pal

Web References:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EET13	POWER SYSTEM ANALYSIS	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Concepts of electrical circuits and Power Systems-II.

Course Objectives:

- To develop the impedance diagram (p.u) and formation of Ybus.
- To learn the different load flow methods.
- To learn the Zbus building algorithm.
- To learn short circuit calculations for symmetrical faults.
- To understand the effects of unsymmetrical faults.
- To learn the stability of power systems and methods to improve stability.

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

CO 1: Draw impedance diagram for a power system network and calculate per unit quantities. L2

CO 2: Apply the load flow solution to a power system using different methods. L2

CO 3: Form Zbus for power system networks and analyse the effect of symmetrical faults. L3

CO 4: Find the sequence components for power system elements and analyse the effects of unsymmetrical faults. L4

CO 5: Analyse the stability concepts of a power system. L5

UNIT–I: (10 Lectures)

Circuit Topology Graph theory definitions – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Ybus 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 (9 Lectures)

Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) – Decoupled and Fast Decoupled methods – Algorithmic approach – Numerical Problems on 3–bus system only.

UNIT–III: **(10 Lectures)**

Z-Bus Algorithm Formation of Zbus: Algorithm for the Modification of Zbus 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: (9 Lectures)

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 (8 Lectures)

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 and D.P. Kothari, Tata McGraw Hill

Reference Books:

1. Power System Analysis by A.R. Bergen
2. Power System Analysis by Hadi Saadat, Tata McGraw Hill, 3rd Edition
3. Power System Analysis by B.R. Gupta
4. Power System Analysis and Design by J. Duncan Glover, M.S. Sarma, T.J. Overbye – Cengage Learning, 5th Edition (2011)

Web References:

1. https://archive.nptel.ac.in/courses/117/105/117105140
2. https://archive.nptel.ac.in/courses/108/105/108105104

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE04	Professional Elective-I Switch Gear and Protection	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power System-II

Course Objectives:

1. To provide the basic principles and operation of various types of circuit breakers.
2. To understand the classification, operation, and application of electromagnetic protective relays.
3. To explain protective schemes for generators and transformers.
4. To understand protective schemes used for feeders and busbars.
5. To explain the principle and operation of static relays.
6. To understand overvoltages in power systems and different neutral grounding methods.

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

CO 1: Illustrate arc interruption principles in high-voltage circuit breakers such as air, oil, vacuum, and SF_6. L2

CO 2: Analyze the operation of various electromagnetic protective relays. L2

CO 3: Acquire knowledge on generator and transformer protection for different fault conditions. L3

CO 4: Classify feeder and bus bar protection schemes, and differentiate between static and digital relays. L3

CO 5: Analyze overvoltage protection, insulation coordination, and neutral grounding methods. L2

UNIT–I: Circuit Breakers (10 Lectures)

Application-oriented evolution of switchgear – Fuse, MCB – Arc interruption principles – Restriking and recovery voltages – RRRV – Current chopping – Resistance switching – Oil circuit breakers – Air blast, Vacuum, SF_6 breakers – Ratings, specifications, auto-reclosing – Numerical examples.

UNIT–II: Electromagnetic Protection (8 Lectures)

Relay conditions – Balanced beam, armature, induction disc and cup relays – Torque equation – Classification: Instantaneous, Inverse time, DMT, IDMT – Overcurrent, undervoltage, directional, differential relays – Distance relays: impedance, reactance, Mho, offset – Characteristics and comparison.

UNIT–III: Generator and Transformer Protection (8 Lectures)
Generator protection against stator, rotor faults – Restricted earth fault – Inter-turn faults – Transformer protection: Percentage differential, CT ratio design, Buchholz relay – Numerical examples.

UNIT–IV: Feeder and Busbar Protection, Static and Digital Relays (10 Lectures)
Overcurrent protection – PSM – TMS – Numerical examples – Carrier current, three-zone distance protection – Bus bar differential protection – Static relay classification and components – Microprocessor-based digital relay.

UNIT–V: Overvoltage Protection and Grounding (9 Lectures)
Generation of overvoltages – Lightning protection – Valve-type and zinc oxide arresters – Insulation coordination – Grounded vs. ungrounded systems – Solid, resistance, reactance grounding – Arcing grounds and grounding practices.

Text Books:

1. Badri Ram, D.N. Viswakarma, *Power System Protection and Switchgear*, 3rd Edition, Tata McGraw Hill, 2022.
2. T.S. Madhava Rao, *Power System Protection – Static Relays with Microprocessor Applications*, 2nd Edition, Tata McGraw Hill, 2017.

Reference Books:

1. S.R. Bhide, Paithankar, *Fundamentals of Power System Protection*, 2nd Edition, PHI, 2010.
2. C.R. Mason, *Art Science of Protective Relaying*, Wiley Eastern Ltd., 1996.
3. Bhavesh Bhalja, R.P. Maheswari, Nilesh G. Chothani, *Protection and Switchgear*, 2nd Edition, Oxford University Press, 2018.

Web References:

1. https://www.digimat.in/nptel/course/video/108107/L03.html
2. http://www.youtube.com/playlist?list=PLLy_2iUCG87BIJ6ZliVIRCx2Crf9_fJMB

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE05	Professional Elective-I Advanced Control Systems	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basic concepts of Control Systems.

Course Objectives:

1. To understand the concept of controllability, observability, and their tests for continuous-time systems, and the principle of duality.
2. To assess controllability, observability and design state feedback controllers via pole placement using state-space methods.
3. To analyze the stability of nonlinear systems using phase-plane, describing functions, and Lyapunov's methods.
4. To understand optimal control using the calculus of variations including constraints and minimum principle.
5. To apply optimal control to regulator problems.

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

CO 1: Explain controllability, observability, and the principle of duality in state-space systems. L1

CO 2: Apply state-space methods to analyze and design state feedback controllers. L2

CO 3: Analyze the stability of nonlinear systems using phase-plane analysis and Lyapunov's theorems. L3

CO 4: Examine the minimization of functionals and inequality constraints. L4

CO 5: Formulate and solve optimal regulator problems. L5

UNIT–I: Controllability, Observability and Pole Placement (11 Lectures)

General concepts of controllability and observability – Tests 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 (9 Lectures)

Introduction to nonlinear systems – Types of nonlinearities – Phase plane analysis – Construction of phase trajectories – Analytical and Isocline methods – Describing functions: on-off nonlinearity, hysteresis, relay with dead zone.

UNIT–III: Stability by Lyapunov Method (9 Lectures)

Stability in the sense of Lyapunov – Lyapunov's stability and instability theorems – Direct method for linear and nonlinear continuous time autonomous systems.

UNIT–IV: Calculus of Variations (9 Lectures)

Minimization of functional – Functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints.

UNIT–V: Optimal Control (7 Lectures)

Necessary conditions for optimal control – Formulation of the optimal control problem – Minimum time, energy, and fuel problems – State regulator problem – Output regulator problem.

Text Books:

1. K. Ogata, *Modern Control Engineering*.
2. B.C. Kuo, *Automatic Control Systems*.

Reference Books:

1. M. Gopal, *Modern Control System Theory*, 2nd Edition, New Age International Publishers, 1996.
2. Donald E. Kirk, *Optimal Control Theory: An Introduction*, Dover Publications.
3. I.J. Nagarath and M. Gopal, *Control Systems Engineering*, New Age International (P) Ltd.

Web References:

1. `https://www.slideshare.net/123ps/managerial-economics-ppt`
2. `https://www.slideshare.net/rossanz/production-and-cost-45827016`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE06	PROFESSIONAL ELECTIVE-II RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: 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 will be able to:

CO 1: Illustrate basic concepts of renewable and distributed sources of wind energy.
CO 2: Demonstrate the components of wind energy conversion systems.
CO 3: Model PV systems and analyze MPPT Techniques.
CO 4: Illustrate the concept of Energy Production from Hydro, Tidal, and Geothermal sources.
CO 5: 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 speedcharacteristics - Fixed speed and variable speed wind turbine control - Power optimization - Electrical

generators - Self-Excited and Doubly-Fed Induction Generators operation and control.

UNIT–III: Solar PV Systems

Present and new technological developments in photovoltaic - estimation of solar irradiance - components of solar energy systems - solarthermal 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. Craig Anderson, Rudolf I. Howard, *Wind and Hydropower Integration: Concepts, Considerations and Case*, Nova Publisher, 2012.
2. Amanda E. Niemi, Cory M. Fincher, *Hydropower from Small and Low-Head Hydro Technologies*, Nova Publisher, 2011.
3. D. Yogi Goswami, Frank Kreith, Jan F. Kreider, *Principles of Solar Engineering*, Taylor & Francis, 2000.
4. S. Heier, R. Waddington, *Grid Integration of Wind Energy Conversion Systems*, Wiley, 2006.
5. Loi Lei Lai, Tze Fun Chan, *Distributed Generation: Induction and Permanent Magnet Generators*, Wiley-IEEE Press, 2007.

6. G.N. Tiwari, *Solar Energy Technology*, Nova Science Publishers, 2005.

Web References:

1. https://archive.nptel.ac.in/courses/103/103/103103206
2. https://archive.nptel.ac.in/courses/103/107/103107157

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE07	Professional Elective-II ELECTRIC DRIVES	3	0	0	3

Internal Marks: 30 External Marks: 70

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

CO 1: Explain the fundamentals of electric drive and different electric braking methods. L2

CO 2: Analyze the operation of three-phase converter-fed DC motors and four-quadrant operations of DC motors using dual converters. L4

CO 3: Describe the DC-DC converter-fed control of DC motors in various quadrants of operation. L2

CO 4: Know the concept of speed control of induction motor using AC voltage controllers and voltage source inverters and differentiate the stator side control and rotor side control. L2

CO 5: Learn the concepts of speed control of synchronous motors with different methods. L2

UNIT–I:Fundamentals of Electric Drives (10 Lectures)

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 (9 Lectures)
3-phase half and fully-controlled converter fed separately and self-excited DC 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: (9 Lectures)
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: (9 Lectures)
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: (8 Lectures)
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. G.K. Dubey, *Fundamentals of Electric Drives*, Narosa Publications, 2nd edition, 2002.
2. S.B. Dewan, G.R. Slemon, A. Straughen, *Power Semiconductor Drives*, Wiley India, 1984.

Reference Books:

1. Austin Hughes, Bill Drury, *Electric Motors and Drives: Fundamentals, Types and Applications*, Newnes, 4th edition, 2013.
2. Vedam Subramanyam, *Thyristor Control of Electric Drives*, Tata McGraw Hill, 1987.
3. M.H. Rashid, *Power Electronic Circuits, Devices and Applications*, PHI, 3rd edition, 2009.

Web References:

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

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE08	Professional Elective-II DIGITAL SIGNAL PROCESSING	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: 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 IIR systems.
- To understand and design FIR Digital filters.
- To explore the concepts of multiple sampling rates for DSP.

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

CO 1: Know the concepts of digital signal processing, frequency domain representation, and Z-transform. L2

CO 2: Compute discrete Fourier transform and fast Fourier transforms for different sequences. L2

CO 3: Design IIR filters through analog filter approximation and understand the basic structures of IIR filters. L3

CO 4: Design FIR filters using window techniques and understand the basic structures of FIR filters. L4

CO 5: Learn the concepts of multirate signal processing. L5

UNIT–I: Introduction to Digital Signal Processing (10 Lectures)
Discrete time signals and sequences — Classification of discrete time systems — Stability of LTI systems — Invertibility — Response to arbitrary inputs — Solution of linear constant coefficient difference equations — Frequency domain representation of discrete time signals and systems — Review of Z-transforms — System function — Solution of difference equations using Z-transforms.

UNIT–II: Discrete Fourier Transforms and FFT Algorithms (9 Lectures)
Discrete Fourier series representation of periodic sequences — Properties — Discrete Fourier Transform (DFT): Properties, linear filtering methods — Fast Fourier Transforms (FFT): Radix-2 DIT and DIF algorithms — Inverse FFT.

UNIT–III: Design and Realization of IIR Digital Filters (10 Lectures)
Analog filter approximations: Butterworth and Chebyshev filters — IIR Digital filters from analog filters — Analog and digital frequency transformations — Basic structures of IIR systems: Direct-form, Transposed, Cascade, Parallel-form — Lattice and Lattice-Ladder structures.

UNIT–IV: Design and Realization of FIR Digital Filters (8 Lectures)
FIR filters with linear phase — Frequency response of linear phase FIR filters — Design of FIR filters: Window techniques and frequency sampling — Comparison of IIR & FIR filters — Basic FIR structures: Direct-form, Cascade-form, Linear phase realizations, Lattice structures.

UNIT–V: Multirate Digital Signal Processing (8 Lectures)
Decimation and interpolation — Sampling rate conversion by rational factor — Implementation of sampling rate converters — Applications of multirate signal processing — Digital filter banks.

Text Books:

1. John G. Proakis, *Digital Signal Processing – Principles, Algorithms and Applications*.
2. A.V. Oppenheim, R.W. Schaffer, *Discrete Time Signal Processing*.
3. Sanjit K. Mitra, *Digital Signal Processing: A Computer Based Approach*.

Reference Books:

1. Andreas Antoniou, *Digital Signal Processing*.
2. M.H. Hayes, *Digital Signal Processing*.
3. *DSP Primer*.
4. Robert J. Schilling, *Fundamentals of DSP using MATLAB*.
5. Alan V. Oppenheim, *Digital Signal Processing*.
6. K. Raja Rajeswari, *Digital Signal Processing*.

Web References:

1. `https://nptel.ac.in/courses/117102060`
2. `https://archive.nptel.ac.in/courses/108/101/108101174`

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEE09	Professional Elective-II HIGH VOLTAGE ENGINEERING	3	0	0	3

Internal Marks: 30 External Marks: 70

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

CO 1: Recognise the dielectric properties of gaseous materials used in HV equipment. L2

CO 2: Differentiate the breakdown phenomenon in liquid and solid dielectric materials. L2

CO 3: Acquaint with the techniques of generation of high AC and DC voltages. L3

CO 4: Acquaint with the techniques of generation of high impulse voltages and currents. L4

CO 5: Gain knowledge of measurement techniques for high AC, DC, and impulse voltages and currents. L5

UNIT–I: Breakdown Phenomenon in Gaseous and Vacuum (11 Lectures)
Insulating Materials: Types, properties and applications — Gases as insulating media – Collision and ionization processes — Townsend's criteria and its limitations – Streamer theory – Time lag — Paschen's law, Paschen's curve, Penning effect — Breakdown mechanisms in vacuum.

UNIT–II: (9 Lectures)
Breakdown Phenomenon in Liquids Liquids as insulators – Pure and commercial types – Breakdown mechanisms

Breakdown Phenomenon in Solids Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown — Breakdown in composite solid dielectrics.

UNIT–III: (8 Lectures)

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: (9 Lectures)

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: (8 Lectures)

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. E. Kuffel, *High Voltage Engineering: Fundamentals*.
2. M.S. Naidu, V. Kamaraju, *High Voltage Engineering*, TMH Publications.

Reference Books:

1. Ryan, *High Voltage Engineering and Technology*.
2. C.L. Wadhwa, *High Voltage Engineering*.
3. Ravindra Arora, *High Voltage Insulation Engineering*.

Web References:

1. https://archive.nptel.ac.in/courses/108/104/108104048
2. https://bharatsrajpurohit.weebly.com/high-voltage-engineering-course.html

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL09	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB	0	0	3	1.5

Internal Marks: 30 External Marks: 70

Course Prerequisite: Physics

Course Objectives:

1. To understand students how different types of meters work and their construction.
2. To make the students understand how to measure resistance, inductance, and capacitance by AC & DC bridges.
3. To understand the testing of CT and PT.
4. To understand the characteristics of thermocouples, LVDT, capacitive transducer, piezoelectric transducer and measurement of strain and choke coil parameters.
5. To study the procedure for standardization and calibration of various methods.

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

CO 1: Know about the phantom loading and calibration process. L2
CO 2: Measure the electrical parameters: voltage, current, power, energy and electrical characteristics of resistance, inductance, and capacitance. L2
CO 3: Gain the skill knowledge of various bridges and their applications. L3
CO 4: Learn the usage of CTs and PTs for measurement purposes. L4
CO 5: Know the characteristics of transducers and measure the strains, frequency, and phase difference. L5

List of Experiments: (Any 10 of the following 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 CT using mutual inductor – Measurement of % ratio error and phase angle by null deflection method.
8. PT testing by comparison – V.G as null detector – Measurement of % ratio error and phase angle.
9. Determination of the characteristics of a thermocouple.
10. Determination of the characteristics of a LVDT.
11. Determination of the characteristics of a capacitive transducer.
12. Measurement of strain using a bridge strain gauge.
13. Measurement of choke coil parameters and single-phase power using three 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 / Cartesian Form) – Calibration of AC voltmeter – Parameters of choke.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EEL10	MICROPROCESSORS AND MICROCONTROLLERS LAB	0	0	3	1.5

Internal Marks: 30 External Marks: 70

Course Prerequisite: Concepts of Microprocessors and Microcontrollers

Course Objectives:

1. To study programming based on 8086 microprocessor and 8051 microcontroller.
2. To study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
3. To study interfacing 8086 with I/O and other devices.
4. To study parallel and serial communication using 8051 & PIC18 microcontrollers.
5. To study programming based on 8086 microprocessor and 8051 microcontroller.

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

CO 1: Write assembly language programs using 8086 microprocessor based on arithmetic, logical, number systems, and shift operations. L2
CO 2: Write assembly language programs for numeric operations and array handling problems. L2
CO 3: Write an assembly language program for string operations. L3
CO 4: Interface 8086 with I/O and other devices. L4
CO 5: Do parallel and serial communication using 8051 & PIC18 microcontrollers. L5
CO 6: Program microprocessors and microcontrollers for real world applications.

List of Experiments: (Any 10 of the following to be conducted)

1. Arithmetic operations – Two 16-bit numbers and multibyte numbers: addition, subtraction, multiplication, and division – Signed and unsigned operations – ASCII arithmetic operations.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD – BCD to ASCII conversion – BCD number addition.
3. Arrange the given array in ascending and descending order.
4. Determine the factorial of a given number.

5. String operations using instruction prefix: Move block, Reverse string, Sorting, Inserting, Deleting, Length of string, String comparison.
6. Find the first and nth number in a Fibonacci series of 'n' natural numbers.
7. Find the number and sum of even and odd numbers in a given array.
8. Find the sum of 'n' natural numbers and the squares of 'n' natural numbers.
9. Arithmetic operations using 8051 microcontroller.
10. Decimal to hexadecimal and hexadecimal to decimal number conversion.
11. Find the sum of elements in an array and identify the largest and smallest number using 8051.

Course Code	Course Name	Course Structure			
		L	T	P	C
P23EES04	SKILL ENHANCEMENT COURSE IOT APPLICATIONS OF ELECTRICAL ENGINEERING	0	1	1	2

Internal Marks: 30 External Marks: 70

Course Prerequisite: None

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, student will be able to

CO 1: Operate the Arduino Integrated Development Environment with embedded C. L3
CO 2: Program the embedded Python in Raspberry Pi OS. L3
CO 3: Interface various sensors with Arduino/Raspberry Pi in the IoT environment. L3
CO 4: Connect different displays with Arduino/Raspberry Pi. L3
CO 5: Interconnect with wireless communication technologies. L3

UNIT–I: Programming Arduino (6 Lectures)
Arduino — Classification of Arduino boards — Pin diagrams — Arduino Integrated Development Environment (IDE) — Programming Arduino.

UNIT–II: Sensors and Actuators (6 Lectures)
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.

UNIT–III: Raspberry Pi (6 Lectures)
Introduction, Classification of Rasperberry Pi Series - Pin diagrams – Programming Rasperberry Pi.

UNIT–IV: Display (6 Lectures)
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.

UNIT–V: Wireless Communication Devices (6 Lectures)

Working of Bluetooth, Wi-Fi, Radio Frequency Identification (RFID), GPRS/GSM Technology, ZigBee, etc and their integration with Arduino/Raspberry Pi. Features of Alexa

Text Books:

1. Charles Bell, *Beginning Sensor Networks with XBee, Raspberry Pi and Arduino*, Second Edition, Apress, 2020.
2. Klaus Elk, *Embedded Software Development for the Internet of Things*, CreateSpace, 2016.

Reference Books:

1. Daniel Minoli, *Building the Internet of Things with IPv6 and MIPv6*, Wiley Publications.
2. Marco Schwartz, *Internet of Things with ESP8266*, Packt Publishing, 2016.
3. Han-Way Huang, *Embedded System Design Using C8051*, Cengage Learning, 2009.

Web References:

1. https://www.youtube.com/watch?v=KZLhvvx5HLw&list=PLm_MSClsnwm-tdvhm-tkqNN8uNAYqrjok
2. https://www.youtube.com/watch?v=8LzSCcRN9q0
3. https://grand-challenges.embs.org/2021datascience
4. https://www.edx.org/course/data-science-visualization

Course Code	Course Name	Course Structure			
		L	T	P	C
–	RESEARCH METHODOLOGY	2	0	0	–

Internal Marks: 30 External Marks: 70

Course Prerequisite: Material Science, Electromagnetic Fields and Basics of Transient Circuits.

Course Objectives:

- To equip students with the knowledge and skills to conduct research effectively.
- To understand theoretical underpinnings of research and develop research designs.
- To select appropriate methods for data collection and analysis.
- To learn how to interpret and present research findings.
- To foster critical thinking, problem-solving abilities, and a systematic approach to inquiry.

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

CO 1: Introduce fundamental concepts, types of research, and literature review. L2

CO 2: Understand various tools and techniques for data collection and analysis. L3

CO 3: Gain orientation regarding intellectual property rights. L2

CO 4: Be aware of ethical concerns in research. L2

CO 5: Prepare research reports by identifying problems and formulating questions and hypotheses. L3

UNIT–I: Research Formulation and Design (6 Lectures)

Definition and objective of research, types of research, steps in research process — Research design: concept and types — Defining and formulating research problems — Importance of literature review, sources: primary, secondary, monographs, patents, databases — Identifying gap areas, surveying synthesis and interpretation.

UNIT–II: Sampling and Data Interpretation (6 Lectures)

Mathematical tools and statistical analysis — Regression analysis, correlation — Concept of best fit, exact fit — Examples from linear regression with one and more unknowns.

UNIT–III: Patent Rights and IPR (6 Lectures)

Introduction to IPR, significance, commercialization, royalty — Copyright, trade aspects, patents basics — Patent filing (national/international), administration in India — Licensing and technology transfer – Case studies.

UNIT–IV: Research and Publication Ethics (6 Lectures)

Research integrity, scientific misconduct: Falsification, Fabrication, Plagiarism (FFP) — Conflict of research, predatory journals and open access — Citation, acknowledgment, reproducibility, accountability — Software tools for similarity checks.

UNIT–V: Report Writing (6 Lectures)

Structure and components, types of research report — Layout, writing mechanism, referencing in academic writing — Abstracting, bibliography.

Text Books:

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International.
2. J.W. Creswell, *Research Design*, Sage South Asia Edition.
3. D.G. Montgomery, *Design and Analysis of Experiments*, John Wiley India.
4. D.P. Mittal, *Indian Patents Law and Procedure*, Taxmann Publication.
5. B.L. Wadera, *Patents, Trademarks, Copyright, Designs and Geographical Judications.*
6. Neuman W. Lawrence, *Social Research Methods*, Allyn and Bacon.
7. Miro Todorovich et al., *The Ethics of Teaching and Scientific Research.*

Reference Books:

1. Edward A. Bender, *An Introduction to Mathematical Modeling.*
2. J.N. Kapoor, *Mathematical Modeling*, Wiley Eastern.
3. P. Narayanan, *Intellectual Property Law*, Eastern Law House.
4. N.S. Gopalakrishnan & T.G. Agitha, *Principles of Intellectual Property*, Eastern Book Co.
5. Barbara H. Stanley et al., *Research Ethics: A Psychological Approach.*
6. Joel Lefkowitz, *Ethics and Values in Industrial-Organizational Psychology*, Lawrence Erlbaum.

Web References:

1. `https://libguides.wpi.edu/researchmethod/resources`
2. `https://www.ncrm.ac.uk/resources/online/`
3. `https://methods.sagepub.com/`