NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

Course Structure and Syllabus

(R23 Regulations)

Electrical & Electronics Engineering

B.Tech – I B.Tech to IV B.Tech
(Applicable for the Batches admitted from 2023-2024)

Academic Regulations (R23) for B.Tech. (Regular)

(Effective for the students admitted into I year from the Academic Year 2023-2024 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

A student will be declared eligible for the award of the B.Tech 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 inB.Tech. Course and their admission stands cancelled. This clause shall be read along with clause 1 a) i).

3. Admissions

Admission to the B.Tech Program shall be made subject to the eligibility, qualificationsand 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 studentin the common entrance examination conducted by the A.P. Government/University or any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

4. Program related terms

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

Credit definition:

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

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

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

5. Semester/Credits:

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

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

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

6. Structure of the Undergraduate Programme

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

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

7. Course Classification:

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

S.No.	Broad Course Classification	Course Category	Description
1.	Foundation Core Courses	Foundation courses	Includes Mathematics, Physics and Chemistry; fundamental engineering courses; humanities, socialsciences and management courses
2.	Core Courses	Professional Core Courses (PC)	Includes subjects related to the discipline/department/branch of parent Engineering
3.	Elective Courses	Professional ElectiveCourses (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 skillenhancement courses (SEC)	Interdisciplinary/job-oriented/domain courses whichare relevant to the industry
4.	Project & Internships	Project	B.Tech. Project or Major Project
		Internships	Summer Internships – Community based and Industry Internships; Industry oriented Full Semester Internship
5.	Audit Courses	Mandatory non-credit courses	Covering subjects of developing desired attitude among the learners

8. Programme Pattern

i. Total duration of the B.Tech (Regular) Programme is four academic years.
ii. Each academic year of study is divided into two semesters.
iii. Minimum number of instruction days in each semester is 90 days.
iv. There shall be mandatory student induction program for freshers, with a three- week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.
v. Health/wellness/yoga/sports and NCC /NSS /Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduatestudents.
vi. Courses like Environmental Sciences, Indian Constitution, and Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.
vii. Design Thinking for Innovation & Tinkering Labs are made mandatory as creditcourses for all the undergraduate students.
viii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.
ix. Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses canlead to students specializing in emerging areas within the chosen field of study.
x. A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for B.Tech. Degree with a Minor within the 160 credits by opting for the courses offered through various verticals/tracks under Open Electives.
xi. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.
xii. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the fiveskill courses, four courses shall focus on the basic and advanced skills related to the domain/interdisciplinary courses and the other shall be a soft skills course.
xiii. Students shall undergo mandatory summer internships, for a minimum of eight weeks duration at the end of second and third year of the programme. The internship at the end of second year shall be community oriented and industry internship at the end of third year.
xiv. There shall also be mandatory full internship in the final semester of the programme along with the project work.
xv. Undergraduate degree with Honors is introduced by the College for the students having good academic record.
xvi. College will plan 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 advancedconcept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.
xvii. College will assign a faculty advisor/mentor after admission to a group of students from same department to provide guidance in courses registration/career growth/placements/opportunities for higher studies/GATE/other competitive exams etc.
xviii. Preferably 25% of course work for the theory courses in every semester shallbe conducted in the blended mode of learning.

9. Evaluation Process

The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 100 marks for practical subject. Summer Internships shall be evaluated for 50 marks, Full Internship & Project work in final semester shall be evaluated for 200 marks, and 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. Incase of a mandatory course, he/she should secure 40% of the total marks.

THEORY COURSES

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

i) For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70marks for the End-Examination.

ii) For practical subject, the distribution shall be 30 marks for Internal Evaluation and70 marks for the End- Examination.

iii) If any course contains two different branch subjects, the syllabus shall be written intwo 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 the 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 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 weightageof 10 marks. Any fraction shall be rounded off to the next higher mark.
- The objective paper shall be conducted either online or offline by the respectivedepartment on the day of subjective paper test.
- If conducted offline, the midterm examination shall be conducted first by distribution of the Objective paper, simultaneously marking the attendance, after 20 minutes the answered objective paper shall be collected back. The student is not allowed to leave the examination hall. Then the descriptive question paper and the answer booklet shall be distributed.After 90 minutes the answered booklets are collected back.

- Assignments shall be in the form of problems, mini projects, design problems, slip tests, quizzes etc., depending on the course content. It should be continuousassessment throughout the semester and the average marks shall be considered.
- Assignment Test if conducted like slip tests, the following procedure may be followed: Two assignment tests may be conducted before first and second mid examinations for 5 marks. First assignment test may be conducted after the 1st Unit of syllabus. 5 or 6 questions may be announced in advance. On the day of test, 2 questions will be given to each student randomly. The test may be conducted in the first hour for 30 minutes. Second assignment test may be conducted in the similar way after the completion of 3rd Unit of syllabus.

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: AbsentMarks obtained in second mid: 25

Final mid semester Marks: (25x0.8) + (0x0.2) =20

b) End Examination Evaluation:

End examination of theory subjects shall have the following pattern:

i) There shall be 6 questions and all questions are compulsory.

ii) Question I shall contain 10 compulsory short answer questions for a total of20 marks such that each question carries 2 marks.

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

iv) 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.

v) The questions from 2 to 6 shall be set by covering one unit of the syllabus for eachquestion.

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 35marks each.

ii) In each part, question 1 shall contain 5 compulsory short answer questions for a totalof 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 markseach. Student shall answer any one of them.

iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

PRACTICAL COURSES

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

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 concernedlaboratory teacher based on the regularity/record/viva and 15 marks for the internaltest.

c) The end examination shall be evaluated for 70 marks, conducted by the concernedlaboratory teacher and External examiner from the other reputed Institutions.

- Procedure: 20 marks
- Experimental work & Results: 30 marks
- Viva voce: 20 marks.

In a practical subject consisting of two parts (Eg: Basic Electrical &Electronics Engineering Lab), the end examination shall be conducted for 70 marks as a singlelaboratory 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.

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

Day-to-day work shall be evaluated for 15 marks by the concerned subject teacherbased 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 withweightage of 80% to better mid marks and 20% for the other. The subjective papershall contain 3 either or type questions of equal weightage of 5 marks. There shallbe no objective paper in mid semester examination. The sum of day-to-dayevaluation 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 withthe syllabus.

10. 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. Skill oriented Courses.

i) There shall be five skill-oriented courses offered during III to VII semesters.
ii) Out of the five skill courses two shall be skill-oriented courses from the same domain of the remaining three skill courses, one shall be a soft skill course and theremaining two shall be skill-advanced courses from the same domain/Interdisciplinary/Job oriented.
iii) The course shall carry 100 marks and shall be evaluated through continuous assessments during the semester for 30 sessional marks and end examination shallbe for 70 marks. Day-to-day work in the class / laboratory shall be evaluated for 30 marks by the concerned teacher based on the regularity/assignments/viva/mid semester test. The end examination similar to practical examination pattern shall be conducted by the concerned teacher and an expert in the subject nominated by the Principal.
iv) The Head of the Department shall identify a faculty member as coordinator for thecourse. A committee consisting of the Head of the Department, coordinator and a senior Faculty member nominated by the Head of the Department shall monitor theevaluation process. The marks/grades shall be assigned to the students by the above committee based on their performance.
v) The student shall be given an option to choose either the skill courses being offeredby 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 theagency. 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 equivalentmarks/grades.
vi) The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the concerted department's HOD at the beginning of the semester.
vii) If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the Principal.

11. Massive Open Online Courses (MOOCs):

A Student has to pursue and complete one course compulsorily through MOOCs approved by the HOD. 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) offeredthrough 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 studentneeds to earn a certificate by passing the exam. The student shall be awarded the creditsassigned 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 MOOCsplatform 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 courseswould be proposed from time to time.

12. Credit Transfer Policy

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

i) The College shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learningcourses.
ii) Student registration for the MOOCs shall be only through the respective department, it is mandatory for the student to share necessary information with the department.
iii) Credit transfer policy will be applicable to the Professional & Open Elective courses only.
iv) The concerned department shall identify the courses permitted for credit transfer.
v) The concerned department shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.
vi) The department's HOD will designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.
vii) The College will ensure no overlap of MOOC exams with that of the End Semester examination schedule.
viii) Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued bythe competent authority along with the percentage of marks and grades.
ix) The Department shall submit the following to the examination section:
    a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
    b) Undertaking form filled by the students for credit transfer.
x) The College 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 respective Department from time to time.

13. Academic Bank of Credits (ABC)

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

i. provide option of mobility for learners across the universities of their choice
ii. Provide option to gain the credits through MOOCs from approved digitalplatforms.
iii. facilitate award of certificate/diploma/degree in line with the accumulatedcredits in ABC
iv. Execute Multiple Entry and Exit system with credit count, credit transfer andcredit acceptance from student's account.

14.Mandatory Internships

Summer Internships

Two summer internships either onsite or virtual each with a minimum of 08 weeks duration, done at the end of second and third years, respectively are mandatory. It shallbe 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 theend of second year (Community Service Project) shall be society oriented and shall becompleted 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 facultymember 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% weightageeach. 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 College.

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 is 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 showcasedat the department for the benefit of all students and staff and the same is to be evaluatedby 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-VoceExamination conducted in the presence of internal examiner and external examiner appointed by the Principal and is evaluated for 140 marks.

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

15. Guidelines for offering a Minor

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

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

Note: A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for Minor within the 160 credits by opting for the courses offered through various verticals/tracks under Open Electives.

16. Guidelines for offering Honors

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally

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

i) Honors is introduced in the curriculum of all B.Tech. Programs offering a major degree and is applicable to all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.
ii) A student shall earn additional 15 credits (4 theory courses of 3 credits each and One MOOC course of 3 credits) for award of B.Tech. (Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 160 credits).
iii) A student is permitted to register for Honors in IV semester after the results of III Semester are declared and students may be allowed to take maximum one subject per semester pertaining to the Honors from IV Semester onwards.
iv) The college will arrange separate class work and timetable of the courses offered under Honors program.
v) Courses that are used to fulfil the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.
vi) Students can complete the MOOC course in online platforms like SWAYAM with a minimum duration of 12 weeks for 3-credits satisfying the criteria for credit mobility. Student can register for online MOOC course in any semester starting from the 4th Semester. Should submit the MOOC certificate before the commencement of 7th Semester End Examinations. For the 4 theory courses offered by the college, the teaching and evaluation procedure shall be similar to regular B.Tech courses.
vii) The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.
viii) A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.
ix) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree programme. Honors courses should be completed in a single attempt otherwise the registration for honors stands cancelled.
x) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
xi) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering.
xii) Student who registered for Honors should pass all subsequent regular semester courses in a single attempt with a minimum of 7 SGPA.

Enrolment into Honors:

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

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

Registration for Honors:

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

17. Attendance Requirements:

i) A student shall be eligible to appear for the University external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% of attendance in aggregate of all the subjects. b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.
ii) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.
iii) A stipulated fee shall be payable towards condonation of shortage of attendance to the College.
iv) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.
v) A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.
vi) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
vii) If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.
viii) For induction programme attendance shall be maintained as per AICTE norms.

18. Promotion Rules:

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

i) A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per College norms.
ii) A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) up to in the subjects that have been studied up to III semester.
iii) A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) in the subjects that have been studied up to V semester. And in case a student is detained for want of credits for a particular academic year by ii) & iii) above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester or VII semester respectively as the case may be.
iv) When a student is detained due to lack of credits/shortage of attendance he/she may be re-

admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

19. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System usingthe 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 beconverted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

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

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

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

Computation of Semester Grade Point Average (SGPA) and Cumulative 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.,

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

Where, Ci is the number of credits of the ith subject and Gi is the grade point scored by the student in the ith course.

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

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

Where "Si" is the SGPA of the ith semester and Ci is the total number of credits up to thatsemester.

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

Semester Grade Point Average (SGPA) for a semster will be computed only for those students, who have successfully passed all the courses of that semester. Similarly Cumulative Grade Point

Average (CGPA) will be computed for the current semester only for those candidates who successfully completed all the courses starting from the 1st Semester to the Current Semester.

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, E and F.

Award of Class:

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

Class Awarded	CGPA Secured
First Class with Distinction	≥ 7.5 (Without any supplementary appearance)
First Class	≥ 6.5 < 7.5
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 5.0 < 5.5

- **Note:** Students who have written supplementary examinations to fulfil the credit requirement will not be awarded First Class with Distinction. For such students thehighest degree that is awarded will be First Class Only.

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

20. With–holding of Results

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

21. Multiple Entry / Exit Option

(a)Exit Policy:

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

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

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

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

(b) Entry Policy:

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

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

22. Gap Year Concept:

Gap year concept for Student Entrepreneur in Residence is introduced and outstanding students

who wish to pursue entrepreneurship / become entrepreneur are allowed to take a break of one year at any time after II year to pursue full-time entrepreneurship programme/to establish startups. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. The HOD of the respective 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

23. Transitory Regulations

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

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

24. Minimum Instruction Days for a Semester:

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

25. Medium of Instruction:

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

26. Student Transfers:

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

27. General Instructions:

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 Vice-Chancellor is final.
e. The Universities may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Universities.
f. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Vice-Chancellor / Head of the institution is final.

*****

ACADEMIC REGULATIONS (R23) FOR B.TECH. (LATERAL ENTRY SCHEME)

*(Effective for the students getting admitted into II year through Lateral Entry Scheme from the Academic Year **2024-2025** 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

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

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

(ii) Registering for Honors is optional.

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

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

3. Minimum Academic Requirements

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

i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.

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

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

4. Course Pattern

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

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

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

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

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

- The Principal shall refer the cases of Malpractices in Internal Assessment Test and Semester end examinations to a malpractice prevention committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the students based on the recommendations of the committee.
- Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained here under.

	Nature of Malpractices/ Improper conduct	**Punishment**
	If the candidate:	
1(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination).	Expulsion from the examination hall and cancellation of the performance in that subject only.
1(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjectsof that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the college.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and to be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant– Superintendent /any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation,	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the Police and a police case is registered against them.

	assaults the officer-in- charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the college expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.

11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the college for further action to award suitable punishment.	

OTHER MATTERS:

1. Physically challenged candidates who have availed additional examination time and a scribe during their intermediate / EAPCET examinations will be given similar concessions on production of relevant proof / documents.
2. The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Controller of Examinations and Heads of the departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the departments shall be reported to the Academic Council for ratification.

GENERAL:

1. The academic council may, from time to time, revise, amend or change the regulations, schemes of examinations and / or syllabi.
2. Where ever the words “he’’, “him’’, “his’’ occur in the regulations, they include “she’’, “her’’, “hers’’.
3. The academic regulation should be read as a whole for the purpose of any interpretation.
4. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.
5. Malpractice cases will be indicated in the grade card with letters ‘MP’.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA-533003, 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 & 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 hurt	2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	10 Months	+	Rs. 50,000/-

In Case of Emergency CALL TOLL FREE No. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

ANNEXURE-I

COMMUNITY SERVICE PROJECT

Experiential learning through community engagement

As per the decision of the concerned department BOS

Introduction

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of the society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.
- Implementation of Community Service Project
- Every student should put in a minimum of **180 hours** for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc
- A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.
- The log book has to be countersigned by the concerned mentor/faculty incharge.
- Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.

- The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
- The Community Service Project is a twofold one –
- First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
- Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –

- Agriculture
- Health
- Marketing and Cooperation
- Animal Husbandry
- Horticulture
- Fisheries
- Sericulture
- Revenue and Survey
- Natural Disaster Management
- Irrigation
- Law & Order
- Excise and Prohibition
- Mines and Geology
- Energy
- Internet
- Free Electricity
- Drinking Water

EXPECTED OUTCOMES

BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

Learning Outcomes

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in "the real world"
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development
- Improved ability to understand complexity and ambiguity

Personal Outcomes

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

Career Development

- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

- Improved institutional commitment
- Improved student retention
- Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

- Satisfaction with student participation
- Valuable human resources needed to achieve community goals
- New energy, enthusiasm and perspectives applied to community work
- Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

The following is the recommended list of projects for engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries

***

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

I B.Tech I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	LINEAR ALGEBRA & CALCULUS	R23CC1101	BS&H	30	70	100	3	0	0	3
2	INTRODUCTION TO PROGRAMMING	R23CC1102	ES	30	70	100	3	0	0	3
3	ENGINEERING PHYSICS	R23CC1106	BS&H	30	70	100	3	0	0	3
4	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	R23CC1107	ES	30	70	100	3	0	0	3
5	ENGINEERING GRAPHICS	R23CC1108	BS&H	30	70	100	3	0	0	3
6	COMPUTER PROGRAMMING LAB	R23CC11L1	ES	30	70	100	0	0	3	1.5
7	IT WORKSHOP	R23CC11L5	BS&H	30	70	100	0	0	2	1
8	ENGINEERING PHYSICS LAB	R23CC11L6	ES	30	70	100	0	0	3	1.5
9	EEE WORKSHOP	R23CC11L7	BS&H	30	70	100	0	0	2	1
10	NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE	R23CC11MC2	BS&H	100	-	100	-	-	1	0.5
TOTAL										**20.5**

I B.Tech II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	DIFFERENTIAL EQUATIONS & VECTOR CALCULUS	R23CC1201	BS&H	30	70	100	3	0	0	3
2	COMMUNICATIVE ENGLISH	R23CC1206	BS&H	30	70	100	3	0	0	2
3	ENGINEERING CHEMISTRY	R23CC1208	BS&H	30	70	100	3	0	0	3
4	ELECTRICAL CIRCUITS ANALYSIS -1	R23EE1210	ES	30	70	100	3	0	0	3
5	BASIC CIVIL & MECHANICAL ENGINEERING	R23CC1212	ES	30	70	100	3	0	0	3
6	ENGINEERING WORKSHOP	R23CC12L9	ES	30	70	100	0	0	3	1.5
7	ELECTRICAL CIRCUITS LAB	R23EE12L5	ES	30	70	100	0	0	3	1.5
8	ENGINEERING CHEMISTRY LAB	R23CC12L11	BS&H	30	70	100	0	0	2	1
9	COMMUNICATIVE ENGLISH LAB	R23CC12L12	BS&H	30	70	100	0	0	2	1
10	HEALTH AND WELLNESS, YOGA AND SPORTS	R23CC12MC1	BS&H	100	-	100	-	-	1	0.5
TOTAL										**19.5**

II B.TECH - I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Complex variables and Numerical Methods	R23EE2101	BS	30	70	100	3	0	0	3
2	Universal Human Values– Understanding Harmony& Ethical Human Conduct	R23CC2102	HSMC	30	70	100	2	1	0	3
3	Electromagnetic Field Theory	R23EE2103	ES	30	70	100	3	0	0	3
4	Electrical Circuit Analysis-II	R23EE2104	PC	30	70	100	3	0	0	3
5	DC Machines & Transformers	R23EE2105	PC	30	70	100	3	0	0	3
6	Electrical Circuit Analysis-II and Simulation Lab	R23EE21L1	PC	30	70	100	0	0	3	1.5
7	DC Machines & Transformers Lab	R23EE21L2	PC	30	70	100	0	0	3	1.5
8	Data Structures Lab	R23EE21L3	SC	30	70	100	0	1	2	2
Total							**15**	**2**	**10**	**20**

II B.TECH - II SEMESTER

S. No	Subject	urse Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	edits
1	Managerial Economics & Financial Analysis	R23CC2201	HS	30	70	100	2	0	0	2
2	Analog Circuits	R23EE2202	BS	30	70	100	3	0	0	3
3	Power Systems-I	R23EE2203	PC	30	70	100	3	0	0	3
4	Induction and Synchronous Machines	R23EE2204	PC	30	70	100	3	0	0	3
5	Control Systems	R23EE2205	PC	30	70	100	3	0	0	3
6	Induction and Synchronous Machines Lab	R23EE22L1	PC	30	70	100	0	0	3	1.5
7	Control Systems Lab	R23EE22L2	PC	30	70	100	0	0	3	1.5
8	Python Programming Lab	R23EE22L4	SC	30	70	100	0	1	2	2
9	Design Thinking & Innovation	R23CC22L3	ES	30	70	100	1	0	2	2
10	Environmental Studies	R23CC22MC	MC	30	70	100	2	0	0	-
Total							15	1	10	21
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation										

III Year-I Semester

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Power Electronics	R23EE3101	PC	30	70	100	3	0	0	3
2	Digital Circuits	R23EE3102	PC	30	70	100	3	0	0	3
3	Power Systems-II	R23EE3103	PC	30	70	100	3	0	0	3
4	**Professional Elective- I** 1. Signals and Systems	R23EE3104	PE	30	70	100	3	0	0	3
	2. Computer Architecture and Organization	R23EE3105								
	3. Communication Systems	R23EE3106								
	4. Special Electrical Machines	R23EE3107								
5	**Open Elective-I** 1. Renewable Energy Sources	R23OE3104	OE	30	70	100	3	0	0	3
	2. Concepts of Energy Auditing & Management	R23OE3105								
	3. Linear Control Systems	R23OE3106								
	4. Electrical Safety	R23OE3107								
6	Power Electronics Lab	R23EE31L1	PC	30	70	100	0	0	3	1.5
7	Analog and Digital Circuits Lab	R23EE31L2	PC	30	70	100	0	0	3	1.5
8	Soft skills	R23EE31L3	SE	30	70	100	0	1	2	2
9	Tinkering Lab	R23EE31L4	ES	30	70	100	0	0	2	1
10	Evaluation of Community Service Internship	R23EE31CSP	PC	30	70	100	-	-	-	2
Total							15	1	10	23

III Year-II Semester

S.No.	Subject	Course Code	Cat. Code	L	T	P	Credits
1	Electrical Measurements and Instrumentation	R23EE3201	PC	3	0	0	3
2	Microprocessors and Microcontrollers	R23EE3202	PC	3	0	0	3
3	Power System Analysis	R23EE3203	PC	3	0	0	3
4	**Professional Elective-II** 1. Switchgear and Protection	R23EE3204	PE-II	3	0	0	3
	2. Advanced Control Systems	R23EE3205					
	3. Renewable and Distributed Energy Technologies	R23EE3206					
	4. Embedded Systems	R23EE3207					
5	**Professional Elective-III** 1. Electric Drives	R23EE3208	PE-III	3	0	0	3
	2. Digital Signal Processing	R23EE3209					
	3. High Voltage Engineering	R23EE3210					
	4. Utilization of Electrical Energy	R23EE3211					
6	**Open Elective - II** 1. Fundamentals of Electric Vehicles	R23OE3205	OE - II	3	0	0	3
	2. Electrical Wiring Estimation and Costing	R23OE3206					
	3. Introduction to Smart Grid	R23OE3207					
	4. Industrial Automation	R23OE3208					
7	Electrical Measurements and Instrumentation Lab	R23EE32L1	PC	0	0	3	1.5
8	Microprocessors and Microcontrollers Lab	R23EE32L2	PC	0	0	3	1.5
9	IoT Applications of Electrical Engineering Lab	R23EE32L3	SEC	0	1	2	2
10	Research Methodology	R23EE32MC	AC	2	0	0	-
		Total		**20**	**1**	**08**	**23**

IV Year-I Semester

S.No.	Subject	Course Code	Cat. Code	L	T	P	Credits
1	Power System Operation and Control	R23EE4101	PC	3	0	0	3
2	Energy Management & Auditing	R23EE4102	MC- II	2	0	0	2
3	**Professional Elective-IV** EHVAC & HVDC Transmission Systems	R23EE4105	PE-IV	3	0	0	3
	Programmable Logic Controllers	R23EE4103					
	Electrical Distribution System	R23EE4106					
	Power Quality	R23EE4107					
4	**Professional Elective-V** 1. Electric Vehicles	R23EE4108	PE-V	3	0	0	3
	2. Switched Mode Power Conversion	R23EE4109					
	3. Design of PV systems	R23EE4110					
	4. Flexible AC Transmission Systems	R23EE4104					
5	**Open Elective – III** 1. Battery Management Systems and Charging Stations	R23OE4123	OE - III	3	0	0	3
	2. Micro Electro Mechanical System	R23OE4124					
	3. Soft Computing	R23OE4125					
	4. Embedded control of electric drives	R23OE4126					
6	**Open Elective-IV** 1. Concepts of Power Quality	R23OE4102	OE-IV	3	0	0	3
	2. Non-Conventional Energy Resources	R23OE4107					
	3. Fundamentals Of Utilization Of Electrical Energy	R23OE4127					
	4. Indian Electricity Act	R23OE4128					
7	Power Systems Simulation Lab	R23EE41L1	SEC	0	0	4	2
8	Constitution of India	R23CC41MC	AC	2	0	0	-
9	Evaluation of Industry Internship	R23CC41IN	Internship	-	-	-	2
Total				**16**	**0**	**02**	**21**

B.Tech. IV Year-II Semester

S.No.	Category	Title	L	T	P	C
1	PR	Internship and Project	**-**	**-**	**24**	**12**

I B.Tech I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	LINEAR ALGEBRA & CALCULUS	R23CC1101	BS&H	30	70	100	3	0	0	3
2	INTRODUCTION TO PROGRAMMING	R23CC1102	ES	30	70	100	3	0	0	3
3	ENGINEERING PHYSICS	R23CC1106	BS&H	30	70	100	3	0	0	3
4	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	R23CC1107	ES	30	70	100	3	0	0	3
5	ENGINEERING GRAPHICS	R23CC1108	BS&H	30	70	100	3	0	0	3
6	COMPUTER PROGRAMMING LAB	R23CC11L1	ES	30	70	100	0	0	3	1.5
7	IT WORKSHOP	R23CC11L5	BS&H	30	70	100	0	0	2	1
8	ENGINEERING PHYSICS LAB	R23CC11L6	ES	30	70	100	0	0	3	1.5
9	EEE WORKSHOP	R23CC11L7	BS&H	30	70	100	0	0	2	1
10	NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE	R23CC11MC2	BS&H	100	-	100	-	-	1	0.5
TOTAL										**20.5**

I B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE: R23CC1101	LINEAR ALGEBRA & CALCULUS						

COURSE OBJECTIVES:

- Grasping fundamental principles in linear algebra, including linear transformations, solving systems of linear equations, and applying matrix calculus.
- To become proficiency in solving computational problems of linear algebra.
- To acquire knowledge on mean value theorems in calculus.
- Familiarization about the techniques in calculus and multivariate analysis.

COURSE OUTCOMES:

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

CO1: **Solve** the system of linear equations and transformations.

CO2: **Analyze** the applications of matrices in various fields and obtain Eigen values and Eigenvectors.

CO3: **Analyze** mean value theorems to real life problems

CO4: **Apply** the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering

CO5: **Identify** the area and volume by interlinking them to appropriate double and triple integrals.

UNIT-I:

MATRICES

Introduction to Linear Transformation-Rank of a matrix by Echelon form and 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 - Gauss elimination method, Jacobi and Gauss-Seidel iteration methods.

Applications: L-C-R Circuits

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 form and nature of a quadratic form - Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT-III:

CALCULUS

Mean Value Theorems (without proofs): Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation - Cauchy's mean value theorem - Taylor's and Maclaurin's theorems with remainders - 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 – Homogeneous function-Euler's Theorem on homogeneous functions-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's 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).

TEXTBOOKS:

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

REFERENCE BOOKS:

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

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE :R23CC1102	INTRODUCTION TO PROGRAMMING						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Infer the basic concepts of computers, algorithms and Flowcharts**.**
CO2: Develop programs using appropriate control structures**.**
CO3: Write programs using arrays and strings**.**
CO4: Develop programs using structures and pointers**.**
CO5: Make use of functions and file Operations in C programming for a given application**.**

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, Operators, Type Conversion, and Casting.

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

UNIT II:
CONTROL STRUCTURES

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, Strings: Introduction – Reading Strings – Writing Strings – String Manipulation functions -Array of Strings.

UNIT IV:
POINTERS & USER DEFINED DATA TYPES

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

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. Scopeand Lifetime of Variables, Basics of File Handling

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

TEXTBOOKS:
1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 2005.
2. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition.
3. How to Solve it by Computer, R G Dromey, Pearson Education.

REFERENCE BOOKS:
1. Computing Fundamentals and C Programming, Balagurusamy, E., McGraw-HillEducation, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education,1998.

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE:R23CC1106	ENGINEERING PHYSICS						

COURSE OBJECTIVES:

- To bridge the gap between the Physics at 10+2 level and UG level engineering courses
- Identifying the importance of Lasers and optical fibers,
- Enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics,
- Introduce novel concepts of magnetic materials and superconductors, physics of semiconductors and smart materials.

COURSE OUTCOMES:

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

CO 1: Analyze the intensity variation of Laser light and it's propagation in optical fibers.
CO 2: Familiarize with the basics of crystals and their structures.
CO 3: Summarize various types of Magnetic materials and Super conductors.
CO 4: Explain the basic concepts of Quantum Mechanics and the band theory of solids.
CO 5: Identify the type of semiconductor and smart materials.

UNIT I:

LASERS AND OPTICAL FIBERS

LASERS: Introduction – Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Population inversion - Einstein's coefficients and relation between them - Ruby laser – Helium Neon laser- Semiconductor laser-Applications.

OPTICAL FIBERS: Introduction- Basic Structure and Principle of optical fiber - Acceptance angle – Acceptance cone - Numerical Aperture - Step Index and Graded index fibers -Applications.

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.

X-RAY DIFFRACTION: Miller indices – separation between successive (hkl) planes. Bragg's law - crystal structure determination by Laue's and powder methods.

UNIT III:

MAGNETIC MATERIALS AND SUPERCONDUCTIVITY

MAGNETIC MATERIALS: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility, permeability and relation between them - Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Hysteresis - soft and hard magnetic materials.

SUPERCONDUCTIVITY: Introduction- Properties, Meissner effect - Type-I and Type-II super conductors- BCS Theory- AC and DC Josephson effect-Applications.

UNIT IV:

QUANTUM MECHANICS AND FREE ELECTRON THEORY

QUANTUM MECHANICS: de-Broglie's matter Waves – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent wave

equation – Particle in a one-dimensional infinite potential well.

FREE ELECTRON THEORY: Classical free electron theory (Qualitative with discussion of merits and demerits) – electrical conductivity based on Classical free electron theory -Quantum free electron theory –- Fermi energy- Fermi-Dirac distribution.

UNIT V:

SEMICONDUCTORS AND SMART MATERIALS

SEMICONDUCTORS: Formation of energy bands – classification of solids – Types of semiconductors - Drift and diffusion currents – Einstein's equation - Hall Effect and its applications.

SMART MATERIALS: Introduction – properties- types of smart materials- shape memory alloys – piezoelectric materials- magneto strictive materials – Thermoelectric materials- magneto rheological fluids- electro rheological fluids- Chromic materials – Engineering applications of smart materials.

TEXTBOOKS:

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

REFERENCE BOOKS:

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

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE :R23CC1107	BASIC ELECTRICAL & ELECTRONICS ENGINEERING						

PART A: BASIC ELECTRICAL ENGINEERING

COURSE OBJECTIVES

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

COURSE OUTCOMES:

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

CO1: Explore the fundamental laws and concept of DC and AC circuits.

CO2: Demonstrate the working and operating principles of electrical machines, measuring instruments.

CO3: Demonstrate the working and operating principles of different power generation stations.

CO4: Calculate electrical load, electricity bill of residential and commercial buildings and safety measures.

UNIT I:

DC & AC CIRCUITS

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

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

UNIT II:

MACHINES AND MEASURING INSTRUMENTS

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

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

UNIT III:

ENERGY RESOURCES, ELECTRICITY BILL & SAFETY MEASURES

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

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

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

TEXTBOOKS:

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

REFERENCE BOOKS:

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

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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:

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

CO1: Describe the working of diode and explore the operation of BJT and its applications.
CO2: Describe the working of Rectifiers and amplifiers in electronic circuits.
CO3: Manipulate numeric information in different forms, various codes such as ASCII, Gray, and BCD, simple Boolean expressions and Boolean Theorems
CO4: Design and analyse combinational circuits, sequential circuits, flip flops Registers and Counters.

UNIT I:

SEMICONDUCTOR DEVICES

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

UNIT II:
BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION

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

UNIT III:
DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to sequential circuits, Flip flops(S-R, J-K, D and T Flip flops), Registers(4-bit Shift Register - serial input and output) and counters (Ripple Counters, Binary Ripple Counter, Ring Counter) (Elementary Treatment only)

TEXTBOOKS:

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

REFERENCE BOOKS:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Salivahanan, N. Suresh Kumar, A. Vallavaraj, "Electronic Devices and Circuits" Tata McGraw-Hill, Second Edition, 2008.
3. Jacob Millman, C. Halkies, C.D. Parikh, Satyabrata Jit, "Integrated Electronics", Tata McGraw-Hill, Second Edition, 2011.

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	1	0	4	30	70	100	3
CODE : R23CC1108	ENGINEERING GRAPHICS						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Construct the principles of engineering drawing, including engineering curves, scales, Orthographic and isometric projections**.**

CO2: Construct orthographic projections of points, lines, planes and solids in front,top and Side views**.**

CO3: Analyze and draw projection of solids in various positions in first Quadrant.

CO4: Develop the sections of Solids & Development of Surfaces**.**

CO5: Compare & Draw isometric Views & Orthographic Views**.**

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: Polyhedral 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 linedevelopment. Development of a cube, prism, cylinder, pyramid and cone.

UNIT V

CONVERSION OF VIEWS: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

COMPUTER GRAPHICS: Creating 2D&3D drawings of objects including PCB and Transformationsusing Auto CAD (*Not for end examination*).

TEXTBOOK:

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

REFERENCE BOOKS:

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

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
CODE:R23CC11L1	COMPUTER PROGRAMMING LAB						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

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

CO2: Implement programs with appropriate control structures for solving the problems

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

CO4: Code, Debug and Execute programs to demonstrate the applications of arrays, functions, files and various other concepts in C

UNIT1

WEEK 1

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

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.

ii) Basic commands of Linux (sudo, pwd, cd, ls, cat, cp, mv, mkdir, rmdir, rm, touch, locate, find, grep, df, du, head, tail, diff, tar, chmod, chown, kill, ping)

iii) Exposure to Turbo C, gcc

iv) Writing simple programs using printf(), scanf()

WEEK 2

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

Suggested Experiments /Activities:

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

Lab 2: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers

ii) Conversion of Fahrenheit to Celsius and vice versa

iii) Simple interest calculation

WEEK 3

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

Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.

i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

UNIT II

WEEK 4

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

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:

Lab4: Simple computational problems using the operator' precedence and associativity

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

WEEK 5

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

Suggested Experiments/Activities:

Tutorial 5: Branching and logical expressions:

Lab 5: Problems involving if-then-else structures.

i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.

WEEK 6

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when eachof these statements is more appropriate to use.

Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems e.g., the sum of series

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

UNIT III

WEEK 7:

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

Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching.

Lab 7:1D Array manipulation, linear search

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

WEEK 8:

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

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

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

UNIT IV

WEEK: 9

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

Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Lab 9: Pointers and structures, memory dereference.

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

WEEK 10:

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

Suggested Experiments/Activities:
Tutorial 10: Bitfields, Self-Referential Structures, Linked lists
Lab10: Bitfields, linked lists
Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields
i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V
WEEK 11:
Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration
Suggested Experiments/Activities:
Tutorial 11: Functions, call by value, scope and extent,
Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.
i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler'smethod

WEEK 12:
Objective: Explore how recursive solutions can be programmed by writing recursive functionsthat can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.
Suggested Experiments/Activities:
Tutorial 12: Recursion, the structure of recursive calls
Lab 12: Recursive functions
i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

WEEK 13:
Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers
Suggested Experiments/Activities:
Tutorial 13: Call by reference, dangling pointers
Lab 13: Simple functions using Call by reference, Dangling pointers.
i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
iv) Write a C program to find no of lowercase, uppercase, digits and othercharacters using pointers.

WEEK14:
Objective: To understand data files and file handling with various file I/O functions. Explore thedifferences between text and binary files.
Suggested Experiments/Activities:
Tutorial 14: File handling
Lab 14: File operations
i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() andfwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-linearguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

WEEK 15: Virtual Labs:
https://ps-iiith.vlabs.ac.in/List%20of%20experiments.html

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

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

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	2	30	70	100	1
CODE:R23CC11L5	IT WORKSHOP						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Identify Hardware components and inter dependencies**.**
CO2: Utilize Antivirus s/w to safeguard computer systems while using Internet
CO3: Develop a Document or Presentation
CO4: Make use of spreadsheets to perform calculations
CO5: Utilize the AI Tool Chat GPT

PC HARDWARE & SOFTWARE INSTALLATION

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

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

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

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

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

INTERNET & WORLD WIDE WEB

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finallystudents should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWWon 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 howto 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 customizetheir browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD
Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent(FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Usinghelp and resources, rulers, format painter in word.
Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing,Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeXand 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 1: 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 – Chat GPT

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 sentencesto see how the model completes them.

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

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a storyor a description of a scene, and let the model generate the rest of the content. This can be a funway 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 tosee how accurate and fluent the translations are.

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

REFERENCE BOOKS:

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

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
CODE: R23CC11L6	ENGINEERING PHYSICS LAB						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO: 1 Operate optical instruments like travelling microscope and spectrometer
CO: 2 Estimate the wavelengths of different colors using diffraction grating.
CO: 3 Plot the intensity of the magnetic field of circular coil carrying current with distance.
CO: 4 Calculate the band gap of a given semiconductor.

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'sMethod.
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 acompound pendulum.
14. Determination of magnetic susptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsionalpendulum.
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'sexperiment.

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

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

URL: *www.vlab.co.in*

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	2	30	70	100	1
CODE :R23CC11L7	EEE WORKSHOP						

PART A: ELECTRICAL ENGINEERING LAB

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Measure voltage, current and power in an electrical circuit.
CO2: Measure of Resistance using Wheatstone bridge
CO3: Discover critical field resistance and critical speed of DC shunt generators.
CO4: Investigate the effect of reactive power and power factor in electrical loads.

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

LIST OF EXPERIMENTS

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheatstone 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
8. Determination of open circuit and short circuit parameters of a 1-phase transformer (Content Beyond syllabus)

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:

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

CO1: Analyze the characteristics of various electronic components. **(K4)**
CO2: Implement Rectifiers circuits. **(K3)**
CO3: Design Amplifiers circuit. **(K6)**
CO4: Examine the operation of Logic gates. **(K4)**

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.
9. Design a Full Adder Circuit and verify the truth table. (Content beyond syllabus)

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

REFERENCES:

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

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

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	1	100	-	100	0.5
CODE :R23CC11MC2	NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

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

UNIT I
ORIENTATION

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

Activities:

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

UNIT II
NATURE & CARE

Activities:

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

UNIT III Community Service

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities experts-etc.
ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.

iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

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

General Guidelines:

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

Evaluation Guidelines:

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, totaling to 90 marks.
3. A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

I B.Tech II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	DIFFERENTIAL EQUATIONS & VECTOR CALCULUS	R23CC1201	BS&H	30	70	100	3	0	0	3
2	COMMUNICATIVE ENGLISH	R23CC1206	BS&H	30	70	100	3	0	0	2
3	ENGINEERING CHEMISTRY	R23CC1208	BS&H	30	70	100	3	0	0	3
4	ELECTRICAL CIRCUITS ANALYSIS -1	R23EE1210	ES	30	70	100	3	0	0	3
5	BASIC CIVIL & MECHANICAL ENGINEERING	R23CC1212	ES	30	70	100	3	0	0	3
6	ENGINEERING WORKSHOP	R23CC12L9	ES	30	70	100	0	0	3	1.5
7	ELECTRICAL CIRCUITS LAB	R23EE12L5	ES	30	70	100	0	0	3	1.5
8	ENGINEERING CHEMISTRY LAB	R23CC12L11	BS&H	30	70	100	0	0	2	1
9	COMMUNICATIVE ENGLISH LAB	R23CC12L12	BS&H	30	70	100	0	0	2	1
10	HEALTH AND WELLNESS, YOGA AND SPORTS	R23CC12MC1	BS&H	100	-	100	-	-	1	0.5
TOTAL										**19.5**

I B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE : R23CC1201	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common to all Engineering Branches)						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO 1: First order ordinary differential equations to real life situations.
CO 2: Identify and apply suitable methods in solving the higher order differential equations
CO 3: Solve the partial differentiation equations.
CO 4: Interpret the physical meaning of different operators as gradient, curl and divergence.
CO 5: 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 - Simultaneous linear equations - Applications to L-C-R circuit problems and Simple harmonic motion.

UNIT-III:

PARTIAL DIFFERENTIAL EQUATIONS

Introduction and formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solutions of first order linear equations using Lagrange's method - Homogeneous and Non-homogeneous linear partial differential equations with constant coefficients.

UNIT-IV:

VECTOR DIFFERENTIATION

Scalar and vector point functions - Vector operator del - Del applied to scalar point functions - Gradient, Directional derivative - Del applied to vector point functions - Divergence and Curl – Solenoidal vector-Irrotational-scalar potential of vector - Vector identities.

UNIT-V:

VECTOR INTEGRATION

Line integral - Circulation - Work done - Surface integral, flux - Green's theorem in the plane (without proof) - Stoke's theorem (without proof) - Volume integral - Gauss divergence theorem (without proof) and related problems.

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones and Bartlett, 2018.
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint). Higher Engineering Mathematics, B. V. Ramana, Mc Graw Hill Education, 2017

I B.Tech II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	30	70	100	2
CODE: R23CC1206	COMMUNICATIVE ENGLISH						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Summarize texts based on the comprehension of the material provided**.**

CO2: Create coherent and well-structured paragraphs, essays, and letters on a range of familiar topics

CO3: Use a diverse array of grammatical structures with flexibility, striving to minimize errors.

CO4: Use vocabulary adequately and appropriately to express and write on a variety of topics.

UNIT I

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

Listening: Identifying the topic, the context and specific pieces of information by listeningto 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 afterlistening to audio texts.

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

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to linkthe ideasin 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 isdiscussed

Reading: Reading a 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 ofrelevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts
Reading: Reading comprehension.
Writing: Writing structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar andusage (articles, prepositions, tenses, subject verb agreement)
Vocabulary: Technical Jargons

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

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

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE :R23CC1208	ENGINEERING CHEMISTRY						

COURSE OBJECTIVES:

- To impart the concept of soft and hard waters, softening methods of hard water
- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry, polymers, cement and advanced engineering materials.

COURSE OUTCOMES:

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

CO1: Understand the difference between soft and hard water and why it matters in daily life and industries.

CO2: Apply electrochemical principles to real-problems, making informed decisions about materials selection, corrosion mitigation, and energy storage solutions

CO3: Analyze the production, properties, and environmental implications of polymers, fuels and biofuels.

CO4: Apply the knowledge of diverse engineering materials like composites, refractories, lubricants, and Portland cement, to make material selection and applications.

CO5: Apply the Knowledge of various applications to synthesize colloids and characterize nano materials.

UNIT I

WATER TECHNOLOGY

Soft and hard water, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming**,** scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, Ion-exchange process - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

UNIT II

ELECTROCHEMISTRY AND APPLICATIONS

Electrochemical cell, Reference electrodes: Metal-metal ion electrode (Calomel electrode) Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCd), Sodium –ion and lithium ion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling-Bedworth ratios and uses, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electroless plating (Nickel and Copper)

UNIT III

POLYMERS AND FUEL CHEMISTRY

Introduction to polymers, Mechanism of chain growth, step growth polymerization. Plastics –Thermo plastics and Thermosetting plastics, Moulding Techniques-Compression moulding, injection moulding, Blow moulding, Elastomers – Preparation, properties and applications of Buna S, Buna N.

Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel

UNIT IV

MODERN ENGINEERING MATERIALS

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.

Building materials- Portland cement, constituents, Setting and Hardening of cement.

UNIT V

SURFACE CHEMISTRY AND NANOMATERIALS

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (Braggs Method), stabilization of colloids by stabilizing agents.

Nano materials: Introduction–Sol-gel method & chemical reduction method of preparation – Characterization by BET method and TEM methods–Carbon nano tubes and fullerenes: Types–preparation–properties and applications.

TEXTBOOKS:

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

REFERENCE BOOKS:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth- Heineman, 1992.
3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition.

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE: R23EE1210	ELECTRICAL CIRCUIT ANALYSIS -I						

Course Objectives:

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

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

CO1: Relate the basic fundamental laws and apply different reduction techniques to different networks. **(K3)**

CO2: Apply the electrical concepts to obtain various mathematical and graphical representations in Single phase AC Circuits**. (K3)**

CO3: Distinguish the concept of self-inductance, mutual inductance and different Magnetic Circuits **(K4)**

CO4: Examine Series and Parallel Resonance circuits to find specifications and to draw Locus diagrams **(K3)**

CO5: Analyse the Electrical Networks using different Network theorems. **(K4)**

UNIT I : INTRODUCTION TO ELECTRICAL CIRCUITS

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

UNIT II : SINGLE PHASE CIRCUITS

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

UNIT III : MAGNETIC CIRCUITS

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

UNIT IV : RESONANCE AND LOCUS DIAGRAMS

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

UNIT V : NETWORK THEOREMS (DC & AC EXCITATIONS)

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

TEXT BOOKS:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, Tata Mc Graw Hill Education, 2005, sixth edition.

2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised Third Edition

REFERENCE BOOKS:

1. Fundamentals of Electrical Circuits, Charles K. Alexander and Mathew N.O. Sadiku, Mc Graw Hill Education (India), 2013, Fifth Edition

2. Electric Circuits (Schaum's outline Series), Mahmood Nahvi, Joseph Edminister, and K. Rao, Mc Graw Hill Education, 2017, Fifth Edition.

3. Electric Circuits, David A. Bell, Oxford University Press, 2009, Seventh Edition.

4. Introductory Circuit Analysis, Robert L Boylestad, Pearson Publications, 2023, Fourteenth Edition.

5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, Seventh Revised Edition.

Web References:

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

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
CODE: R23CC1212	BASIC CIVIL AND MECHANICAL ENGINEERING						

PART A: BASIC CIVIL ENGINEERING

COURSE OBJECTIVES:

- To introduce basic laws, mesh & nodal analysis techniques for solving electrical circuits
- To impart knowledge on applying appropriate theorem for electrical circuit analysis
- To explain transient behavior of circuits in time and frequency domains
- To teach concepts of resonance
- To introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship.

COURSE OUTCOMES:

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

CO1: Acquire knowledge on various sub-divisions of Civil Engineering and to appreciate their role inensuring better society.

CO2: Apply the concepts of surveying to calculate distances, anglesand levels.

CO3: Realize the importance of transportation in nation's economy and to identify the importance of Water Storage and Conveyance Structures.

UNIT I

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

UNIT II

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

UNIT III

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

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

TEXTBOOKS:

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

REFERENCE BOOKS:

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

PART B: BASIC MECHANICAL ENGINEERING

COURSE OBJECTIVES:

The students after completing the course are expected to

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

COURSE OUTCOMES:

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

CO1: Illustrate the role of mechanical engineering and its technologies in various sectors and knowledge of engineering materials.

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

CO3: Describe the working of different powerplants, mechanical power transmission systems and basics of robotics and its applications.

UNIT I

INTRODUCTION TO MECHANICAL ENGINEERING: Role of Mechanical Engineering in Industries andSociety - Mechanical Engineering Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace and Marine Engineering.

ENGINEERING MATERIALS – Basics of **Metals** (Ferrous & Non-ferrous), Ceramics, Composites, Smart materials.

UNIT II

MANUFACTURING PROCESSES: Basics of - Principles of Casting**,** Forming and joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

THERMAL ENGINEERING: Basics of - 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: Basics of - Working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission: Basics of - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics: Basics of - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering

systems. The evaluation shall be intended to test only the fundamentals of the subject)

Textbooks:

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

Reference Books:

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

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
SUB CODE: R23CC12L9	ENGINEERING WORKSHOP						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Identify workshop tools and their operational capabilities. **[K3]**
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry, welding and Plumbing. **[K3]**
CO3: Apply fitting operations in various applications. **[K3]**
CO4: Apply basic electrical engineering knowledge for House Wiring Practice **[K3]**

LIST OF EXPERIMENTS:

ENGINEERING WORKSHOP TRADES FOR EXERCISE:

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) Dovetail 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) Conical funnel
   b) Brazing
4. **Fitting**: Familiarity with different types of tools used in fitting and do the following Fitting exercises.
   a) V-fit
   b) Bicycle tire puncture
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make The following connections.
   a) Parallel and Series

b) Tube light

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. Demonstration and basic repair works of two wheeler vehicle

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
CODE: R23EE12L5	**ELECTRICAL CIRCUITS LAB**						

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

COURSE OUTCOMES:

CO1: Describe the concepts of network theorems, node and mesh networks, series and parallel resonance and Locus diagrams. **[K2]**
CO2: Apply various theorems to compare practical results obtained with theoretical calculations. **[K3]**
CO3: Determine self, mutual inductances and coefficient of coupling values, parameters of choke coil. **[K3]**
CO4: Analyse different circuit characteristics with the help of fundamental laws and various configurations. **[K4]**
CO5: Create locus diagrams of RL, RC series circuits and examine series and parallel resonance. **[K4]**

Students have to perform any 10 of the following Experiments:

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

Experiment beyond Syllabus

1. Determination of Z and Y Parameters of a Two-Port Network.
2. Determination of Transmission and Hybrid Parameters of a Two-Port Network.

Reference Books:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, Tata Mc Graw Hill Education, 2005, sixth edition.

2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised Third Edition (https://vlab.amrita.edu/index.php?sub=1&brch=74&sim=571&cnt=1)

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	2	30	70	100	1
CODE: R23CC12L11	**ENGINEERING CHEMISTRY LAB**						

Course Objectives:

- Verify the fundamental concepts with experiments.

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

CO 1: Develop and perform analytical chemistry techniques to address the water related problems. **[K6]**

CO 2: Determine the strength of an acid, cell constant, potentials and conductance of solutions. **[K5]**

CO 3: Prepare advanced polymer Bakelite and nanomaterials. **[K4]**

CO 4: Explain the functioning of different analytical instruments. **[K3]**

List of Experiments:

1. Determination of hardness of water sample by EDTA method
2. Determination of alkalinity of water sample
3. Estimation of Dissolved Oxygen by Winkler's method
4. Estimation of Ferrous Iron by Dichrometry
5. Determination of Strength of an acid in Pb-Acid battery
6. Estimation of Mg in Antacid
7. Estimation of Vitamin C
8. Preparation of a polymer (Bakelite)/urea formaldehyde resin.
9. Preparation of nanomaterials by precipitation method
10. Conductometric titration of strong acid vs. strong base
11. Conductometric titration of weak acid vs. strong base
12. Determination of cell constant and conductance of solutions
13. Potentiometry - determination of redox potentials and emfs
14. Verify Lambert-Beer's law
15. Wavelength measurement of sample through UV-Visible Spectroscopy

Note: Any TEN of the listed experiments are to be conducted.

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

I B.Tech II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	2	30	70	100	1
CODE : R23CC12L12	**COMMUNICATIVE ENGLISH LAB** (COMMON TO ALL BRANCHES)						

Course Objectives:

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

Course Outcomes:

After completion of the course, the students will be able to

CO 1: Use connected speech, applying a range of phonological features like rhythm, stress and intonation to convey clear meaning. **[K3]**
CO 2: Create a compelling resume, cover letter and Sop. **[K6]**
CO 3: Make formal presentations and engage effectively in debates and group discussions in academic and professional contexts. **[K3]**
CO 4: Apply employability skills to confidently navigate job interviews. **[K3]**

List of Topics:

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

Suggested Software:

- Walden Infotech
- Young India Films

Reference Books:

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

Web Resources:

Spoken English:

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

Voice & Accent:

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

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	1	100	-	100	0.5
CODE: R23CC12MC1	**HEALTH AND WELLNESS, YOGA AND SPORTS**						

Course Objectives:

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

Course Outcomes:

After completion of the course, the students will be able to

CO 1: Use connected speech, applying a range of phonological features like rhythm, stress and intonation to convey clear meaning. **[K3]**
CO 2: Create a compelling resume, cover letter and Sop. **[K6]**
CO 3: Make formal presentations and engage effectively in debates and group discussions in academic and professional contexts. **[K3]**
CO 4: Apply employability skills to confidently navigate job interviews. **[K3]**

UNIT I

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

Activities:

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

UNIT II

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

Activities:

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

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket

etc.Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

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

General Guidelines:

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

Evaluation Guidelines:

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, totaling to 90 marks.
3. A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

II B.TECH - I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Complex variables and Numerical Methods	R23EE2101	BS	30	70	100	3	0	0	3
2	Universal Human Values–Understanding Harmony& Ethical Human Conduct	R23CC2102	HSMC	30	70	100	2	1	0	3
3	Electromagnetic Field Theory	R23EE2103	ES	30	70	100	3	0	0	3
4	Electrical Circuit Analysis-II	R23EE2104	PC	30	70	100	3	0	0	3
5	DC Machines & Transformers	R23EE2105	PC	30	70	100	3	0	0	3
6	Electrical Circuit Analysis-II and Simulation Lab	R23EE21L1	PC	30	70	100	0	0	3	1.5
7	DC Machines & Transformers Lab	R23EE21L2	PC	30	70	100	0	0	3	1.5
8	Data Structures Lab	R23EE21L3	SC	30	70	100	0	1	2	2
Total							15	2	10	20

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2101	COMPLEX VARIABLES & NUMERICAL METHODS						

Course Objectives:

To elucidate the different numerical methods to solve nonlinear algebraic equations.
To disseminate the use of different numerical techniques for carrying out numerical integration.
To familiarize the complex variables
To equip the students to solve application problems in their disciplines.

Course Outcomes:

1. Evaluate 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 (L3)
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 (L3)
3. Apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic(L3)
4. Evaluate 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 (L3)
5. Explain properties of various types of conformal mappings (L5)

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 (Simultaneous Equations).

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

UNIT – II: Numerical integration, 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 seriesand Laurent series. Types of Singularities: Isolated, Essential singularities, Pole of order m, Residues, Residue theorem (without proof), Evaluation of real integral of the types

$\int_{-\infty}^{\infty} f(x)dx$ and $\int_{C}^{c+2\pi} f(\cos\theta,\sin\theta)d\theta.$

UNIT – V: Conformal mapping:

Transformation by $e^z, \ln z, z^2, z^n$ (n positive integer), $\sin(z), \cos(z), z + \frac{a}{z}$. Translation, rotation, inversion and bilinear transformation, fixed point cross ratio, properties, inversion 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. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.
3. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
4. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press.

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R23CC2102	**UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY& ETHICAL HUMAN CONDUCT**						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

CO1: Interpret 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 settings in real life
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

COURSE TOPICS:

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1- hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions. The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I

Introduction to Value Education (6 lectures and 3 tutorials for practice session)
Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II

Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and thebody.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self andbody.
Lecture 9: The body as an Instrument of the self

Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III
Harmony in the Family and Society (6 lectures and 3 tutorials for practicesession)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV
Harmony in the Nature/Existence (4 lectures and 2 tutorials for practicesession)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment amongthe Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

UNIT V
Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models- Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

READINGS:

Textbook and Teachers Manual

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

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

REFERENCE BOOKS

1. Jeevan Vidya: E k Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karam chand 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 - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

MODE OF CONDUCT:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
Tutorial hours are to be used for practice sessions.
While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.
Scenarios may be used to initiate discussion. The student is encouraged to take up"ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared

and discussed with other students and faculty mentor, in a group sitting.
Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.
Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

ONLINE RESOURCES:

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

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2103	**ELECTROMAGNETIC FIELD THEORY**						

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

Course Objectives:

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

Course Outcomes:

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

CO1: Compute electric fields and potentials using Gauss law/ solve Laplace's or Poisson's equations for various electric charge distributions **[K3]**.

CO2: Analyse the behaviour of conductors in electric fields, electric diploe and the capacitance and energy stored in dielectrics **[K4].**

CO3: Calculate the magnetic field intensity due to current carrying conductor and understanding the application of Ampere's law, Maxwell's second and third law **[K3].**

CO4: Determine the self and mutual inductances and the energy stored in the magnetic field **[K3].**

CO5: Apply the concepts of Faraday's laws, Displacement current, Poynting theorem and Poynting vector **[K3].**

CO-PO Mapping:

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

UNIT - I

Vector Analysis:

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

Coordinate Systems: Rectangular, Cylindrical and Spherical coordinate systems.

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

Electrostatics:

Coulomb's law and Electric field intensity (EFI)- EFI due to Continuous charge distributions (line and surface charge), Electric flux density, Gauss's law (Maxwell's first equation), Applications of Gauss's law, Electric Potential, Work done in moving a point charge in an electrostatic field (second Maxwell's equation for static electric field), Potential gradient, Laplace's and Poison's equations.

UNIT - II

Conductors – Dielectrics and Capacitance:

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

UNIT - III

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

Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire- Magnetic flux density and Maxwell's second Equation, Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation.

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

UNIT - IV

Self and mutual inductance:

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

UNIT - V

Time Varying Fields:

Faraday's laws of electromagnetic induction, Maxwell's fourth equation, integral and point forms of Maxwell's equations, statically and dynamically induced EMF, Displacement current, Modification of Maxwell's equations for time varying fields, Poynting theorem and Poynting vector.

TEXT BOOKS:

1."Elements of Electromagnetics" by Matthew N O Sadiku, Oxford Publications, 7th edition, 2018.
2. "Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw-Hill, 7th Edition, 2006.

REFERENCE BOOKS:

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

ONLINE LEARNING RESOURCES:

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

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2104	**ELECTRICAL CIRCUIT ANALYSIS-II**						

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

COURSE OBJECTIVES:

- To understand three phase circuits
- To know the transients behavior in electrical systems
- To understand different network parameters of given electrical network
- To familiarize Fourier analysis to electrical systems
- To understand graph theory for circuit analysis and to understand the behavior of filters

COURSE OUTCOMES:

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

CO1: Analyse the balanced and unbalanced 3 phase circuits for power calculations **(K4)**
CO2: Analyse the transient behaviour of electrical networks in different domains **(K4)**
CO3: Estimate various Network parameters **(K4)**
CO4: Apply the concept of Fourier series to electrical systems **(K3)**
CO5: Analyse the filter circuit and network topology for electrical circuits (K4)

CO-PO MAPPING:

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

UNIT– I

Analysis of three phase balanced circuits:

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

Analysis of three phase unbalanced circuits:

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

UNIT–II

Laplace transforms – Definition and Laplace transforms of standard functions– Shifting theorem – Transforms of derivatives and integrals, Inverse Laplace transforms and applications.

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

UNIT–III

Network Parameters:

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

UNIT–IV

Analysis of Electric Circuits with Periodic Excitation: Fourier series and evaluation of Fourier coefficients, Trigonometric and complex Fourier series for periodic waveforms, Application to Electrical Systems – Effective value and average value of non-sinusoidal periodic waveforms, power factor, effect of harmonics

UNIT– V

Network Topology: Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, basic tie set schedule, basic cut set schedule

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

TEXT BOOKS:

1.Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, 8th Edition McGraw-Hill, 2013

2. Fundamentals of Electric Circuits, Charles K. Alexander, Mathew N. O. Sadiku, 3rd Edition, Tata McGraw-Hill, 2019

REFERENCE BOOKS:

1.Network Analysis, M. E. Van Valkenburg, 3rd Edition, PHI, 2019.

2. Network Theory, N. C. Jagan and C. Lakshminarayana, 1st Edition, B. S. Publications, 2012.

3.Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan S. Palli, 5th Edition, Tata McGraw-Hill, 2017.

4. Engineering Network Analysis and Filter Design (Including Synthesis of One Port Networks)-Durgesh C. Kulshreshtha Gopal G. Bhise, Prem R. Chadha ,Umesh Publications 2012.

5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, 7th Revised Edition.

ONLINE LEARNING RESOURCES:

1.https://archive.nptel.ac.in/courses/117/106/117106108/

2.https://archive.nptel.ac.in/courses/108/105/108105159/

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2105	**DC MACHINES & TRANSFORMERS**						

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

COURSE OBJECTIVE:

The objective of this course is,

- To draw the characteristics and applications of DC Machines.
- To introduce the methods of starting, speed control and testing of DC Machines.
- To impart knowledge on the concepts of efficiency and regulation of a transformer.
- To know the performance of single-phase transformers and to understand the connection diagrams of three-phase transformers.

COURSE OUTCOMES:

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

CO1: Sketch the characteristics of DC generators
CO2: Analyze starting and speed control methods of DC motors.
CO3: Calculate the efficiency and regulation of single phase transformers.
CO4: Analyze the testing of single phase transformers.
CO5: Differentiate various configurations of three-phase transformers.

CO-PO MAPPING:

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

UNIT – I: DC Machines

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

UNIT – II: Speed Control and Testing of DC Machines

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

UNIT – III: Single-phase Transformers

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

UNIT –IV: Testing of Transformers

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

UNIT – V

Three-Phase Transformers:

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.Electrical Machinery by Dr. P S Bimbhra, 7th edition, Khanna Publishers, New Delhi, 1995.
Performance and analysis of AC machines by M.G. Say, CBS, 2002.

REFERENCE BOOKS:

1.Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 5th edition
2.Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2011.
3.Generalized Theory of Electrical Machines by Dr. P S Bimbhra, 7th Edition, Khanna Publishers, 2021.
4.Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria & Sons, 2007.
5.Electric Machinery by Fitzgerald, A.E.,Kingsley, Jr.,C.,& Umans, S. D, 7th edition, McGraw-Hill Education, 2014.

ONLINE LEARNING RESOURCES:

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

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE21L1	**ELECTRICAL CIRCUIT ANALYSIS-II AND SIMULATION LAB**						

COURSE OBJECTIVE:

- To measure three phase Active and Reactive power
- To analyse transient behaviour of circuits
- To determine 2-port network parameters
- To analyse filter circuits

COURSE OUTCOMES:

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

CO1: Apply the power calculations in three phase circuits. **(K3)**
CO2: Evaluate the time response of given network. **(K5)**
CO3: Evaluate two port network parameters. **(K5)**
CO4: Evaluate of Filters circuits. **(K5)**

CO-PO Mapping

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

List of Experiments

Any 10 experiments of the following are required 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. Simulation and analysis of transient response of RL, RC and RLC circuits with AC Excitation
6. Simulation and analysis of transient response of RL, RC and RLC circuits with DC Excitation
7. Obtain the Frequency response of Band pass Filter
8. Obtain the Frequency response of Band Reject Filter
9. Obtain the Frequency response of Low Pass Filter
10. Obtain the Frequency response of High Pass Filter
11. Obtain the Frequency response of K Filter

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
Code: R23EE21L2	**DC MACHINES & TRANSFORMERS LAB**						

COURSE OBJECTIVES:

The objectives of this course is

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

COURSE OUTCOMES:

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

CO1: Demonstrate starting and speed control methods of DC Machines.
CO2: Predetermine performance of DC machine.
CO3: Determine performance of DC machines by direct tests
CO4: Design experiments for testing of transformers & operate the transformers in parallel.

CO-PO Mapping

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

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 teston DC shunt Machines.
5. Load test on DC compound generator-Determination of characteristics.
6. Load test on DC shunt generator-Determination of characteristics.
7. Fields test on DC series machines-Determination of efficiency.
8. Brake test on DC compound motor-Determination of performance curves.
9. OC & SC tests on single phase transformer.
10. Sumpner's test on single phase transformer.
11. Scott connection of transformers.
12. Parallel operation of Single-phase Transformers.
13. Separation of core losses of a single-phase transformer.

Online Learning Resources:

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

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	1	2	30	70	100	1.5
Code: R23EE21L3	**DATA STRUCTURES LAB**						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Identify the role of data structures in organizing andaccessing data.

CO2: Design, implement, and apply linked lists for dynamic datastorage.

CO3: Develop applications using stacks and queues.

CO4: Design and implement algorithms for operations on binary trees and trees binary search.

CO5: Devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees.

UNIT I

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

Sample experiments:

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

UNIT II

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

Sample experiments:

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

UNIT III

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

Sample experiments:

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

UNIT IV

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

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

Sample experiments:

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

UNIT V

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

Sample experiments:

1. Implement binary tree traversals using linked list.

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

Textbooks:

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

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders.
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft.
3. Problem Solving with Algorithms and Data Structures by Brad Miller and David Ranum.
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick.

II B.TECH - II SEMESTER

S. No	Subject	urse Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	edits
1	Managerial Economics & Financial Analysis	R23CC2201	HS	30	70	100	2	0	0	2
2	Analog Circuits	R23EE2202	BS	30	70	100	3	0	0	3
3	Power Systems-I	R23EE2203	PC	30	70	100	3	0	0	3
4	Induction and Synchronous Machines	R23EE2204	PC	30	70	100	3	0	0	3
5	Control Systems	R23EE2205	PC	30	70	100	3	0	0	3
6	Induction and Synchronous Machines Lab	R23EE22L1	PC	30	70	100	0	0	3	1.5
7	Control Systems Lab	R23EE22L2	PC	30	70	100	0	0	3	1.5
8	Python Programming Lab	R23EE22L4	SC	30	70	100	0	1	2	2
9	Design Thinking & Innovation	R23CC22L3	ES	30	70	100	1	0	2	2
10	Environmental Studies	R23CC22MC	MC	30	70	100	2	0	0	-
Total							15	1	10	21
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation										

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	30	70	100	3
Code: R23CC2201	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS						

Course Objectives:

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

Course Outcomes:

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

UNIT - I Managerial Economics

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

UNIT - II Production and Cost Analysis

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

UNIT - IIIBusiness 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 - IVCapital Budgeting

Introduction – Nature, meaning, significance. Types of Working Capital, Working capital cycle, Sources of Short-term and Long-term Capital, Features, Proposals,

Methods and Evaluation. Projects– Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems).

UNIT - V Financial Accounting and Analysis

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

Textbooks:

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

Reference Books:

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

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

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2202	**ANALOG CIRCUITS**						

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

COURSE OBJECTIVES:

- Design and understand the operation of analog electronics circuits such as feedback amplifiers
- Discuss the operation of Linear, Non-Linear wave shaping circuits and its applications
- Analyze the different basic op-amp circuits and its applications.
- Compare the working of multivibrators using op-amp, IC 555 and the operation of different
- oscillators.
- Discuss the operation of the most commonly used D/A and A/D converters.

COURSE OUTCOMES:

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

CO1: Design the operation of feedback amplifiers.

CO2: Explain different wave shaping circuits

CO3: Design different basic op-amp circuits.

CO4: Design different multivibrators using op-amp and 555 timers, different oscillators.

CO5: Analyze about different D/A and A/D converters.

UNIT -I: Feedback Amplifiers

Feedback principle and concept, Types of feedback, Classification of amplifiers-Voltage amplifier, Current amplifier, Trans conductance amplifier, Trans resistance amplifier, Feedback topologies, Characteristics of negative feedback amplifiers, General analysis of feedback amplifiers-input resistance and output resistance, Performance comparison of feedback amplifiers, introduction to Power Amplifiers and Oscillators.

UNIT -II: Linear and Non-Linear Wave Shaping

Linear Wave Shaping: The high pass and low pass RC circuits: Sinusoidal input, Step input, Pulse input, Square and Ramp input, RC network as a differentiator and an integrator.

Non-Linear Wave Shaping: Diode and its characteristics, Diode series clippers, Diode parallel

clippers, Two level clipping circuits and Emitter coupled clipper, Clamping operation

UNIT -III: Operational Amplifier and its Applications

Different stages of Operational Amplifier: Differential Amplifier, Ideal and practical Op-Amp.

Characteristics of OP-Amps, DC and AC characteristics, Inverting and Non-inverting amplifier,

Integrator and differentiator, Instrumentation amplifier, V to I and I to V converters, Log and Anti log amplifiers.

UNIT -IV: Multivibrators and Timers

Multivibrators: Monostable, Bistable and Astable multivibrators using Op-amp. **Timers:** Introduction to 555 timer, Functional diagram, Monostable and Astable operation using 555 Timer

UNIT -V: Active Filters, D/A and A/D Converters

Active Filters Introduction–Merits and demerits of active filters over passive filters–1st order, LPF, HPF filters, Band pass, Band reject.

D/A and A/D Converters: Introduction, Basic DAC techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different types of ADCs -Parallel comparator type ADC, Counter type ADC, Successive approximation ADC and Dual slope ADC.

TEXT BOOKS:

1. Integrated Electronics-Jacob Millman, C. Halkies, C.D. Parikh, Satyabrata Jit, Tata McGraw-Hill, Second Edition, 2011.
2. Linear Integrated Circuits -D. Roy Chowdhury, New Age International Pvt Ltd, Second Edition, 2003.
3. Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. Prakash Rao, Tata McGraw-Hill, Second Edition, 2008.

REFERENCE BOOKS:

1. Op-Amps & Linear ICs -Ramakanth A. Gayakwad, Pearson Education, Fourth Edition, 2015.
2. Electronic Devices and Circuit Theory–R.L. Boylestad and Louis Nashelsky, Pearson Publications, Eleventh Edition, 2013.
3. Operational Amplifiers with Linear Integrated Circuits–William D. Stanley, Pearson Education India, Fourth Edition, 2002.

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2203	**POWER SYSTEM - I**						

Pre-requisite: Electrical Circuit Analysis

Course Objectives:

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

Course Outcomes:

At the end of the course, the student will be able to,
CO1: Demonstrate the different types of power plants, operation of power plants.(K2)
CO2: Describe the different components of air and gas insulated substations.(K4)
CO3: Discuss the construction of single core and three core cables and describe distribution system configurations.(K2)
CO4: Analyze different economic factors of power generation and tariffs.(K4)

CO-PO MAPPING:

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

Unit I:
Hydroelectric Power Stations:
Selection of site, general layout of a hydroelectric power plant with brief description of major components and principle of operation
Thermal Power Stations:
Selection of site, general layout of a thermal power plant. Brief description of components: boilers, super heaters, economizers and electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.
Unit II:
Nuclear Power Stations:
Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants,

types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

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

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

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

Distribution Systems:
Classification of Distribution systems, A.C Distribution, Overhead versus Underground system, Connection schemes of Distribution system, Requirements of Distribution system, Design considerations in Distribution system.

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

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

Text Books:
1. 1.S. N. Singh, Electric Power Generation, Transmission and Distribution, PHI Learning Pvt Ltd, New Delhi, 2nd Edition, 2010.
2. J.B.Gupta, Transmission Distribution of Electrical Power, S.K.Kataria and sons,10th Edition, 2012.

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

4. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1985.
5. Handbook of switchgear, BHEL, McGraw-Hill Education, 2007.

Online Learning Resources:

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

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2204	**INDUCTION & SYNCHRONOUS MACHINES**						

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

Course Objectives:

Students will get exposure to understand the concepts of

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

Course Outcomes:

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

CO1: Explain the construction and operation of three-phase induction motor.(K2)
CO2: Analyse the performance of three-phase induction motor (K4).
CO3: Describe the working of single-phase induction motors.(k2)
CO4: Analyse the performance of Synchronous generators and motors.(k4)

CO-PO MAPPING:

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

UNIT-I:

3-phase induction motors:

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

UNIT-II:

Performance of 3-Phase induction motors:

Torque equation – expressions for maximum torque and starting torque – torque- slip characteristics – double cage and deep bar rotors –No load, Brake test and Blocked rotortests – 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 generator operation.

UNIT – III:

Single Phase Motors:

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

UNIT–IV:

Synchronous Generator:

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

UNIT–V:

Synchronous Motor:

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

Text Books:

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

Reference Books:

1.Electrical machines, D.P. Kothari and I.J. Nagrath, McGraw Hill Education, 2017, Fifth Edition.
2.Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria& Sons, 2007.
3.ElectricMachinery,A.E.Fitzgerald,Charleskingsley,Stephen D.Umans, McGraw-Hill, 2020, Seventh edition.

Online Learning Resources:

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

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE2205	CONTROL SYSTEMS						

Pre-requisite: Basic Engineering Mathematics

Course Objectives:

- To impart the mathematical models of physical systems and derive transfer function.
- To study the time response of systems and system stability.
- To inculcate system stability using frequency response methods.
- To explain compensators using Bode diagrams.
- To study the mathematical models of physical systems using state space approach and determine the response.

Course Outcomes:

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

CO1: Derive the transfer function of physical systems and determine overall transfer function using block diagram algebra and signal flow graphs**. (K2)**

CO2: Analyze the time response of first & second order systems and absolute and relative stability of LTI systems using Routh's stability criterion and root locus method**.(K3)**

CO3: Analyze the stability of LTI systems using frequency response methods**. (K4)**

CO4: Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode Diagrams (K4).

CO5: Apply state space analysis concepts to represent physical systems as state models **(K3)**

CO-PO MAPPING:

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

UNIT – 1

Mathematical Modelling Of Control Systems

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

UNIT – 2

Time Response Analysis

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

Stability And Root Locus Technique

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

UNIT - 3

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 - 4

Classical Control Design Techniques

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

UNIT - 5

State Space Analysis of LTI Systems

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

Text Books:

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

Reference Books:

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

Online Learning Resources:

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

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	3
Code: R23EE22L1	**INDUCTION AND SYNCHRONOUS MACHINES LAB**						

Course Objectives:

The objectives of this course is

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

Course Outcomes:

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

CO1: Analyze the performance characteristics of Induction motors.

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

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

CO4: Examine performance of alternators using various methods.

CO5: Assess direct and quadrature axes reactance for a given synchronous machine

CO-PO Mapping

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

List of Experiments

Any 10 experiments of the following are required to be conducted

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

Online Learning Resources:

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

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	3
Code: R23EE22L2	CONTROL SYSTEMS LAB						

Course Objectives:

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

Course Outcomes:

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

CO1: Analyze the performance of Magnetic amplifier, D.C and A.C. servo motors and synchros.

CO2: Design of PID controllers and compensators.

CO3: Evaluate temperature control of an oven using PID controller

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

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

CO-PO MAPPING:

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

List of Experiments

Any 10 of the following experiments are to be conducted:

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 orderusing MATLAB.
7. Kalman's test of Controllability and Observability using MAT LAB.
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Characteristics of DC servo motor
12. Study and verify the truth table of logic gates and simple Boolean expressions using PLC.

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	3
Code: R23EE22L4	**SKILL ENHANCEMENT COURSE: PYTHON PROGRAMMING LAB**						

Course Objectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Functions,

Modules and Regular Expressions in Python Programming and to create practical and contem porary applications using these.

UNTI-I:

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

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

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

Sample Experiments:

1.Write a program to find the largest element among three Numbers.

2.Write a Program to display all prime numbers within an interval

3.Write a program to swap two numbers without using a temporary variable.

4.Demonstrate the following Operators in Python with suitable examples.

i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical O perators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity OperatorsWrite a program to add and multiply complex numbers

5. Write a program to print multiplication table of a given number.

UNIT-II:

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

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

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

Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.
5. Write a program to perform the given operations on a list:

i. addition ii. insertion iii. slicing

6. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:

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

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-

In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Frozenset.Set Methods, Dictionaries, Using zip() Function,Sets,

Sample Experiments:

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

UNIT-IV:

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

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

Sample Experiments:

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

UNIT-V:

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

Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python Program to demonstrate NumPy arrays creation using array () function.
3. Python program to demonstrate use of ndim, shape, size, dtype.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:

1. Apply head () function to the pandas data frame
2. Perform various data selection operations on Data Frame
7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

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

Online Learning Resources/Virtual Labs:

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	1	2	30	70	100	2
Code: R23CC22L3	**DESIGN THINKING & INNOVATION**						

COURSE OBJECTIVES:

The objectives of the course are to

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

COURSE OUTCOMES:

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

CO1: Explain the concepts related to design thinking.
CO2: Explain the fundamentals of Design Thinking and innovation.
CO3: Apply the design thinking techniques for solving problems in various sectors.
CO4: Analyse to work in a multidisciplinary environment.
CO5: Evaluate the value of creativity.

UNIT – I

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

UNIT - II

DESIGN THINKING PROCESS: Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development. **Activity:** Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT - III

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

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

UNIT - IV

PRODUCT DESIGN: Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies. **Activity:** Importance of modeling, how to set specifications, Explaining their own product design.

UNIT – V

DESIGN THINKING IN BUSINESS PROCESSES: Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges:

Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.
Activity: How to market our own product, about maintenance, Reliability and plan for startup.

TEXTBOOKS:

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

REFERENCE BOOKS:

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

ONLINE LEARNING RESOURCES:

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

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	30	70	100	-
Code: R23CC22MC	ENVIRONMENTAL STUDIES						

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

CO1: Analyze the natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources.

CO2: Explain the concepts of the ecosystem, need, biodiversity and its functions.

CO3: Distinguish various attributes of the pollution, their impacts and measures to reduce or control the pollution along with waste management

CO4: Analyze the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.

CO5: Illustrate the causes of population explosion, value education and welfare programmes.

UNIT – I

Multidisciplinary Nature of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

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

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

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

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

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV

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

UNIT – V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

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

TEXTBOOKS:

1. Erach Bharucha, Text book of Environmental Studies for Undergraduate Courses, Universities Press (India) Private Limited, 2019.
2. Palaniswamy, Environmental Studies, 2/e, Pearson education, 2014.
3. S.Azeem Unnisa, Environmental Studies, Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", SciTech Publications (India), Pvt. Ltd, 2010.

REFERENCE BOOKS:

1. Deeksha Dave and E.Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.
2. M.Anji Reddy, "Textbook of Environmental Sciences and Technology", BS Publication, 2014.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 2006.
4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private limited, 1988.
5. G.R. Chatwal, A Text Book of Environmental Studies, Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering

and Science, 1/e, Prentice Hall of India Private limited, 1991.

ONLINE LEARNING RESOURCES:

- https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental- science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c- 4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science++Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental- science
- http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/ lec07.pdf
- https://www.youtube.com/watch?v=5QxxaVfgQ3k

B.Tech. III Year-I Semester

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Power Electronics	R23EE3101	PC	30	70	100	3	0	0	3
2	Digital Circuits	R23EE3102	PC	30	70	100	3	0	0	3
3	Power Systems-II	R23EE3103	PC	30	70	100	3	0	0	3
4	**Professional Elective- I** 1. Signals and Systems	R23EE3104	PE	30	70	100	3	0	0	3
	2. Computer Architecture and Organization	R23EE3105								
	3. Communication Systems	R23EE3106								
	4. Special Electrical Machines	R23EE3107								
5	**Open Elective-I** 1. Renewable Energy Sources	R23OE3104	OE	30	70	100	3	0	0	3
	2. Concepts of Energy Auditing & Management	R23OE3105								
	3. Linear Control Systems	R23OE3106								
	4. Electrical Safety	R23OE3107								
6	Power Electronics Lab	R23EE31L1	PC	30	70	100	0	0	3	1.5
7	Analog and Digital Circuits Lab	R23EE31L2	PC	30	70	100	0	0	3	1.5
8	Soft skills	R23EE31L3	SE	30	70	100	0	1	2	2
9	Tinkering Lab	R23EE31L4	ES	30	70	100	0	0	2	1
10	Evaluation of Community Service Internship	R23EE31CSP	PC	30	70	100	-	-	-	2
Total							15	1	10	23

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3101	**POWER ELECTRONICS (PROFESSIONAL CORE)**						

Course Objectives:

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

Course Outcomes:

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

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

UNIT – I

Power Semi-Conductor Devices

Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC) –, Snubber circuit. Static and Dynamic Characteristics of Power MOSFET and Power IGBT, Gate Driver Circuit for MOSFET & IGBT - Problems.

UNIT – II

Single-phase AC-DC Converters

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

UNIT – III

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

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

UNIT – IV

DC–DC Converters

Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations – Control techniques - Problems.

UNIT – V

DC–AC Converters

Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads – Phase Displacement Control –Three-phase square wave inverters - 120^0 conduction and 180^0 conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Problems.

Text Books:

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

Reference Books:

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

Online Learning Resources:

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

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: **R23EE3102**	**DIGITAL CIRCUITS (PROFESSIONAL CORE)**						

Course Objectives:

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

Course Outcomes:

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

CO1: Use the concepts of Number System, Logic gates, Boolean algebra and basic theorems.
CO2: Solve K-map, tabulation method in minimization of switching functions and able to design the arithmetic combinational circuits.
CO3: Realize different types of data routing combinational circuits.
CO4: Apply knowledge of flip-flops in designing of registers and counters.
CO5: Analyze synchronous sequential circuits and apply different methods for the design of synchronous sequential circuits.

UNIT – I:

Number System & Logic Gates

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

UNIT – II:

Combinational logic circuits – I

Definition of combinational logic, canonical forms, NAND and NOR implementations, Karnaugh maps – 3 &4 variables, Simplifying Max term equations, General approach to combinational logic design, Look ahead carry adder, Cascading full adders, 4-bit adder- subtractor circuit

UNIT – III:

Combinational logic circuits – II

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

Unit – IV

Sequential logic circuits

Timing considerations of flip-flops, master-slave flip-flop, edge triggered flip-flops, excitation tables, conversion from one flip-flop to another flip-flop, Johnson counter, ring counter, design of registers - buffer register, control buffer register, shift register, bi-directional shift register, universal shift register.

UNIT – V

Sequential Circuit Design

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

Textbooks:

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

Reference Books:

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

Online Learning Resources:

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

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3103	**POWER SYSTEMS-II (PROFESSIONAL CORE)**						

Course Objectives:

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

Course Outcomes:

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

CO1: Calculate parameters of transmission lines for different circuit configurations.

CO2: Analyze the performance of short, medium and long transmission lines.

CO3: Analyze the effect of travelling waves on transmission lines.

CO4: Estimate the effects of corona in transmission lines.

CO5: Calculate sag and tension of transmission lines and design the line insulators.

UNIT–I

Transmission Line Parameters Calculations

Conductor materials – Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for Single-phase and Three-phase single 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.

UNIT–II

Performance Analysis of Transmission Lines

Classification of Transmission Lines – Short, medium, long lines and their model representation – Nominal-T, Nominal-π and A, B, C, D Constants for symmetrical Networks.

Rigorous Solution for long line equations–Surge Impedance and Surge Impedance Loading of Long Lines - Regulation and efficiency for all types of lines – Ferranti effect.

UNIT – III

Power System Transients

Types of System Transients – Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients. Termination of lines with different types of conditions: Open Circuited Line– Short Circuited Line, Line terminated through a resistance and line connected to a cable. Reflection and Refraction at a T-Junction.

UNIT–IV

Corona& Effects of transmission lines

Description of the phenomenon – Types of Corona - critical voltages and power loss – Advantages and Disadvantages of Corona - Factors affecting corona - Radio Interference.

UNIT–V

Sag and Tension Calculations and Overhead Line Insulators:

Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice weight on conductor – Stringing chart and sag template and its applications.

Types of Insulators – Voltage distribution in suspension insulators–Calculation of string efficiency and Methods for String efficiency improvement – Capacitance grading and Static Shielding.

Text Books:

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

Reference Books:

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

Online Learning Resources:

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

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: **R23EE3104**	**SIGNALS & SYSTEMS**						

Course Outcomes:

- Differentiate the various classifications of signals and systems
- Analyze the frequency domain representation of signals using Fourier concepts
- Classify the systems based on their properties and determine the response of LTI Systems.
- Know the sampling process and various types of sampling techniques.
- Apply Laplace and z-transforms to analyze signals and Systems (continuous & discrete).

UNIT- I: INTRODUCTION: Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling. Problems on classification and characteristics of Signals and Systems, Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function signum function and ramp function.

UNIT–II: FOURIER SERIES AND FOURIER TRANSFORM:
Fourier series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Relation between Trigonometric and Exponential Fourier series, Complex Fourier spectrum. Deriving Fourier transform from Fourier series, Fourier transform of standard signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Related problems

UNIT-III:
CORRELATION: Auto-correlation and cross-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between Convolution and correlation, Detection of periodic signals in the presence of noise by correlation.
SAMPLING THEOREM: Graphical and analytical proof or Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Aliasing, Related problems.

UNIT–IV:
LAPLACE TRANSFORMS: Introduction**,** Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Inverse Laplace transform, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform synthesis.

UNIT–V:
Z–TRANSFORMS: Concept of Z-Transform of a discrete sequence. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms, Distinction between Laplace, Fourier and Z transforms.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3105	COMPUTER ARCHITECTURE AND ORGANIZATION						

Pre-requisite:

Basic knowledge in digital electronics, fundamentals of computers.

Course Objectives:

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

Course Outcomes:

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text Books:

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

References Books:

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

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3106	COMMUNICATION SYSTEMS						

Course Objectives

- To develop a fundamental understanding on communication systems with emphasis on analog and digital modulation techniques.
- To introduce the basics of error control coding techniques.

Course Outcomes

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

- understand the basics of communication system, analog and digital modulation techniques.
- apply the knowledge of digital electronics and understand the error control coding techniques.
- summarize different types of communication systems and its requirements.

Course Content

UNIT – I: Basic Blocks of Communication System

Analog Modulation - Principles of Amplitude Modulation, DSBSC, SSB-SC and VSB-SC, AM transmitters and receivers.

UNIT – II: Angle Modulation - Frequency and Phase Modulation

Transmission Bandwidth of FM signals, Methods of generation and detection, FM Transmitters and Receivers.

UNIT – III: Sampling Theorem - Pulse Modulation Techniques

PAM, PWM and PPM concepts - PCM system – Data transmission using analog carriers (BASK, BFSK, BPSK, QPSK).

UNIT – IV: Error Control Coding Techniques

Linear block codes- Encoder and decoder, Cyclic codes – Encoder, Syndrome Calculator, Convolution codes.

UNIT – V: Modern Communication Systems

Microwave communication systems, Optical communication system, Satellite communication system, Mobile communication system.

Text Books

1. Simon Haykins, “Communication Systems”, John Wiley, 3rd Edition, 1995.
2. D.Roddy and J.Coolen, “Electronic Communications”, Prentice Hall of India, 4th Edition, 1999.
3. Kennedy G, “Electronic Communication System”, McGraw Hill, 1987.

Reference Books

1. Shulin Daniel, “Error Control Coding”, Pearson, 2nd Edition, 2011.
2. B.P. Lathi and Zhi Ding, “Modern Digital and Analog Communication Systems”, OUP USA Publications, 4th Edition, 2009.

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3107	**SPECIAL ELECTRICAL MACHINES**						

Course Objective:

- To describe the operation and characteristics of permanent magnet dc motor.
- To understand the performance and control of stepper motors, and their applications.
- To explain operation and control of switched reluctance motor.
- To distinguish between brush dc motor and brush less dc motor.
- To explain the theory of travelling magnetic field and applications of linear motors.

Course Outcomes:

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

CO 1: Demonstrate the merits of PM motors.

CO 2: Choose best control scheme for stepper motors.

CO 3: Construct the various converter circuits for Switched Reluctance Motors.

CO 4: Analyse the characteristics of Brushless dc Motor.

CO 5: Understand the applications and operation of Linear Induction Motors.

UNIT - I

Permanent Magnet Materials

Introduction - classification of permanent magnet materials used in electrical machines - minor hysteresis loop and recoil line - Stator frames of conventional dc machines - Development of electronically commutated dc motor from conventional dc motor – Permanent magnet materials and characteristics - B-H loop and demagnetization characteristics-high temperature effects-reversible losses - Irreversible losses - Mechanical properties.

UNIT - II

PMDC motors and Stepper Motors

Construction and working principle of PMDC motors-merits, demerits and applications of PMDC motors- Hysteresis - Eddy current Motors-Principle of operation of Stepper Motor – Constructional details - Classification of stepper motors – Different configuration for switching the phase windings - Control circuits for stepper motors – Open loop and closed loop control of two phase hybrid stepping motor.

UNIT - III

Switched Reluctance Motors

Construction and Principle of operation of Switched Reluctance Motor – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs. Torque producing principle and torque expression – Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

UNIT - IV

Permanent Magnet Brushless DC Motor

Principle of operation of BLDC motor - Types of constructions - Surface mounted and interior type permanent magnet BLDC Motors - Torque and EMF equations for Square wave & Sine wave for PMBLDC Motor – Torque - Speed characteristics of Square wave & Sine wave for PMBLDC Motor - Merits & demerits of Square wave & Sine wave for PMBLDC Motor - Performance and efficiency – Applications.

UNIT - V

Linear Induction Motors (LIM)

Construction– principle of operation – Double sided LIM from rotating type Induction Motor – Schematic of LIM drive for traction – Development of one sided LIM with back iron - equivalent circuit of LIM.

Text Books:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special electrical Machines, K.Venkata Ratnam, University press, 2009, New Delhi.

Reference Books:

1. E. G. Janardhanan, 'Special Electrical Machines' PHI Learning Private Limited.
2. Krishnan, Ramu. Switched reluctance motor drives: modeling, simulation, analysis, design, and applications. CRC press, 2017.
3. Krishnan, Ramu. Permanent magnet synchronous and brushless DC motor drives. CRC press, 2017.

Online Learning Resources:

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

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
Code: R23EE31L1	POWER ELECTRONICS LAB						

Course objectives:

- To learn the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter and Boost converter.
- To understand the working of single-phase & three-phase inverters.

Course outcomes:

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

CO1: Analyse characteristics of various power electronic devices and design firing circuits for SCR.

CO2: Analyse the performance of single–phase dual, three–phase full–wave bridge converters and dual converter with both resistive and inductive loads.

CO3: Examine the operation of Single-phase AC voltage regulator and Cyclo converter with resistive and inductive loads.

CO4: Differentiate the working and control of Buck converter and Boost converter.

CO5: Differentiate the working & control of Square wave inverter and PWM inverter.

Any 10 of the Following Experiments are to be conducted

1. Characteristics of SCR - Power MOSFET & Power IGBT.
2. R, RC & UJT firing circuits for SCR.
3. Single -Phase full-converter with R & RL loads.
4. Three- Phase full-converter with R & RL loads.
5. Single-phase dual converter in circulating current & non circulating current mode of operation.
6. Single-Phase AC Voltage Regulator with R & RL Loads.
7. Single-phase step down Cycloconverter with R & RL Loads.
8. Boost converter in Continuous Conduction Mode operation.
9. Buck converter in Continuous Conduction Mode operation.
10. Single -Phase square wave bridge inverter with R & RL Loads.
11. Single - Phase unipolar switching and bipolar switching PWM inverter.
12. Three-phase bridge inverter with 120^0 and 180^0 conduction mode.
13. SPWM control of Three-phase bridge inverter

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
Code: R23EE31L2	ANALOG AND DIGITAL CIRCUITS LAB						

Course Objectives:

To impart knowledge on

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

Course Outcomes:

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

CO1: Analyse diode clipper/clamper circuits and transistor biasing.

CO2: Illustrate the operation of feedback amplifiers and oscillator circuits.

CO3: Analyze the applications of linear IC's

CO4: Demonstrate the operation of digital circuits such as arithmetic, data routing, registers and counters.

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

PART-A

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

PART-B

1. Design of Full adder and Full Subtractor using logic gates.
2. Realization of parallel adder/subtractor using IC 7483.
3. Implementation of 3 to 8 line decoder using logic gates and IC 7445.
4. Implementation of 8 to 1 multiplexer using logic gates and IC 74151.
5. Verify the operation of master-slave JK flip-flop using IC7476.
6. Realization of the following shift registers using IC7495.
    a) SISO
    b) SIPO
    c) PISO
    d) PIPO
7. Implementation ofMod-10 ripples counter using flip-flops and IC 7490.
8. Implementation of Mod-8 synchronous up/down counters using flip-flops.
9. Implementation of 4 bit Ring Counter and Johnson Counter using D flip-flops/J-K flip-flops.

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	1	2	30	70	100	2
Code: R23EE31L3	SKILL ENHANCEMENT COURSE: SOFT SKILLS						

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

Course Outcomes:

CO1: Demonstrate effective verbal and non-verbal communication skills in academic and professional settings.

CO2: Apply appropriate techniques in interviews, group discussions, and oral presentations with increased confidence.

CO3: Exhibit enhanced interpersonal and teamwork skills in collaborative environments.

CO4: Produce clear, coherent, and professional written content such as emails, reports, and resumes.

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 Grammars, 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:

1. https://swayam-plus.swayam2.ac.in/courses/course-

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	2	30	70	100	1
Code: R23EE31L4	TINKERING LAB						

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

Course Objectives: To

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

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

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

List of experiments:

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

Students need to refer to the following links:

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

B.Tech. III Year-II Semester

S.No.	Subject	Course Code	Cat. Code	L	T	P	Credits
1	Electrical Measurements and Instrumentation	R23EE3201	PC	3	0	0	3
2	Microprocessors and Microcontrollers	R23EE3202	PC	3	0	0	3
3	Power System Analysis	R23EE3203	PC	3	0	0	3
4	**Professional Elective-II** 1. Switchgear and Protection	R23EE3204	PE-II	3	0	0	3
	2. Advanced Control Systems	R23EE3205					
	3. Renewable and Distributed Energy Technologies	R23EE3206					
	4. Embedded Systems	R23EE3207					
5	**Professional Elective-III** 1. Electric Drives	R23EE3208	PE-III	3	0	0	3
	2. Digital Signal Processing	R23EE3209					
	3. High Voltage Engineering	R23EE3210					
	4. Utilization of Electrical Energy	R23EE3211					
6	**Open Elective - II** 1. Fundamentals of Electric Vehicles	R23OE3205	OE - II	3	0	0	3
	2. Electrical Wiring Estimation and Costing	R23OE3206					
	3. Introduction to Smart Grid	R23OE3207					
	4. Industrial Automation	R23OE3208					
7	Electrical Measurements and Instrumentation Lab	R23EE32L1	PC	0	0	3	1.5
8	Microprocessors and Microcontrollers Lab	R23EE32L2	PC	0	0	3	1.5
9	IoT Applications of Electrical Engineering Lab	R23EE32L3	SEC	0	1	2	2
10	Research Methodology	R23EE32MC	AC	2	0	0	-
		Total		**20**	**1**	**08**	**23**

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3201	**ELECTRICAL MEASUREMENTS AND INSTRUMENTATION**						

Course Objectives:

- To understand and analyze the factors that effect the various measuring units.
- To choose the appropriate meters for measuring of voltage, current, power, power factor and energy qualities and understand the concept of standardization.
- Describe the operating principle of AC & DC bridges for measurement of resistance, inductance and capacitance.
- To understand the concept of the transducer and their effectiveness in converting from one form to the other form for the ease of calculating and measuring purposes.
- To understand the operating principles of basic building blocks of digital systems, record and display units.

Course Outcomes:

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

CO1: Know the construction and working of various types of analog instruments.

CO2: Describe the construction and working of wattmeter and power factor meters

CO3: Know the construction and working various bridges for the measurement resistance inductance and capacitance

CO4: Know the operational concepts of various transducers

CO5: Know the construction and operation digital meters

UNIT - I

Analog Ammeter and Voltmeters

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

UNIT - II

Analog Wattmeters and Power Factor Meters

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

UNIT - III

Measurements of Electrical parameters

DC Bridges: Method of measuring low, medium and high resistance –Wheat stone's bridge for measuring medium resistance– Kelvin's double bridge for measuring low resistance – Loss of charge method for measurement of high resistance – Megger – measurement of earth resistance – Numerical Problems.

AC Bridges: Measurement of inductance and quality factor – Maxwell's bridge – Anderson's bridge. Measurement of capacitance and loss angle – Desauty's bridge – Schering Bridge – Numerical Problems.

UNIT - IV

Transducers and Sensors

Definition – Classification – Resistive, Inductive and Capacitive Transducer – LVDT – Strain Gauge – Thermistors – Thermocouples – Piezo electric and Photo Diode Transducers – Hall effect sensors – Numerical Problems.

UNIT - V

Digital meters

Digital Voltmeters – Successive approximation DVM – Ramp type DVM and Integrating type DVM – Digital frequency meter – Digital multimeter – Digital tachometer – Digital Energy Meter – Q meter. CRO – measurement of phase difference and Frequency using lissajious patterns – Numerical Problems.

Text Books:

1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis - 5th Edition - Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper - PHI - 5th Edition - 2002.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co. Publications - 19th revised edition - 2011.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput - S.Chand - 3rd edition.
3. Electrical Measurements by Buckingham and Price - Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons

Online Learning Resources:

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

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3202	**MICROPROCESSORS AND MICROCONTROLLERS**						

Pre-requisite:

Basic knowledge in digital electronics, fundamentals of computers.

Course objectives:

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

Course Outcomes:

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

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

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

CO3: Analyse the Microcontroller and interfacing capability

CO4: Describe the architecture and interfacing of 8051 controller

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

UNIT - I

Introduction to Microprocessor Architecture

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

UNIT - II

Minimum and Maximum Mode Operations

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

UNIT - III

Microprocessors I/O interfacing

8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255– Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086 – Architecture and interfacing of DMA controller (8257).

UNIT - IV

8051 Microcontroller

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

UNIT - V

PIC Architecture

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

Text Books:

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

Reference Books:

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

Online Learning Resources:

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

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3203	**POWER SYSTEM ANALYSIS**						

Course Objectives:

- To develop the impedance diagram (p.u) and formation of Y_{bus}
- To learn the different load flow methods.
- To learn the Z_{bus} building algorithm.
- To learn short circuit calculation for symmetrical faults
- To learn the effect of unsymmetrical faults and their effects.
- To learn the stability of power systems and method to improve stability.

Course Outcomes:

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

CO1: Draw impedance diagram for a power system network and calculate per unit quantities.

CO2: Apply the load flow solution to a power system using different methods.

CO3: Form Zbus for a power system networks and analyse the effect of symmetrical faults.

CO4: Find the sequence components for power system Components and analyse its effects of unsymmetrical faults.

CO5: Analyse the stability concepts of a power system.

UNIT - I

Circuit Topology

Graph theory definitions – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y_{bus} matrix by singular transformation and direct inspection methods.

Per Unit Representation

Per Unit Quantities–Single line diagram – Impedance diagram of a power system – Numerical Problems.

UNIT - II

Power Flow Studies

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

UNIT - III

Z-Bus Algorithm

Formation of Z_{bus}**:** Algorithm for the Modification of Z_{bus} Matrix (without mutual impedance) – Numerical Problems.

Symmetrical Fault Analysis

Reactance's of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems – Numerical Problems.

UNIT - IV

Symmetrical Components

Definition of symmetrical components – symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances and Sequence networks of Synchronous generator , Transformers and Transmission line-Numerical Problems.

Unsymmetrical Fault analysis

Various types of faults: LG– LL– LLG and LLL on unloaded alternator-Numerical problems.

UNIT - V

Power System Stability Analysis

Elementary concepts of Steady state – Dynamic and Transient Stabilities – Swing equation – Steady state stability – Equal area criterion of stability – Applications of Equal area criterion – Factors affecting transient stability – Methods to improve steady state and transient stability – Numerical problems.

Text Books:

1. Power System Analysis by Grainger and Stevenson - Tata McGraw Hill.2003
2. Modern Power system Analysis – by I.J.Nagrath & D .P.Kothari: Tata McGraw–Hill Publishing Company - 3rd edition - 2007.

Reference Books:

1. Power System Analysis – by A.R.Bergen - Prentice Hall - 2nd edition - 2009.
2. Power System Analysis by HadiSaadat – Tata McGraw–Hill 3rd edition - 2010.
3. Power System Analysis by B.R.Gupta - A H Wheeler Publishing Company Limited - 1998.
4. Power System Analysis and Design by J.Duncan Glover - M.S.Sarma - T.J.Overbye – Cengage Learning publications - 5th edition - 2011.

Online Learning Resources:

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

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3204	**SWITCHGEAR AND PROTECTION**						

Course Objectives:

- To explain the working principles and applications of circuit breakers in power systems, including MCBs, oil, SF6, and vacuum breakers.
- To provide an understanding of electromagnetic protection mechanisms, particularly relays used in fault detection and system protection (overcurrent, under-voltage, directional, differential).
- To analyze protection techniques for generators and transformers, including fault protection schemes like percentage differential protection and Buchholz relays.
- To explore feeder and busbar protection methods using advanced relay systems such as distance and static relays.
- To study over-voltage protection systems including lightning arresters and neutral grounding methods to safeguard the power system.

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

CO1: Understand and describe the operation of circuit breakers, including their ratings, principles of arc interruption, and types.

CO2: Analyze relay-based protection systems, identifying and explaining their roles in overcurrent, under voltage, and fault detection.

CO3: Design protection schemes for generators and transformers, addressing faults like restricted earth faults and inter-turn faults.

CO4: Implement feeder and busbar protection using advanced relays such as distance, impedance, and static relays.

CO5: Evaluate over-voltage protection strategies, including the use of lightning arresters, and understand various neutral grounding techniques.

UNIT – I

Circuit Breakers

Miniature Circuit Breaker(MCB)– Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Concept of oil circuit breakers– Description and operation of Air Blast– Vacuum and SF_6 circuit breakers– Circuit Breaker ratings and specifications– Concept of Auto reclosing.

UNIT – II

Electromagnetic Protection

Relay connection – Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification–Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

UNIT – III

Generator Protection

Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples.

Transformer Protection

Percentage differential protection– Design of CT's ratio– Buchholz relay protection– Numerical examples.

UNIT – IV

Feeder and Bus bar Protection & Static Relays:

Over current Protection schemes – PSM - TMS – Numerical examples – Carrier current and three zone distance relay using impedance relays. Protection of bus bars by using Differential protection. Static relays: Introduction – Classification of Static Relays – Basic Components of Static Relays.

UNIT – V

Protection against over voltage and grounding

Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters. Grounded and ungrounded neutral systems – Effects of ungrounded neutral on system performance – Methods of neutral grounding: Solid– resistance–Reactance–Arcing grounds and grounding Practices.

Text Books:

1. Power System Protection and Switchgear by Badri Ram and D.N Viswakarma - Tata McGraw Hill Publications - 2nd edition - 2011.
2. Power system protection- Static Relays with microprocessor applications by T.S.Madhava Rao - Tata McGraw Hill - 2nd edition.

Reference Books:

1. Fundamentals of Power System Protection by Paithankar and S.R.Bhide. - PHI - 2003.
2. Art & Science of Protective Relaying – by C R Mason - Wiley Eastern Ltd.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/107/108107167
2. https://archive.nptel.ac.in/courses/108/105/108105167

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3205	**ADVANCED CONTROL SYSTEMS**						

Course Objectives:

- To understand the concept of controllability, observability, and their tests for continuous-time systems, as well as the principle of duality in state-space analysis.
- To understand the state-space methods to assess controllability, observability, and design state feedback controllers via pole placement.
- To know the stability of nonlinear systems using phase-plane analysis, describing functions, and Lyapunov's stability theorems.
- To learn optimal control strategies using the calculus of variations, including constrained minimization and the minimum principle.
- To learn Optimal control and state regulator problems.

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

CO1: Explain controllability, observability, and the principle of duality in state-space systems.

CO2: Apply state-space methods to analyze controllability, observability, and design state feedback controllers.

CO3: Analyze the stability of nonlinear systems using phase-plane analysis and Lyapunov's stability theorems.

CO4: Examine the minimization of functional and control variable inequality constraints.

CO5: Formulate and solve the optimal regulator problems.

UNIT – I

Controllability - Observability and Design of Pole Placement

General concepts of controllability and observability -Tests for controllability and observability for continuous time systems - Principle of duality - Effect of state feedback on controllability and observability - Design of state feedback control through pole placement, full order and reduced order observers.

UNIT – II

Nonlinear Systems

Introduction to nonlinear systems - Types of nonlinearities. Introduction to phase plane analysis, construction of phase trajectories-Analytical and Isocline method, Describing function - Describing functions of on-off nonlinearity, on-off nonlinearity with hysteresis, and relay with dead zone.

UNIT – III

Stability analysis by Lyapunov Method

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

UNIT – IV

Calculus of Variations

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

UNIT –V

Optimal Control

Necessary conditions for optimal control, Formulation of the optimal control problem, minimum time problem, minimum energy problem, minimum fuel problem, state regulator problem, output regulator problem.

Text Books:

1. Modern Control Engineering – by K. Ogata - Prentice Hall of India - 3rd edition - 1998.
2. Automatic Control Systems by B.C. Kuo - Prentice Hall Publication.

Reference Books:

1. Modern Control System Theory – by M. Gopal - New Age International Publishers - 2nd edition – 1996.
2. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
3. Control Systems Engineering by I.J. Nagarath and M.Gopal - New Age International (P) Ltd.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/103/108103007
2. https://archive.nptel.ac.in/courses/108/107/108107115

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3206	**RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES**						

Course Objectives:

- To understand the basic concepts on wind energy systems.
- To understand the various relations between speed, power and energy in the wind systems.
- To analyze the solar energy systems, various components of solar thermal systems, applications in the relevant fields and design of PV systems.
- To design the Hydel system components and to get an idea on different other sources like tidal, geothermal and gas based units.
- To understand the concepts of hybrid renewable energy systems.

Course Outcomes:

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

CO1: Illustrate basic concepts of renewable and distributed sources of wind energy.

CO2: Demonstrate the components of wind energy conversion systems.

CO3: Model PV systems and analyze MPPT Techniques.

CO4: Illustrate the concept of Energy Production from Hydro - Tidal and Geothermal.

CO5: Explain the aspects of hybrid renewable energy systems.

UNIT – I

Introduction and Wind energy systems

Brief idea on renewable and distributed sources - their usefulness and advantages. Wind Energy Systems: Estimates of wind energy potential-wind maps- Aerodynamic and mechanical aspects of wind machine design - Conversion to electrical energy - Aspects of location of wind farms.

UNIT – II

Wind power and energy

Wind speed and energy - Speed and power relations - Power extraction from wind - Tip speed ratio (TSR) - TSR characteristics- Functional structure of wind energy conversion systems - Pitch and speed control - Power vs 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-voltagecharacteristics - Effects of temperature and irradiance - Solar array simulator - Sun tracking - Peak power operations - PV system - MPPT techniques: Perturb and observe method, hill climbing and incremental conductance methods-Effects of partial shading on the characteristic curves and associated MPPT techniques - Solar park design outline- Solar Pond-Types of PV systems.

UNIT – IV

Small Hydro and other sources

Hydel: Small-Mini-Medium -Plant layouts Water power estimates -use of hydrographs -hydraulic turbine - characteristics and part load performance - design of wheels - draft tubes and penstocks. Other sources**:** Tidal - geothermal - gas-based generations.

UNIT – V

Hybrid Renewable systems

Requirements of hybrid/combined use of different renewable and distributed sources -Need of energy storage- Control of frequency and voltage of distributed generation in Stand-alone and Grid-connected mode - use of energy storage and power electronics interfaces for the connection to grid and loads - Design and optimization of size of renewable sources andtheir storages.

Text Books :

1. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
2. G.D.Rai 'Non-Conventional Energy Sources' KHANNA PUBLISHERS.

Reference Books

1. Studies' Craig Anderson and Rudolf I. Howard 'Wind and Hydropower Integration: Concepts - Considerations and Case - Nova Publisher - 2012.
2. Amanda E. Niemi and Cory M. Fincher 'Hydropower from Small and Low- Head Hydro Technologies' - Nova Publisher - 2011.
3. D. YogiGoswami - Frank Kreith and Jan F. Kreider 'Principles of Solar Engineering' - Taylor & Francis 2000.
4. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
5. S. Heier and R. Waddington 'Grid Integration of Wind Energy Conversion Systems' – Wiley - 2006.
6. Loi Lei Lai and Tze Fun Chan 'Distributed Generation: Induction and Permanent Magnet Generators' - Wiley-IEEE Press - 2007.
7. G.N. Tiwari 'Solar Energy Technology' - Nova Science Publishers - 2005.

Online Learning Resources:

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

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: **R23EE3207**	**EMBEDDED SYSTEMS**						

COURSE OBJECTIVES:

1. To gain knowledge and fundamental concepts and basic building blocks of an embedded system
2. To learn characteristics, quality attributes and applications of embedded systems
3. To understand the concept of real time operating systems
4. To learn the RTOS basics and various Communication & Synchronization techniques
5. To understand the classification and applications of embedded systems

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Illustrate the classification and applications of embedded systems. [K3]
CO2: Classify the memory devices and passive components of embedded systems. [K4] .
CO3: Summarize various Communication interface in Embedded Systems. [K2]
CO4: Summarize the steps involved in developing application specific embedded systems with suitable example. [K6]
CO5: Describe the RTOS basics and various Communication & Synchronization techniques. [K2]

UNIT–I: INTRODUCTION

Embedded Systems vs. general computing systems, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems.

UNIT–II: CORE AND MEMORY

Core of the embedded system: general purpose and domain specific processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS). Memory: ROM, RAM, memory according to the type of interface, memory shading, memory selection for embedded system.

UNIT–III: COMMUNICATION INTERFACE AND EMBEDDED SYSTEM COMPONENTS

Communication Interface: Onboard and external Communication Interfaces embedded firmware. Embedded system Components: reset circuit, brown-out protection circuit, oscillator unit, Real Time Clock (RTC), watchdog timer, PCB and passive components.

UNIT–IV: CHARACTERISTICS, QUALITY ATTRIBUTES AND EXAMPLES OF EMBEDDED SYSTEMS.

Characteristics of embedded systems and quality attributes of embedded systems. Embedded systems application and domain-specific: washing machine-application-specific embedded system, automotive- domain-specific embedded system.

UNIT–V: RTOS BASED EMBEDDED SYSTEM DESIGN

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling. Task communication, task synchronization, task communication/synchronization issues, task synchronization techniques, device drivers, How to choose an RTOS?

TEXT BOOKS:

1. Shibu K.V, Introduction to Embedded Systems, Mc Graw Hill Education, 2013.
2. Raj Kamal, Embedded Systems, TMH, 2007.
3. Tammy Noergaard, Embedded systems Architecture, Elsevier publications, 2005.

REFERENCE BOOKS:

1. Frank Vahid, Tony Givargis, Embedded System Design, John Wiley, 1999.
2. David E. Simon, An Embedded Software Primer, Pearson Education, 1999.

WEB RESOURCES:

1. http://www.embeddedtechnology.com/
2. http://www.omg.org/realtime/
3. http://www.eembc.org
4. http://www.instantweb.com/~foldoc/
5. http://www.realtime-info.be/magazine/98q4/1998q4_p014.pdf
6. http://www.eet.com/
7. http://www.zdnet.com/intweek/

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3208	**ELECTRIC DRIVES**						

Course Objectives:

- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- To discuss the DC-DC converter control of dc motors.
- To understand the concept of speed control of induction motor by using AC voltage controllers, voltage source inverters and slip power recovery scheme.
- To learn the speed control mechanism of synchronous motors.

Course Outcomes:

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

CO1: Explain the fundamentals of electric drive and different electric braking methods.

CO2: Analyze the operation of three-phase converter fed dc motors and four quadrant operations of dc motors using dual converters.

CO3: Describe the DC-DC converter fed control of dc motors in various quadrants of operation

CO4: Know the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters and differentiate the stator side control and rotor side control

CO5: Learn the concepts of speed control of synchronous motor with different methods.

UNIT - I

Fundamentals of Electric Drives

Electric drive and its components– Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic Braking, Plugging and Regenerative Braking –Numerical problems.

UNIT - II

Converter Fed DC Motor Drives

3-phase half and fully-controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque characteristics and expressions – 3-phase Dual converter fed DC motor drives – Numerical problems.

UNIT - III

DC–DC Converter Fed DC Motor Drives

Single quadrant, two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous Current Mode of operation - Output voltage and current waveforms – Speed-torque characteristics and expressions – Closed loop operation (qualitative treatment only) – Numerical problems.

UNIT - IV

Control of 3-phase Induction motor Drives

Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop V/f control of induction motor drives (qualitative treatment only). Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics– Numerical problems.

UNIT - V

Control of Synchronous Motor Drives

Separate control of synchronous motor – self-control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive (qualitative treatment only)– PMSM: Basic operation and advantages – Numerical problems.

Text Books:

1. Fundamentals of Electric Drives – G K Dubey - Narosa Publications - 2nd edition – 2002.
2. Power Semiconductor Drives - S.B.Dewan - G.R.Slemon - A.Straughen - Wiley India - 1984.

Reference Books:

1. Electric Motors and Drives Fundamentals - Types and Apllications - by Austin Hughes and Bill Drury - Newnes.4th edition - 2013.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications - 1987.
3. Power Electronic Circuits - Devices and applications by M.H.Rashid - PHI - 3rd edition - 2009.

Online Learning Resources:

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

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3209	**DIGITAL SIGNAL PROCESSING**						

Pre-requisite:

Laplace Transforms, Z- Transforms, Fourier series and transforms.

Course Objectives:

- To explore the basic concepts of digital signal processing.
- To connect the time domain signal to frequency domain signals using Fourier transform.
- To understand the basic structures of IRR systems.
- To understand and design FIR Digital filters.
- To explore the concepts of multiple sampling rates for DSP.

Course Outcomes:

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

CO1: Know the concepts of Digital signal processing - frequency domain representation &z- transform.

CO2: Compute discrete Fourier transform and fast Fourier transforms for different sequences.

CO3: Design IIR filters through analog filter approximation and basic structure of IIR filters.

CO4: Design FIR filters with window techniques and basic structure of FIR filters.

CO5: Learn the concepts of Multirate Signal Processing.

UNIT - I

Introduction to Digital Signal Processing

Discrete time signals & sequences - Classification of Discrete time systems - stability of LTI systems - Invertability - Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms - solution of difference equations using Z-transforms - System function.

UNIT - II

Discrete Fourier Transforms and FFT Algorithms

Discrete Fourier Series representation of periodic sequences -Properties of Discrete Fourier Series - Discrete Fourier transforms: Properties of DFT - linear filtering methods based on DFT - Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms - Inverse FFT.

UNIT - III

Design and Realizations of IIR Digital Filters

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

Basic structures of IIR systems – Direct-Form Structures - Transposed Structures - Cascade-Form Structures - Parallel-Form Structures Lattice and Lattice-Ladder Structures.

UNIT - IV

Design and Realizations of FIR Digital Filters

Characteristics of FIR Filters with Linear Phase - Frequency Response of Linear Phase FIR Filters - Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique - Comparison of IIR & FIR filters.

Basic structures of FIR systems – Direct-Form Structure - Cascade-Form Structures Linear Phase Realizations - Lattice structures.

UNIT - V

Multirate Digital Signal Processing

Decimation –Interpolation-Sampling Rate Conversion by a Rational Factor–Implementation of sampling rate converters–Applications of Multirate Signal Processing-Digital Filter Banks.

Text Books:

1. Digital Signal Processing – Principles Algorithms and Applications: John G. Proakis - Dimitris G.Manolakis - 4th Edition - Pearson Education / PHI - 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer - PHI.
3. Digital Signal Processing: A Computer based approach. Sanjit K Mitra - 4th Edition - TMH - 2014.

Reference Books:

1. Digital Signal Processing: Andreas Antoniou - TATA McGraw Hill - 2006.
2. Digital Signal Processing: MH Hayes - Schaum's Outlines - TATA Mc-Graw Hill - 2007.
3. DSP Primer - C. Britton Rorabaugh - Tata McGraw Hill - 2005.
4. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling - Sandra L.Harris - Thomson - 2007.
5. Digital Signal Processing – Alan V. Oppenheim - Ronald W. Schafer - PHI Ed. - 2006.
6. Digital Signal Processing – K Raja Rajeswari - 1st edition - I.K. International Publishing - House - 2014.

Online Learning Resources:

1. https://nptel.ac.in/courses/117102060
2. https://archive.nptel.ac.in/courses/108/101/108101174

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3210	**HIGH VOLTAGE ENGINEERING**						

Course Objectives:

- To understand HV breakdown phenomena in gases.
- To understand the breakdown phenomenon of liquids and solid dielectrics.
- To acquaint with the generating principle of operation and design of HVDC, AC voltages.
- To understand the generating principles of Impulse voltages & currents.
- To understand various techniques for AC, DC and Impulse measurements of high voltages and currents.

Course Outcomes:

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

CO 1: Recognise the dielectric properties of gaseous materials used in HV equipment.

CO 2: Differentiate the break down phenomenon in liquid and solid dielectric materials.

CO 3: Acquaint with the techniques of generation of high AC and DC voltages

CO 4: Acquaint with the techniques of generation of high Impulse voltages and currents.

CO 5: Getting the knowledge of measurement of high AC - DC - Impulse Voltages and currents.

UNIT - I

Break down phenomenon in Gaseous and Vacuum:

Insulating Materials: Types, properties and its applications. Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases and its limitations – Streamers Theory of break down – time lag – Paschen's law- Paschen's curve, Penning Effect. Breakdown mechanisms in Vacuum.

UNIT - II

Break down phenomenon in Liquids:

Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquids- Mechanisms.

Break down phenomenon in Solids:

Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown – Breakdown of composite solid dielectrics.

UNIT - III

Generation of High DC voltages:

Voltage Doubler Circuit - Voltage Multiplier Circuit – Vande- Graaff Generator.

Generation of High AC voltages:

Cascaded Transformers – Resonant Transformers –Tesla Coil.

UNIT - IV

Generation of Impulse voltages:

Specifications of impulse wave – Analysis of RLC circuits - Marx Circuit.

Generation of Impulse currents:

Definitions – Circuits for producing Impulse current waves – Wave shape control - Tripping and control of impulse generators.

UNIT - V

Measurement of High DC & AC Voltages:

Resistance potential divider - Generating Voltmeter - Capacitor Voltage Transformer (CVT) - Electrostatic Voltmeters – Sphere Gaps.

Measurement of Impulse Voltages & Currents:

Potential dividers with CRO - Hall Generator - Rogowski Coils.

Text Books:

1. High Voltage Engineering: Fundamentals by E.Kuffel - W.S.Zaengl - J.Kuffel by Elsevier - 2nd Edition.
2. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications - 3rd Edition.

Reference Books:

1. High Voltage Engineering and Technology by Ryan - IET Publishers - 2nd edition.
2. High Voltage Engineering by C.L.Wadhwa - New Age Internationals (P) Limited – 1997.
3. High Voltage Insulation Engineering by RavindraArora - Wolfgang Mosch - New Age International (P) Limited - 1995.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/104/108104048
2. https://bharatsrajpurohit.weebly.com/high-voltage-engineering-course.html

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE3211	UTILIZATION OF ELECTRICAL ENERGY						

Course Objectives:

1. To impart knowledge on electric heating and welding methods for residential, commercial and industrial applications.
2. To familiarize with the fundamental laws of illumination & basic principle of light control.
3. To study working principles of different lamps and various types of lightning system including design.
4. To understand the basic principle of electric traction including speed–time curves of different types of services.
5. To impart the concepts and calculations of tractive effort and specific energy consumption.

Course Outcomes:

After completion of this course students will be able to

1. Differentiate the various types of heating and Welding methods
2. Demonstrate the basic principles of illumination and light control
3. Design illumination systems for residential, commercial and industrial environments**.**
4. Illustrate the basic principles of electric traction including speed–time curves of different traction services
5. Calculate Adhesive force,tractive power and specific energy consumption

UNIT-I: Illumination

Introduction to sources of light -Terms used in illumination -Laws of illumination - Basic principles of light control-Illumination measuring instruments-Lux meter- Types of Lamps: Discharge lamps, MV and SV lamps, tungsten filament lamps and fluorescent tubes - Comparison between tungsten filament lamps and fluorescent tubes - Problems.

UNIT-II: Electric Heating & Electric Welding

Advantages and methods of electric heating - Resistance heating - Induction heating and dielectric heating - Electric Welding - Resistance and arc welding - Electric welding equipment - Comparison between A.C. and D.C. Welding.

UNIT-III: Selection of Motors

Choice of Motor - Type of Electric Drives - Starting and Running Characteristics – Speed Control - Temperature Rise – Applications of Electric Drives–Types of Industrial Loads– Continuous– Intermittent and Variable Loads–Load Equalization.

UNIT-IV: Electric Traction – I

Systems of electric traction and track electrification - Review of existing electric traction systems in India - Special features of traction motor - Mechanics of train movement - Speed- time curves for different services - Trapezoidal and quadrilateral speed time curves- Problems

UNIT-V: Electric Traction – II

Calculations of tractive effort – Power - Specific energy consumption for given run - Effect of varying acceleration and braking retardation - Adhesive weight and braking retardation adhesive weight and coefficient of adhesion- Problems

Text Books:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Utilization of Electrical Energy – by G.C.Garg Khanna Publications.
3. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai& Sons.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V. Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.

Online Learning Resources:

1. https://www.youtube.com/watch?v=fQrZMMWo1mA
2. https://www.youtube.com/watch?v=uy9lZCdkQIM

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
Code: R23EE32L1	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB						

Course Objectives:

- To understand students how different types of meters work and their construction.
- To make the students understand how to measure resistance, inductance and capacitance by AC & DC bridges.
- To understand the testing of CT and PT.
- To Understand and the characteristics of Thermo couples, LVDT, Capacitive transducer, piezoelectric transducer and measurement of strain and choke coil parameters.

Course Outcomes:

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

CO1: Know about the phantom loading and calibration process.

CO2: Measure the electrical parameters voltage - current - power- energy and electrical characteristics of resistance - inductance and capacitance.

CO3: Gain the skill knowledge of various brides and their applications.

CO4: Learn the usage of CT's - PT's for measurement purpose.

CO5: Know the characteristics of transducers and measure the strains - frequency and phase difference.

Any 10 of the following experiments are to be conducted

1. Calibration of dynamometer wattmeter using phantom loading
2. Measurement of resistance using Kelvin's double Bridge and Determination of its tolerance.
3. Measurement of Capacitance using Schering Bridge.
4. Measurement of Inductance using Anderson Bridge.
5. Calibration of LPF Wattmeter by direct loading.
6. Measurement of 3 phase reactive power using single wattmeter method for a balanced load.
7. Testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null deflection method.
8. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.
9. Determination of the characteristics of a Thermocouple.
10. Determination of the characteristics of a LVDT.
11. Determination of the characteristics for a capacitive transducer.
12. Measurement of strain for a bridge strain gauge.
13. Measurement of Choke coil parameters and single-phase power using three voltmeter and three ammeter methods.
14. Calibration of single-phase Induction Type Energy Meter.
15. Calibration of DC ammeter and voltmeter using Crompton DC Potentiometer.
16. AC Potentiometer: Polar Form / Cartesian Form - Calibration of AC voltmeter - Parameters of choke.

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	30	70	100	1.5
Code: R23EE32L2	MICROPROCESSORS AND MICROCONTROLLERS LAB						

Pre-requisite:

Concepts of Microprocessors and Microcontrollers

Course Objectives:

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

Course Outcomes:

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

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

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

CO3: Write a assembly program on string operations.

CO4: Interface 8086 with I/O and other devices.

CO5: Do parallel and serial communication using 8051 & PIC 18 micro controllers.

CO6: Program microprocessors and microcontrollers for real world applications.

List of experiments

Any 10 of the following experiments are to be conducted:

8086 Microprocessor Programs

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

Programs on Interfacing

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

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	1	2	30	70	100	2
Code: R23EE32L3	IOT APPLICATIONS OF ELECTRICAL ENGINEERING LAB						

Pre-requisite: Concepts of Computer Organization, Computer Networks.

Course Objectives:

- To understand the working of Arduino.
- To learn the programming of Raspberry PI.
- To know various sensors with Arduino/Raspberry Pi.
- To interface various displays with Arduino/Raspberry Pi.
- To connect with various wireless communication devices

Course Outcomes:

At the end of the course - students will be able to:

CO1: Operate the Arduino Integrated Development Environment with embedded c.

CO2: Program the embedded Python in Raspberry Pi OS.

CO3: Interface various sensors with Arduino/Raspberry Pi in the IoT environment.

CO4: Connect different displays with Arduino/Raspberry Pi

C05: Interconnect with wireless communication technologies.

Topics to be covered in Tutorials

Module–1: Programming Arduino: (3 hrs)

Arduino - Classification of Arduino Boards - Pin diagrams – Arduino Integrated Development Environment (IDE) – Programming Arduino.

Module–2: Sensors: (5 hrs)

Working of temperature sensor, proximity sensor, IR sensor, Light sensor, ultrasonic sensor, PIR Sensor, Colour sensor, Soil Sensor, Heart Beat Sensor, Fire Alarms etc. Actuators: Stepper Motor, Servo Motor and their integration with Arduino/Raspberry Pi.

Module–3: Raspberry Pi: (2 hrs)

Introduction, Classification of Rasperberry Pi Series - Pin diagrams – Programming Rasperberry Pi.

Module–4: Display: (2 hrs)

Working of LEDs, LED, OLED display, LCDs, Seven Segment Display, Touch Screen etc. Analog Input and Digital Output Converter etc. and their integration with Arduino/Raspberry Pi.

Module–5: Wireless Communication Devices: (4 hrs)

Working of Bluetooth, Wi-Fi, Radio Frequency Identification (RFID), GPRS/GSM Technology, ZigBee, etc and their integration with Arduino/Raspberry Pi. Features of Alexa.

List of experiments

Any 10 of the following experiments are to be conducted:

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. Interfacing of LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. Interfacing of Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. Interfacing of temperature sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. Interfacing of Organic Light Emitting Diode (OLED) with Arduino/Raspberry Pi
6. Interfacing of Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
7. Interfacing of Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
8. Write a program on Arduino/Raspberry Pi to upload and retrieve temperature and humidity data to thingspeak cloud.
9. Interfacing of 7 Segment Display with Arduino/Raspberry Pi
10. Interfacing of Joystick with Arduino/Raspberry Pi
11. Interfacing of Analog Input & Digital Output with Arduino/Raspberry Pi
12. Night Light Controlled & Monitoring System
13. Interfacing of Fire Alarm Using Arduino/Raspberry Pi
14. IR Remote Control for Home Appliances
15. A Heart Rate Monitoring System
16. Alexa based Home Automation System

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	30	70	100	-
Code: R23EE32MC	AUDIT COURSE RESEARCH METHODOLOGY						

Course Objectives

- To equip students with the skills to identify and investigate research problems through effective data collection, literature review, research ethics, technical writing, and proposal development.
- To provide an understanding of Intellectual Property Rights (IPR), including patents, copyrights, licensing, and recent developments in IPR with emphasis on practical applications and case studies.

Course Outcomes

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

- Formulate a clear and researchable problem using appropriate investigation and data analysis methods.
- Conduct ethical literature reviews and prepare effective technical reports and research proposals.
- Explain key concepts of intellectual property and the process of patenting innovations.
- Interpret patent rights, licensing, and access relevant IPR databases.
- Assess recent trends and applications of IPR in emerging fields and case studies.

UNIT – I: Research Problem

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT – II: Literature Study

Effective literature studies approaches, analysis Plagiarism, Research ethics, Technical writing: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT – III: Nature of Intellectual Property

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT – IV: Patent Rights

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT – V: New Developments in IPR

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc, Traditional knowledge Case Studies, IPR and IITs.

Text Books

1. Stuart Melville and Wayne Goddard, “Research Methodology: An Introduction for Science & Engineering Students”, 2004.
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”, 2004.
3. Ranjit Kumar, “Research Methodology: A Step-by-Step Guide for Beginners”, SAGE

Publications, 5th Edition, 2019.

Reference Books

1. Kothari C.R. and Garg Gaurav, “Research Methodology: Methods and Techniques”, New Age International Publishers, New Delhi, 4th Edition, 2019.
2. Creswell John W. and Creswell J. David, “Research Design: Qualitative, Quantitative, and Mixed Methods Approaches”, SAGE Publications, Los Angeles, 5th Edition, 2018.
3. Booth Wayne C., Colomb Gregory G., and Williams Joseph M., “The Craft of Research”, University of Chicago Press, Chicago, 4th Edition, 2016.
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

Online Learning Resources

1. https://onlinecourses.swayam2.ac.in/ntr24_ed08/
2. https://onlinecourses.swayam2.ac.in/ini25_hs10/

IV Year-I Semester

S.No.	Subject	Course Code	Cat. Code	L	T	P	Credits
1	Power System Operation and Control	R23EE4101	PC	3	0	0	3
2	Energy Management & Auditing	R23EE4102	MC- II	2	0	0	2
3	**Professional Elective-IV** EHVAC & HVDC Transmission Systems	R23EE4105	PE-IV	3	0	0	3
	Programmable Logic Controllers	R23EE4103					
	Electrical Distribution System	R23EE4106					
	Power Quality	R23EE4107					
4	**Professional Elective-V** 1. Electric Vehicles	R23EE4108	PE-V	3	0	0	3
	2. Switched Mode Power Conversion	R23EE4109					
	3. Design of PV systems	R23EE4110					
	4. Flexible AC Transmission Systems	R23EE4104					
5	**Open Elective – III** 1. Battery Management Systems and Charging Stations	R23OE4123	OE - III	3	0	0	3
	2. Micro Electro Mechanical System	R23OE4124					
	3. Soft Computing	R23OE4125					
	4. Embedded control of electric drives	R23OE4126					
6	**Open Elective-IV** 1. Concepts of Power Quality	R23OE4102	OE-IV	3	0	0	3
	2. Non-Conventional Energy Resources	R23OE4107					
	3. Fundamentals Of Utilization Of Electrical Energy	R23OE4127					
	4. Indian Electricity Act	R23OE4128					
7	Power Systems Simulation Lab	R23EE41L1	SEC	0	0	4	2
8	Constitution of India	R23CC41MC	AC	2	0	0	-
9	Evaluation of Industry Internship	R23CC41IN	Internship	-	-	-	2
Total				**16**	**0**	**02**	**21**

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4101	POWER SYSTEM OPERATION AND CONTROL (PROFESSIONAL CORE)						

Course Objectives:

1. To understand optimal dispatch of generation with and without losses.
2. To understand the optimal scheduling of hydro thermal systems.
3. To understand the optimal unit commitment problem.
4. To understand the load frequency control for single area system with and without controllers
5. To understand the load frequency control for two area system with and without controllers
6. To understand the reactive power control and compensation of transmission lines.

Course Outcomes:

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

1. Compute optimal load scheduling of Generators.
2. Formulate hydrothermal scheduling and unit commitment problem.
3. Analyse effect of Load Frequency Control for single area systems
4. Analyse effect of Load Frequency Control for two area systems.
5. Describe the effect of reactive power control for transmission lines.

UNIT - I

Economic Operation of Power Systems

Optimal operation of Generators in Thermal power stations - – Heat rate curve – Cost Curve – Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

UNIT - II

Hydrothermal Scheduling

Mathematical Formulation – Short term Solution Technique. Unit Commitment Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

UNIT – III

Load Frequency Control-I

Modelling of steam turbine – Generator – Mathematical modelling of speed governing system – Transfer function – Necessity of keeping frequency constant. Definitions of Control area –Single area control system – Block diagram representation of an isolated power system –Steady state analysis – Dynamic response – Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation – Steady state response.

UNIT - IV

Load Frequency Control-II

Block diagram development of load frequency control of two area system: uncontrolled case and controlled case – Tie-line bias control – Load frequency control and economic dispatch control.

UNIT - V

Compensation in Power Systems

Overview of Reactive Power control – Reactive power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – Compensated transmission lines. Introduction of FACTS devices – Need of FACTS controllers – Types of FACTS devices.

Text Books:

1. Power Generation - Operation and Control by Allen J Wood - Bruce F WollenBerg 3rd Edition - Wiley Publication 2014.
2. Electric Energy systems Theory – by O.I.Elgerd - Tata McGraw–hill Publishing Company Ltd. - Second edition.
3. Modern Power System Analysis – by I.J.Nagrath & D.P.Kothari Tata McGraw Hill Publishing Company Ltd - 2nd edition.

Reference Books:

1. Power System Analysis and Stability by S.S.Vadhera - Khanna Publications - 4th edition - 2005.
2. Power System Analysis by Grainger and Stevenson - Tata McGraw Hill.
3. Power System Analysis by HadiSaadat – – Tata McGraw–Hill 3rd edition - 2010.
4. Power System stability & control - Prabha Kundur - TMH - 1994.

Online Learning Resources:

1. https://nptel.ac.in/courses/108104191
2. https://nptel.ac.in/courses/108104052

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4102	ENERGY MANAGEMENT & AUDITING (Management Course- II)						

Course Objectives:

1. To understand basic concepts of Energy Audit & various Energy conservation schemes.
2. To design energy an energy management program.
3. To understand concept of Energy Efficient Motors and lighting control efficiencies.
4. To understand the concept of Demand side management and significance of Energy instruments
5. To calculate life cycle costing analysis and return on investment on energy efficient
6. technologies.

Course Outcomes:

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

1. Understand the principles of energy audit along with various Energy related terminologies.
2. Asses the role of Energy Manager and Energy Management program.
3. Design an energy efficient motors and good lighting system.
4. To understand the significance of Demand side management and identify the energy instruments for various real time applications.
5. Evaluate the computational techniques about economic aspects.

Unit–I

Basic Principles of Energy Audit

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

Unit–II

Energy Management

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

Unit–III

Energy Efficient Motors and Lighting

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

Unit–IV

Demand Side Management and Energy Instruments

Introduction to DSM - concept of DSM - benefits of DSM - Different techniques of DSM – time of day pricing - multi-utility power exchange model - time of day models for planning. Load management - load priority technique - peak clipping - peak shifting - valley filling - strategic conservation– Energy Instruments- data loggers - thermocouples - pyrometers - lux
meters - tongue testers.

Unit–V

Economic Aspects and Their Computation

Economics Analysis depreciation Methods - time value of money - rate of return – present worth method - replacement analysis - life cycle costing analysis – Energy efficient motors. Calculation of simple payback method - net present value method – Applications of life cycle
costing analysis - return on investment.

Text Books:

1. Energy management by W.R.Murphy & G.Mckay Butter worth - Heinemann publications - 1982.
2. Energy management hand book by W.CTurner - John wiley and sons - 1982.

Reference Books:

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

Online Learning Resources:

1. https://nptel.ac.in/courses/112105221
2. https://nptel.ac.in/courses/109106161

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4105	EHVAC & HVDC TRANSMISSIONSYSTEMS Professional Elective-IV						

Course Objectives

1. Role of EHVAC transmission, Electrostatics and voltage gradient distribution.
2. The objective is to discuss phenomena of corona, losses, audible noise, radio interference and measurement of these quantities.
3. To explain fundamental principles of HVDC transmission system, including their advantages, limitations and modern trends in DC transmission.
4. To Interpret the operation and control of power converters used in HVDC systems
5. To educate students on the generation and impact of harmonics in HVDC systems, methods for their calculation, and design of effective AC filters such as single-tuned and high-pass filters.

Course Outcomes:

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

1. Acquaint with HV transmission system with regard to power handling capacity, losses, conductor resistance and electrostatic field associate with HV. Further knowledge is gained in area of bundle conductor system to improve electrical and mechanical performance.
2. Develop ability for determining corona, radio interference, audible noise generation and frequency spectrum for single and three phase transmission lines.
3. Understand the basic concepts, economic considerations, and terminal equipment of HVDC transmission systems, including different types of HVDC and MTDC links.
4. Analyze and compare the configurations and characteristics of HVDC converters such as 6-pulse and 12-pulse Graetz circuits, and explain the principles and methods of DC link control.
5. Evaluate the origin and effects of harmonics in HVDC systems, calculate harmonic components, and design appropriate AC filters including single-tuned and high-pass filters.

Unit – I

Introduction of EHV AC transmission

Necessity of EHV AC transmission – Advantages and problems– Power handling capacity and line losses– Mechanical considerations in line performance –Electrostatics – Field of sphere gap – Field of line charges and properties – Charge – potential relations for multi–conductors – Surface voltage gradient on conductors – Bundle spacing and bundle radius– Examples – Distribution of voltage gradient on sub conductors of bundle – Examples.

Unit – II

Corona effects

Power loss and audible noise (AN) – Corona loss formulae – Charge voltage diagram – Generation – Characteristics – Limits and measurements of AN – Relation between 1–phase and 3–phase AN levels – Examples – Radio interference (RI) – Corona pulses and their generation – Properties and limits – Frequency spectrum – Modes of propagation – Excitation function – Measurement of RI, RIV and excitation functions – Examples.

UNIT – III

Basic Concepts of DC Transmission

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC transmission – Application of DC Transmission System – Planning & Modern trends in DC transmission – Types of MTDC systems.

UNIT – IV

Analysis of HVDC Converters and System Control

Choice of Converter configuration – Analysis of Graetz circuit – Characteristics of 6 Pulse & 12 Pulse converters — Principal of DC Link Control – Converters Control Characteristics – Firing angle control –Constant Current and extinction angle control –Starting and stopping of DC link – Power Control.

UNIT–V

Harmonics in HVDC System

Generation of Harmonics – Characteristics harmonics – Calculation of AC Harmonics – Non–Characteristics harmonics – Adverse effects of harmonics – Calculation of voltage & current harmonics – Effect of Pulse number on harmonics. Types of AC filters, Design of Single tuned filters –Design of High pass filters.

Text Books:

1. HVDC Power Transmission Systems: Technology and system Interactions – by K.R.Padiyar, New Age International (P) Limited, and Publishers.
2. Direct Current Transmission – by E.W.Kimbark, John Wiley & Sons.
3. EHVAC Transmission Engineering by R. D. Begamudre, New Age International (p) Ltd.

Reference Books:

1. EHVAC and HVDC Transmission Engineering and Practice – Sunil S.Rao.
2. Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications
3. HVDC Transmission – J.Arrillaga.

Online Learning Resources:

1. https://nptel.ac.in/courses/108104013
2. https://nptel.ac.in/courses/108108099

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4103	PROGRAMMABLE LOGIC CONTROLLERS Professional Elective-IV						

Course Objectives:

1. To understand the various components of PLC systems and Input/output devices.
2. To know the programming instructions and ladder diagram construction in the PLC.
3. To understand the use and applications of timer and counter functions.
4. To familiar the data handling function and their applications.
5. To understand and implementation of analog operations and PID modules.

Course Outcomes:

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

1. Illustrate I/O modules of PLC systems and Input/output devices.
2. Demonstrate various the programming instructions and ladder diagram construction in the PLC.
3. Examine various types of PLC functions and counters and their applications.
4. Assess different data handling functions and its applications.
5. Describe the analog operations and PID modules.

UNIT – I

PLC Basics

PLC Advantages and disadvantages – Overall PLC system – Central Processing Unit - I/O modules Power supplies- programming Equipment - programming formats - construction of PLC ladder diagrams – Input On/Off Switching Devices – Input Analog Devices – Output On/Off Switching Devices – Output Analog Devices.

UNIT – II

PLC Programming

PLC Input instructions - outputs - operational procedures - programming examples using contacts and coils - Drill press operation. Digital logic gates - Boolean algebra PLC programming - conversion examples- Ladder diagrams and sequence listings - ladder diagram
construction and flowchart for spray process system.

UNIT – III

Basic and Intermediate PLC Functions:

General Characteristics of Registers - module addressing - holding registers - Input Registers
- Output Registers. PLC Timer functions & Industrial applications - counters – counter function industrial applications - Arithmetic functions - Number comparison functions - number conversion functions.

UNIT – IV

Data Handling functions:

SKIP - Master control Relay - Jump - Move - FIFO - FAL - ONS - CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register - sequence functions and applications - controlling of two-axis & three axis Robots with PLC - Matrix functions.

UNIT – V

Analog PLC operation:

Analog modules & systems - Analog signal processing - Multi bit Data Processing – Analog output Application Examples - PID principles - position indicator with PID control – PID Modules - PID tuning - PID functions.

Text books:

1. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss - Fifth Edition - PHI
2. Programmable Logic Controllers- Programming Method and Applications – JR.Hackworth &F.D Hackworth Jr. –Pearson - 2004

Reference Books:

1. Introduction to Programmable Logic Controllers- Gary A. Dunning - 3rd edition - Cengage Learning - 2005.
2. Programmable Logic Controllers –W.Bolton - 5th Edition - Elsevier publisher - 2009.

Online Learning Resources:

1. https://nptel.ac.in/courses/108105062
2. https://nptel.ac.in/courses/108105063

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4106	ELECTRICAL DISTRIBUTION SYSTEM Professional Elective-IV						

Course Objectives

1. To learn different factors of distribution system.
2. To learn and design aspects of the substations and distribution systems.
3. To learn the concepts of voltage drop and power loss.
4. To learn the distribution system protection and its coordination.
5. To learn the effect of compensation for power factor improvement.
6. To learn the effect of voltage control on distribution system.

Course Outcomes:

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

1. Discriminate various factors of distribution system - load modelling and characteristic of loads.
2. Know the concept of design considerations of substation and feeders.
3. Determine the voltage drop and power loss for different types of distribution loads.
4. Analyse the protection and its coordination for distribution systems.
5. Analyse the effect of compensation for p.f improvement and voltage improvement.

UNIT - I

General Concepts

Introduction to distribution systems - Distribution system losses – Coincidence factor – Contribution factor – loss factor – Relationship between the load factor and loss factor – Numerical Problems – Load modeling and characteristics – Classification and characteristics
of loads (Residential - Commercial - Agricultural and Industrial).

UNIT - II

Substations

Selection for location of substations - Rating of distribution substation – Service area with 'n'
primary feeders – Benefits and methods of optimal location of substations. Distribution Feeders
Design Considerations of distribution feeders: Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT - III

System Analysis

Voltage drop and power loss calculations: Derivation for voltage drop and power loss in lines
– Uniformly distributed loads and non-uniformly distributed loads – Three phase balanced primary lines and Non three phase balanced primary lines.

UNIT - IV

Protection

Objectives of distribution system protection –Time current characteristics – Protective devices:
Principle of operation of fuses – Circuit reclosures – Line sectionaliser and circuit breakers -
Earth leakage circuit breakers – Protection schemes of parallel & Ring-main feeders.
Coordination of protective devices General coordination procedure –Various types of co-ordinated operation of protective devices - Residual Current Circuit Breaker.

UNIT - V

Compensation for Power Factor Improvement

Capacitive compensation for power factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location. Voltage Control Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation.

Text Book:

1. "Electric Power Distribution system - Engineering" – by Turan Gonen - McGraw–hill - 2nd edition - 2008.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo - CRC press - 2nd edition.
2. Electric Power Distribution – by A.S. Pabla - Tata McGraw–hill Publishing Company - 4th edition - 1997.
3. Electrical Power Distribution Systems by V.Kamaraju - Right Publishers. Online Learning

Resources:

1. https://nptel.ac.in/courses/108107112
2. https://www.mooc-list.com/tags/electrical-distribution

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4107	POWER QUALITY Professional Elective-IV						

COURSE OBJECTIVES:

1. To impart the knowledge on fundamentals of power quality problems.
2. To identify the various causes which create the distortion in the power supply.
3. To learn the various mitigation techniques and voltage regulation methods.
4. To impart the knowledge on various custom power devices
5. To know about power quality issues in distributed generation.

COURSE OUTCOMES:

After completion of this course students will be able to

CO1: Demonstrate the various power quality problems in power system [K3]

CO2: Illustrate the harmonic distortion problem due to commercial and industrial loads[K3] CO3: Examine the suitable device for power quality measurements & voltage regulation methods [K4]

CO4: Apply skills in design of various custom power devices for power quality improvement [K3]

CO5: Differentiate the different power quality issues in Distributed Generation[K4]

UNIT-I

Fundamentals of Power Quality: Definition of Power Quality - Classification of Power Quality Issues - Power Quality Standards - Categories and Characteristics of Electromagnetic Phenomena in Power Systems: Impulsive and Oscillatory Transients – Interruption – Sag – Swell - Sustained Interruption - Under Voltage - Over Voltage and Outage - Sources and causes of different Power Quality Disturbances.

UNIT-II

Harmonics and Applied Harmonics: Harmonic Distortion - Voltage vs. Current Distortion - Harmonics Vs. Transients - Power System Qualities under Non-Sinusoidal Conditions - Harmonic Indices - Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads - Applied Harmonics: Effects of Harmonics - harmonic distortion evaluations -Principles of controlling harmonics and devices for controlling harmonic distortion.

UNIT-III

Voltage Regulation using Conventional Methods: Principles of regulating the voltage - Devices for voltage regulation: utility step voltage regulators - Ferro-resonant transformers -Magnetic synthesizers - On-line UPS systems - Motor-generator sets - Static VAR compensators - Shunt capacitors and series capacitors.

UNIT-IV

Power Quality Enhancement using Custom Power Devices: Introduction to Custom Power Devices - Network Reconfiguring Type: Solid State Current Limiter (SSCL) - Solid State Breaker (SSB) – Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer - Distribution STATCOM and Unified Power Quality Conditioner – operation - Realization and control of DVR, DSTATCOM and UPQC – load compensation. Power quality monitoring – Power quality monitoring standards.

UNIT-V

Power Quality issues In Distributed Generation DG Technologies: Perspectives on DG benefits - Interface to the Utility System - power quality issues affected by DG - Operating Conflicts: Utility fault clearing - Reclosing - Interference with relaying - Voltage regulation issues - Islanding - siting DG.

TEXT BOOKS:

1. Roger C. Dugan, Mark E. Mc. Granaghan, Surya Santosoh and H. WayneBeaty, Electrical Power Systems Quality, 2nd edition, TATA McGraw Hill,2010.
2. ArindamGhosh, Gerard Ledwich, Power Quality Enhancement Using CustomPower Devices, Springer, 2002.

REFERENCE BOOKS:

1. Math H J Bollen, “Understanding Power Quality Problems” IEEE Press, 1998.
2. C.Sankaran, Power Quality, CRC press, 2000.

WEB REFERENCES:

1. https://www.captech.com.au/what-is-power-quality/.
2.https://www.cet.edu.in/noticefiles/227_Electrical_Power_Quality-PEEL5403-8th_Sem- Electrical.pdf

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4108	ELECTRIC VEHICLES Professional Elective-V						

Course Objectives:

1. To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
2. To know various architectures of hybrid electric vehicles.
3. To understand the power management of plug in electric vehicles.
4. To study and understand different power converters used in electrical vehicles.
5. To familiarize with different batteries and other storage systems.

Course Outcomes:

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

1. Know the concept of electric vehicles and hybrid electric vehicles.
2. Familiar with different configuration of hybrid electric vehicles.
3. Choose an effective motor for EV and HEV application
4. Understand the power converters used in hybrid electric vehicles
5. Know different batteries and other energy storage systems.

UNIT - I

Introduction

Fundamentals of vehicle - components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles - advantages and applications of Electric and Hybrid Electric Vehicles.

UNIT - II

Hybridization of Automobile

Architectures of HEVs - series and parallel HEVs - complex HEVs. Plug-in hybrid vehicle(PHEV) - constituents of PHEV - comparison of HEV and PHEV; Extended range hybrid electric vehicles(EREVs) - blended PHEVs - Fuel Cell vehicles and its constituents.

UNIT - III

Special Machines for EV and HEVs

Characteristics of traction drive - requirement of electric motors for EV/HEVs. Induction Motor drives - their control and applications in EV/HEVs. Permanent magnet Synchronous motor: configuration - control and applications in EV/HEVs. Brushless DC Motors: Advantages - control of application in EV/HEVs. Switch reluctance motors: Merits limitations
- converter configuration - control of SRM for EV/HEVs.

UNIT - IV

Power Electronics in HEVs

Boost and Buck-Boost converters - Multi Quadrant DC-DC converters - DC-AC Inverter for
EV and HEV applications - Three Phase DC-AC inverters - Voltage control of DC-AC inverters using PWM - EV and PHEV battery chargers.

UNIT - V

Energy Sources for HEVs

Energy Storage - Battery based energy storage and simplified models of battery - fuel cells - their characteristics and simplified models - super capacitor based energy storage - its analysis
and simplified models - flywheels and their modeling for energy storage in EV/HEV - Hybridization of various energy storage devices.

Text Books

1. Ali Emadi - Advanced Electric Drive Vehicles - CRC Press - 2014.
2. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2003.

Reference Books:

1. MehrdadEhsani - YimiGao - Sebastian E. Gay - Ali Emadi - Modern Electric - Hybrid Electric and Fuel Cell Vehicles: Fundamentals - Theory and Design – CRC Press - 2004.
2. James Larminie - John Lowry - Electric Vehicle Technology Explained - Wiley - 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co - 2007.
4. Pistooa G. - “Power Sources - Models - Sustanability - Infrstructure and the market” - Elsevier 2008
5. Mi Chris - Masrur A. - and Gao D.W. - “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 1995.

Online Learning Resources:

1. https://nptel.ac.in/courses/108106182
2. https://nptel.ac.in/courses/108102121

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4109	SWITCHED MODE POWER CONVERSION Professional Elective-V						

Course Objectives:

1. To illustrate CCM and DCM modes of operation of non-isolated switched mode converters.
2. To illustrate the working of isolated switched mode converters.
3. To analyze ZVS and ZCS operation of buck, boost converters.
4. To learn about the control schemes & design aspects of transformers, inductors and capacitors.
5. To model the converters and design controller for closed loop operation of switched mode converters.

Course Outcomes:

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

1. Design and analyse the operation of non-isolated switch mode converters.
2. Analyze the operation of isolated switch mode converters.
3. Illustrate the operation of resonant converters.
4. Analyse the control schemes of converters and design transformer and inductor.
5. Model the converters and design controller for closed loop operation.

UNIT – I

Non-Isolated Switch Mode Converters

Control of DC-DC converters: Buck converters - Boost converters - Buck-Boost converter - CUK Converter - continuous and discontinuous operation - Converter realization with nonideal components.

UNIT – II

Isolated Switched Mode Converters

Forwarded converter - flyback converter - push-pull converter - half-bridge converter – full bridge converter.

UNIT – III

Resonant Converters

Basic resonant circuit concepts - series resonant circuits - parallel resonant circuits – zero current switching quasi-resonant buck converter - zero current switching quasi-resonant boost converter - zero voltage switching quasi-resonant buck converter - zero voltage switching quasi-resonant boost converter.

UNIT – IV

Control Schemes of Converters and Magnetic Design

Voltage mode control - Current mode control - Current control mode instability. Magnetic Design: Transformer design - inductor and capacitor design.

UNIT – V

Modelling of Converters and Controller Design Based on Linearization:

Formulation of large signal models for buck and boost converters using state space analysis derivation of averaged large signal model using circuit averaging method-small signal model derivation- average switch modelling technique to obtain small signal models of buck and boost converters- Transfer function of converters- Controller design based on linearization.

Text Books:

1. Fundamentals of Power Electronics- Erickson - Robert W. - Maksimovic - Dragan - Springer - 2011.
2. Power switching converters- Simon Ang - Alejandro Oliva - CRC Press - 2010.
3. Power Electronics: Essentials & Applications- L. Umanand, S.P. Bhat, John Wiley & Sons . Australia, 1992

Reference Books:

1. Switching Power Supply Design- Abraham I. Pressman - McGraw-Hill Ryerson - Limited - 1991.
2. Power Electronics: converters Applications & Design – Mohan - Undeland - Robbins-Wiley publications.
3. Design of Magnetic Components for Switched Mode Power Converters- Z Umanand - S.P. Bhat - John Wiley & Sons Australia - 1992.
4. Elements of Power Electronics – Philip T. Krein - Oxford University press - 2014.

Online Learning Resources:

1. https://nptel.ac.in/courses/108108036
2. https://nptel.ac.in/courses/108105180

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4110	DESIGN OF PV SYSTEMS Professional Elective-V						

Course Objectives:

The objectives of this course are to:

1. Provide a comprehensive understanding of solar energy fundamentals and solar radiation parameters relevant to PV system design.
2. Introduce the working principles, types, and characteristics of photovoltaic (PV) cells and modules.
3. Familiarize students with various components of a PV system including inverters, batteries, and controllers.
4. Enable students to perform load analysis, sizing, and design of standalone and grid connected PV systems.
5. Impart knowledge on the installation, maintenance, performance evaluation, and safety practices of PV systems in accordance with national and international standards.

Course Outcomes:

On successful completion of this course, students will be able to:

1. Analyze solar radiation data and evaluate site conditions for PV applications.
2. Explain the operation and characteristics of various types of PV cells and modules.
3. Identify and select appropriate components for different PV system configurations.
4. Design and size standalone, hybrid, and grid-tied PV systems using analytical and simulation tools.
5. Apply standards and practices for the installation, testing, maintenance, and economic evaluation of PV systems.

UNIT 1: Solar Energy Basics:

Solar radiation – Extraterrestrial and terrestrial, Solar geometry – Declination, altitude angle, hour angle, air mass Radiation measurement and estimation, Effect of tilt angle on radiation, Overview of solar energy conversion technologies, Introduction to PV effect and materials used

UNIT 2: Solar Photovoltaic Cell Technologies

Types of solar cells: Crystalline silicon, thin-film, multi-junction, emerging technologies, Cell structure and working principle, I-V characteristics of solar cells – Effect of irradiance and temperature, Efficiency, fill factor, and performance parameters, Maximum Power Point Tracking (MPPT) – Algorithms and techniques

UNIT 3: PV Module and System Components

PV module characteristics and rating, Module interconnections – Series and parallel configurations, Balance of System (BoS): Batteries, charge controllers, inverters, protection devices PV system configurations: Standalone, grid-connected, hybrid Energy storage options
– Battery types and characteristics

UNIT 4: PV System Design

Load estimation and energy requirement analysis-Sizing of PV array, battery bank, and inverter-Shadow analysis and tilt optimization -Wiring, cabling, earthing, and protection design-Simulation tools (e.g., PVsyst, HOMER, SAM) – Basic introduction

UNIT 5: Installation, Operation & Maintenance

Installation guidelines and standards (e.g., MNRE, IEC codes)-Testing, Commissioning, and troubleshooting of PV systems Maintenance strategies and fault diagnostics-Performance evaluation and economic analysis (Payback period, LCOE)-Environmental and safety considerations

Text Books

1. Chetan Singh Solanki, 'Solar Photovoltaics: Fundamentals, Technologies and Applications', PHI Learning, 3rd Edition (or latest).
2. James P. Dunlop, 'Photovoltaic Systems', American Technical Publishers.

Reference Books

1. Mohanlal Kolhe, Pradip Bansal, T. K. Mallick, 'Design and Installation of Photovoltaic Systems', Springer.
2. John A. Duffie and William A. Beckman, 'Solar Engineering of Thermal Processes', Wiley.
3. B.H. Khan, 'Renewable Energy Systems', McGraw Hill Education.
4. S.P. Sukhatme and J.K. Nayak, 'Solar Energy: Principles of Thermal Collection and Storage', Tata McGraw Hill.

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R23EE4104	FLEXIBLE AC TRANSMISSION SYSTEMS Professional Elective-V						

COURSE OBJECTIVES:

1. To learn the basics of power flow control in transmission lines using FACTS controllers
2. To explain operation and control of voltage source converter.
3. To understand compensation methods to improve stability and reduce power oscillations of a power system.
4. To learn the method of shunt compensation using static VAR compensators.
5. To learn the methods of compensation using series compensators and Unified Power Flow Controller (UPFC).

COURSE OUTCOMES:

After completion of this course student will be able to

CO1: Analyze the power flow control in transmission lines using facts controllers. [K2]
CO2: Explain the operation and control of voltage and current source converter. [K2]
CO3: Analyze method of shunt compensation using static VAR compensators. [K4]
CO4: Evaluate different methods of compensations using series compensators. [K5]
CO5: Apply unified power flow controller (UPFC) on transmission systems. [K3]

UNIT-I

Introduction to FACTS: Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching.

UNIT-II

Voltage source and Current source converters: Concept of voltage source converter(VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter – Threephase current source converter – Comparison of current source converter with voltage source converter.

UNIT-III

Shunt Compensators–1: Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping.

UNIT-IV

Shunt Compensators–2: Thyristor Switched Capacitor (TSC) –Thyristor Controlled Reactor (TCR) – TSC–TCR. Static VAR compensator (SVC) and Static Compensator (STATCOM): The regulation and slope transfer function and dynamic performance – Transient stability enhancement and power oscillation damping – Operating point control and summary of compensation control.

UNIT-V

Series Compensators & Combined Controllers Static series compensators: Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) - Schematic and

basic operating principles of Unified Power Flow Controller (UPFC).

TEXT BOOKS:

1. "Understanding FACTS" N.G.Hingorani and L.Guygi, IEEE Press.Indian Edition is Available:—Standard Publications, 2001.

REFERENCE BOOKS:

1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.Mohan Mathur and Rajiv k.Varma, Wiley.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108107114
2. https://vemu.org/uploads/lecture_notes/03_01_2020_358499686.pdf
3. https://www.iare.ac.in/sites/default/files/IARE_FACTS_LN.pdf

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	4	30	70	100	2
Code: R23EE41L1	Power Systems Simulation Lab Skill Enhancement Course						

Course Objectives:

1. Understand the formation of Y-Bus and Z-Bus matrices for power system network modeling.
2. Apply various load flow analysis methods including Gauss-Seidel, Newton-Raphson, and Fast Decoupled techniques.
3. Analyze symmetrical and unsymmetrical faults using Z-Bus and sequence components.
4. Perform Economic Load Dispatch with and without considering transmission losses.
5. Study transient stability and load frequency control for single and multi-area power systems.

Course Outcomes:

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

1. Distinguish between different load flow methods.
2. Building and analyzing Y-bus & Z-bus algorithms.
3. Practice and analyze the symmetrical & unsymmetrical faults.
4. Recognize the importance of Load flow control and Economic load dispatch.
5. Recognize the importance of Economic load dispatch and transient stability analysis.

List of Experiments

Any 10 of the following experiments are to be conducted

1. Formation of Y- Bus by Direct-Inspection Method.
2. Load Flow Solution Using Gauss Siedel Method
3. Load Flow Solution Using Newton Raphson Method
4. Load Flow Solution Using Decoupled Method
5. Load Flow Solution Using Fast Decoupled Method
6. Formation of Z-Bus by Z-bus building algorithm
7. Symmetrical Fault analysis using Z-bus
8. Unsymmetrical Fault analysis using Z-bus
9. Economic Load Dispatch with & without transmission losses
10. Transient Stability Analysis Using Point By Point Method
11. Load Frequency Control of Single Area Control & Two Area Control system with and without controllers.

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	-
Code: R23CC41MC	CONSTITUTION OF INDIA Audit Course						

COURSE OBJECTIVES

1. To train students in understanding the basic structure of Indian Constitution
2. To aware the students about the role of constitution in a democratic society
3. To prepare students to live better and happily with other fellow beings through the application of Fundamental Rights in their lives.
4. To know about the powers of Union Government and State Government

COURSE OUTCOMES

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

CO 1: Examine salient features of Indian Constitution and live accordingly in society and interpret the meaning of Fundamental Rights of State Policy

CO 2: Discover various aspects of Union Government legislation and live up to the Expectations of the rules.

CO 3: Critically examine State Government legislation and improve your living standards by following the rules strictly

CO 4: Examine powers and functions of local bodies such as Municipalities and Panchayats and, take advantage of available resources for better living

CO 5: Analyze the powers and functions of Election Commission and The Union Public Service Commission and decide upon it for safe and secured life.

UNIT-I

INTRODUCTION TO INDIAN CONSTITUTION and FUNDAMENTAL RIGHTS: Meaning of the term Indian Constitution –Preamble- Constituent Assembly- Salient Features of Indian Constitution. Fundamental Rights - Fundamental Duties -The Directive Principles of State Policy.

UNIT-II

UNION GOVERNMENT: Union Government -Union Legislature (Parliament) -Lok Sabha and Rajya Sabha (with Powers and Functions) -Union Executive -President of India (with Powers and Functions) -Prime Minister of India (with Powers and Functions) -Union Judiciary (Supreme Court) -Jurisdiction of the Supreme Court

UNIT-III

STATE GOVERNMENT: State Government -State Legislature (Legislative Assembly / Vidhan Sabha, Legislative Council / Vidhan Parishad) -Powers and Functions of the State Legislature -State Executive-Governor of the State (with Powers and Functions) -The Chief Minister of the State (with Powers and Functions) - State Judiciary (High Courts)

UNIT-IV

LOCAL SELF GOVERNANCE: Powers and functions of Municipalities, Panchyats, ZP's and Co – Operative Societies

UNIT-V

SOVEREIGN BODIES: Election Commission of India (with Powers and Functions) -The Union Public Service Commission (with Powers and Functions)

TEXT BOOKS:

1. Introduction to constitution of India, Durga Das Basu, Lexis Nexis Publications
2. Constitution of India by PRFESSIONAL BOOK PUBLISHERS
3. The Constitution of India by Arun K Tiru vengadam, Blooms bury publishers.
4. The constitution of India by PM Bakshi, Universal law publishing co
5. The Constitution of India by S.R. Bhansali, Universal law publishing co

B.Tech. IV Year-II Semester

S.No.	Category	Title	L	T	P	C
1	PR	Internship and Project	**-**	**-**	**24**	**12**

OPEN ELECTIVES

S.No.	Category	Title	L	T	P	C
1	Open Elective-I (III-I)	1. Renewable Energy Sources 2. Concepts of Energy Auditing & Management 3. Linear Control Systems 4. Electrical Safety	3	0	0	3
2	Open Elective – II (III-II)	1. Fundamentals of Electric Vehicles 2. Electrical Wiring Estimation and Costing 3. Introduction to Smart Grid 4. Industrial Automation	3	0	0	3
3	Open Elective – III (IV-I)	1. Battery Management Systems and Charging Stations 2. Micro Electro Mechanical System 3. Soft Computing 4. Embedded control of electric drives	3	0	0	3
4	Open Elective – IV (IV-I)	1. Concepts of Power Quality 2. Non-Conventional Energy Resources 3. Fundamentals Of Utilization Of Electrical Energy 4. Indian Electricity Act	3	0	0	3

III Year – I Semester	OPEN ELECTIVE-I RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

Course Objectives:

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

Course Outcomes:

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

CO1: Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.

CO2: Illustrate the components of wind energy systems.

CO3: Illustrate the working of biomass, hydel plants and Geothermal plants.

CO4: Demonstrate the principle of Energy production from OTEC, Tidal and Waves.

CO5: Evaluate the concept and working of Fuel cells & MHD power generation.

UNIT–I

Solar Energy

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

UNIT–II

Wind Energy

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

UNIT–III

Biomass, Hydel and Geothermal Energy

Biomass: Introduction - Biomass conversion technologies- Photosynthesis. Factors affecting Bio digestion.

Hydro plants: Basic working principle – Classification of hydro systems**:** Large, small, micro hydel plants.

Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmental problems.

UNIT–IV

Energy From oceans, Waves & Tides:

Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India.

Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.

Tides: Basic principle of Tide Energy -Components of Tidal Energy.

UNIT–V

Chemical Energy Sources:

Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.

Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications

Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation - Types.

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell& Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

Reference Books:

1. S.P.Sukhatme&J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. ShobaNath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

Online Learning Resources:

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

III Year – I Semester	OPEN ELECTIVE-I CONCEPTS OF ENERGY AUDITING & MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

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

Course Outcomes:

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

CO1: Understand the principles of energy audit along with various Energy related terminologies.
CO2: Asses the role of Energy Manager and Energy Management program.
CO3: Design a energy efficient motors and good lighting system.
CO4: Analyse the methods to improve the power factor and identify the energy instruments for various real time applications.
CO5: Evaluate the computational techniques with regard to economic aspects.

UNIT–I

Basic Principles of Energy Audit

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

UNIT–II:

Energy Management

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

UNIT–III:

Energy Efficient Motors and Lighting

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

UNIT–IV

Power Factor Improvement and Energy Instruments

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

UNIT–V

Economic Aspects and their Computation

Economics Analysis depreciation Methods - time value of money - rate of return - present worth method - replacement analysis - lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method - net present value method- Power factor correction - lighting – Applications of life cycle costing analysis - return on investment.

Text Books:

1. Energy management by W.R.Murphy & G.Mckay Butter worth - Heinemann publications - 1982.
2. Energy management hand book by W.CTurner - John wiley and sons - 1982.

Reference Books:

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

Online Learning Resources:

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

III Year – I Semester	OPEN ELECTIVE-I MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the basics of Micro Electro Mechanical Systems (MEMS).
2. To know the principle and various devices of MOEMS
3. To learn about various sensors and actuators used in MEMS.
4. To understand the principle and various devices of Micro Fluidic systems.
5. To acquire the knowledge on concepts of bio and chemical systems and devices.

Course Outcomes:

After completion of this course, Students will be able to

1. **Understand** the basics of MEMS sensors and actuators. **(K2)**
2. **Know** the working principle of MOEMS. **(K2)**
3. **Use** various Magnetic Sensors and Actuators. **(K3)**
4. **Explain** the principle of Micro Fluidic systems. **(K2)**
5. **Illustrate** the Chemical and Bio Medical Micro Systems. **(K4)**

UNIT-I: Introduction & Thermal Sensors and Actuators

Definition of MEMS, MEMS history and development, micro machining, Principles of sensing and actuation: piezo electric, strain, pressure, flow, MEMS gyroscopes, Thermal energy basics and heat transfer processes, thermo devices, thermal flow sensors, micro hot plate gas sensors, micro spring thermal actuator, data storage cantilever.

UNIT-II: Micro-Opto-Electro Mechanical Systems

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT-III Magnetic Sensors and Actuators

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on Hall Effect, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, bidirectional micro actuator, and feedback circuit integrated magnetic actuator.

UNIT-IV: Micro Fluidic Systems

Applications, considerations on micro scale fluid, fluid actuation methods, electro wetting, electro thermal flow. Radio Frequency MEMS: RF - based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, MEMS switches, phase shifter.

UNIT-V: Chemical and Bio Medical Micro Systems

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors, chemo transistors, electronic nose(E-nose), mass sensitive chemo sensors, fluorescence detection, calorimetric.

Text Books:

1. MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

Reference Books:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Web Resources:

1. https://nptel.ac.in/courses/117105082
2. https://nptel.ac.in/courses/108108113

III Year – I Semester	OPEN ELECTIVE-I ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide a comprehensive exposure to electrical hazards, various grounding techniques and safety.
- To know various safety Procedures and safety Equipment.
- To know about Safety programme structure.
- To analyse various electrical maintenance techniques.

COURSE OUTCOMES:

After completion of this course student will be able to

CO 1: Describe electrical hazards and safety equipment. [**K3**]
CO 2: Analyse and apply various grounding and bonding techniques. [**K4**]
CO 3: Select appropriate safety method for low, medium and high voltage equipment. [**K3**]
CO 4: Develop different types of safety programme structures. [**K3**]
CO 5: Analyse the maintenance of electrical equipment by using various safety & health Standards. [**K4**]

UNIT-I: Hazards of Electricity and Safety Equipment

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician's safety kit.

UNIT-II: Grounding and Bonding of Electrical Systems and Equipment

General requirements for grounding and bonding- definitions- grounding of electrical equipment bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

UNIT-III: Safety Procedures and Methods

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems- the one minute safety audit.

UNIT-IV: Safety Management and Organizational Structure

Electrical safety programme structure, development- company safety team- safety policy programme implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation.

UNIT-V: Electrical Maintenance and its Relationship to Safety

Safety related case for electrical maintenance- reliability centered maintenance (RCM) - eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code- standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

TEXT BOOKS:

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, 'Electrical Safety Handbook',McGraw-Hill Education, 4thEdition, 2012.

REFERENCE BOOKS:

1. Maxwell Adams.J, 'Electrical Safety- a guide to the causes and prevention of electric hazards', TheInstitution of Electric Engineers, IET 1994.
2. Ray A. Jones, Jane G. Jones, 'Electrical Safety in the Workplace', Jones & Bartlett Learning, 2000.

WEB REFERENCES:

1. https://www.labtrain.noaa.gov/osha600/refer/menu12a.pdf.
2. https://nptel.ac.in/courses/108107167.
3. https://onlinecourses.swayam2.ac.in/nou20_cs08/preview.

III Year – II SEMESTER	OPEN ELECTIVE-II FUNDAMENTALS OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:

- To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
- To understand various power converters used in electric vehicles.
- To be familiar all the different types of motors suitable for electric vehicles.
- To know various architecture of hybrid electric vehicles.
- To have knowledge on latest developments in batteries and other storage systems.

Course Outcomes:

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

CO1: Illustrate the use and advantages of different types of electric vehicles.
CO2: Use suitable power converters for EV application.
CO3: Select suitable electric motor for EV power train.
CO4: Design HEV configuration for a specific application.
CO5: Analyse various storage systems and battery management system for EVs.

UNIT – I

Introduction

Fundamentals of vehicles – Vehicle model – Calculation road load and tractive force – Components of conventional vehicles – Drawbacks of conventional vehicles – Need for electric vehicles– Advantages and applications of Electric Vehicles – History of Electric Vehicles – EV Market in India and outside India –Types of Electric Vehicles.

UNIT – II

Components of Electric Vehicles

Main components of Electric Vehicles – Electric Traction MotorandController –Power Converters – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.

UNIT – III

Motors for Electric Vehicles

Characteristics of traction drive – requirements of electric machines for EVs – Comparison of Different motors for Electric and Hybrid Vehicles – Induction Motors – Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only).

UNIT – IV

Hybrid Electric Vehicles

Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs – Series and Parallel HEVs – Complex HEVs – Range extended HEVs – Examples – Merits and Demerits.

UNIT – V

Energy Sources for Electric Vehicles

Batteries– Types of Batteries – Lithium-ion – Nickel-metal hydride – Lead-acid – Comparison of Batteries – Battery Charging – Fast Charging –Battery Management System – Ultra capacitors – Flywheels – Compressed air energy storage (CAES)– Fuel Cell – it's working.

Text Books

1. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.
2. Tom Denton, Hayley Pells - Electric and hybrid vehicles, Third Edition, 2024

Reference Books:

1. Kumar - L. Ashok - and S. Albert Alexander. Power Converters for Electric Vehicles. CRC Press - 2020.
2. Chau - Kwok Tong. Electric vehicle machines and drives: design - analysis and application. John Wiley & Sons - 2015.
3. Berg - Helena. Batteries for electric vehicles: materials and electrochemistry. Cambridge university press - 2015.

Online Learning Resources:

1. MOOC at https://www.edx.org/learn/electric-cars
2. https://archive.nptel.ac.in/courses/108/106/108106170

III Year – II SEMESTER	OPEN ELECTIVE-II ELECTRICAL WIRING ESTIMATION AND COSTING	L	T	P	C
		3	0	0	3

Course Objectives:

- Introduce the electrical symbols and simple electrical circuits
- Able to learn the design of electrical installations.
- Able to learn the design of electrical installation for different types of buildings and small industries.
- Learn the basic components of electrical substations.
- Familiarize with the motor control circuits

Course Outcomes:

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

CO1: Demonstrate the various electrical apparatus and their interconnections.
CO2: Examine various components of electrical installations.
CO3: Estimate the cost for installation of wiring for different types of building and small industries.
CO4: Illustrate the components of electrical substations.
CO5: Design suitable control circuit for starting of three phase induction motor and synchronous motor.

UNIT - I

Electrical Symbols and Simple Electrical Circuits

Identification of electrical symbols - Electrical wiring Diagrams - Methods of representation of wiring diagrams - introduction to simple light and fan circuits - system of connection of appliances and accessories.

UNIT - II

Design Considerations of Electrical Installations

Electric supply system - Three-phase four wire distribution system - protection of electric installation against overload - short circuit and earth fault - earthing - neutral and earth wire - types of loads - systems of wiring - permissible of voltage drops and sizes of wires - estimating and costing of electrical installations.

UNIT - III

Electrical Installation for Different Types of Buildings and Small Industries

Electrical installations for electrical buildings - estimating and costing of material - simple examples on electrical installation for residential buildings - electrical installations for commercial buildings - electrical installation for small industries-case study.

UNIT - IV

Substations

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

UNIT - V

Motor control circuits

Introduction to AC motors - starting of three phase squirrel cage induction motors - starting of wound rotor motors - starting of synchronous motors - contractor control circuit components - basic control circuits - motor protection – Schematic and wiring diagrams for motor control circuits.

Text Books:

1. Electrical Design and Estimation Costing - K. B. Raina and S.K.Bhattacharya – New Age International Publishers - 2007.

References Books:

1. Electrical wiring estimating and costing – S.L.Uppal and G.C.Garg – Khanna publishers - 6th edition - 1987.
2. A course in electrical installation estimating and costing – J.B.Gupta –Kataria SK & Sons - 2013.

Online Learning Resources:

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

III Year – II SEMESTER	OPEN ELECTIVE-II INTRODUCTION TO SMART GRID	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is

1. To explain the concept of smart grid and developments on smart grid.
2. To Impart Knowledge in Smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
3. To inculcate the security in smart substations, feeder automation and application for monitoring and protection.
4. To gain the knowledge on micro grids and distributed energy systems.
5. To know power quality aspects in smart grid.

Course Outcomes:

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

1. **Understand** smart grids and analyse the smart grid policies and developments in smart grids. **[K2]**
2. **Develop** concepts of smart grid technologies in hybrid electrical vehicles etc**.[K4]**
3. **Illustrate** the different types of smart substations and feeder automation**.[K4]**
4. **Analyse** micro grids and distributed generation systems.**[K4]**
5. **Analyse** the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.**[K4]**

Unit-I: Introduction to Smart Grid

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

Unit-II: Smart Grid Technologies: Part 1

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR),Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV),Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

Unit-III: Smart Grid Technologies: Part 2

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

Unit-IV: Micro grids and Distributed Energy Resources

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of Inter connection, protection & control of microgrid. Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources.

Unit-V:Power Quality Management in Smart Grid

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press

Reference Books:

1. The Smart Grid – Enabling Energy efficiency and demand response, Clark W. Gellings, P.E., CRC Press, Taylor & Francis group, First Indian Reprint. 2015.
2. Smart Grid – Applications, Communications, and Security Edited by Lars Torsten Berger, Krzysztof Iniewski, WILEY, 2012, Reprint 2015.
3. Practical Electrical Network Automation and Communication Systems, Cobus Strauss, ELSVIER, 2003.

Web Reference:

1. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_eee/Notes/CE3/BEE019%20smart%20grid.pdf
2. https://ctijabalpur.com/Download/Study-Material/Smart%20Grid%20Notes.pdf

https://onlinecourses.nptel.ac.in/noc21_ee68/preview

III Year – II SEMESTER	OPEN ELECTIVE-II INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

Course Objectives:
The objectives of this course is to acquire knowledge on
1. The basic concepts of programmable logic controllers and its applications.
2. Familiarize the students in programming formats and construction of PLC ladder diagrams.
3. The various PLC registers.
4. PLC functions, Data handling functions and controlling of two axes and three axes Robots with PLC.
5. Study the Analog PLC operation and different examples.

Course Outcomes:
After completion of this course, Students will be able to
1. **Illustrate** the basics of PLC & its Programming. [K2]
2. **Analyze** the Characteristics of Registers, module addressing and its importance in Ladder diagram. [K4]
3. **Develop** PLC programs using various functions of PLCs for various Industrial applications of PLC [K4]
4. **Distinguish** between various data handling functions. [K4]
5. **Differentiate** the Analog modules and systems, Analog signal processing, multi bit data processing. [K2, K4]

UNIT-I: Basics of PLC & PLC Programming
PLC system - I/O modules and interfacing – CPU processor - Programming equipment - Programming formats - construction of PLC ladder diagrams -Devices connected to I/O modules - Input instructions – Outputs - Operational procedures - Programming examples using contacts and coils - Ladder diagrams for process control: Ladder diagrams - ladder diagram construction and flow chart for spray process system.

UNIT-II: PLC Registers
Characteristics of Registers - module addressing -Holding registers - Input registers - Output registers.

UNIT-III: PLC Functions
PLC Functions: Timer functions and Industrial applications – Counters - Counter function industrial applications - Arithmetic functions - Number comparison functions -Number conversion functions.

UNIT-IV: Data Handling Functions
Data handling functions: SKIP - Master control Relay - Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register - Sequence functions and applications - Controlling of two axes and three axis Robots with PLC - Matrix function.

UNIT-V: Analogue PLC Operation
Analog modules and systems - Analog signal processing, multi bit data processing - Analog output application examples - PID principles - Position indicator with PID control - PID modules - PID tuning - PID functions.

Text Books:
1. Programmable Logic Controllers – Principle and Applications by John W. Webb and

Ronald A. Reiss, Fifth Edition, PHI.
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

Reference Books:

1. Programmable Logic Controllers Hardware and Programming by Max Rabiee Goodheart-Wilcox.
2. Programmable Logic Controllers by Frank D. Petuzeela McGraw-Hill.
3. Industrial Automation and Process control by Jon Stenerson Prentice-Hall.

Web Reference:

1. http://users.isr.ist.utl.pt/~jag/courses/api13/docs/API_I_C2.pdf
2. https://nptel.ac.in/courses/108105063
3. https://nptel.ac.in/courses/108105088

IV Year – I SEMESTER	OPEN ELECTIVE-III BATTERY MANAGEMENT SYSTEMS AND CHARGING STATIONS	L	T	P	C
		3	0	0	3

Course objectives:

- To understand the fundamentals of batteries, configurations, and charging processes.
- To learn the functional requirements and architecture of a Battery Management System (DBMS).
- To explore methods for estimating battery state of charge and health, along with balancing techniques.
- To study modeling approaches for simulating batteries and electric vehicle performance.
- To Analyze design considerations for practical implementation of BMS in multi-battery systems.
- To understand the charging infrastructure and its various types

Course Outcomes:

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

- Describe the construction and operation of different batteries for EV applications
- Describe charging algorithms of different batteries and balancing methods of battery packs
- Describe the different kinds of infrastructure needed in the charging stations
- Describe the requirements of battery management and their maintenance. Obtain the modelling of batteries and develop their simulation models.
- Develop various charging types and their usage for different applications

Unit - I:

Introduction

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cells, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

Unit - II:

Battery Management System Requirement

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power.

Unit -III:

Battery State of Charge and State of Health Estimation, Cell Balancing

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Modelbased state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing.

Unit - IV:

Modelling and Simulation

Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, simulating an electric vehicle, Vehicle range calculations, simulating constant power and voltage, Simulating battery packs. Battery-Management-System Requirements

Unit - V:

Charging Infrastructure

Domestic Charging Infrastructure, Public charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-andcharge zone

Text Books:

1. Plett, Gregory L. Battery management systems, Volume I: Battery modeling. Artech House, 2015.
2. Plett, Gregory L. Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.

Reference Books:

1. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems - Design by Modelling" Philips Research Book Series 2002.
2. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010
3. Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery-powered applications. Vol. 9. Springer Science & Business Media, 2008.

Online Learning Resources:

1. https://nptel.ac.in/courses/108106170
2. http://www.digimat.in/nptel/courses/video/108106170/L65.html

IV Year – I SEMESTER	OPEN ELECTIVE-III MICRO ELECTRO MECHANICAL SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge of Micro Electro Mechanical Systems (MEMS).
2. To impart various sensors and actuators used in MEMS.
3. To educate the principle and various devices of MOEMS, Fluidic.
4. To educate the concepts of bio and chemical systems and devices.

Course Outcomes:

After completion of this course, Students will be able to

1. Apply thermal sensors and actuators for MEMS fabrication process.
2. Model various devices of MOEMS, Micro Fluidic systems.
3. Utilize the magnetic sensors and actuators in interdisciplinary studies
4. Explain the micro fluidic systems process.
5. Interpret the various sensor mechanism in chemical and bio-medical system.

UNIT-I: Introduction & Thermal Sensors and Actuators

Definition of MEMS, MEMS history and development, micro machining, Principles of sensing and actuation: piezo electric, strain, pressure, flow, MEMS gyroscopes, Thermal energy basics and heat transfer processes, thermo devices, thermal flow sensors, micro hot plate gas sensors, micro spring thermal actuator, data storage cantilever.

UNIT-II: Micro-Opto-Electro Mechanical Systems

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT-III Magnetic Sensors and Actuators

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on Hall Effect, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, bidirectional micro actuator, and feedback circuit integrated magnetic actuator.

UNIT-IV: Micro Fluidic Systems

Applications, considerations on micro scale fluid, fluid actuation methods, electro wetting, electro thermal flow. Radio Frequency MEMS: RF - based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, MEMS switches, phase shifter.

UNIT-V: Chemical and Bio Medical Micro Systems

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors, chemo transistors, electronic nose (E-nose), mass sensitive chemo sensors, fluorescence detection, calorimetric.

Text Books:

1. MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

Reference Books:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Web References:

1. https://en.wikipedia.org/wiki/Microelectromechanical_systems
2. https://www.mems-exchange.org/MEMS/what-is.html

IV Year – I SEMESTER	OPEN ELECTIVE-III SOFT COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:
1. To study various methods of AI, models and architecture of artificial neural networks.
2. To study the ANN paradigms.
3. To study the fuzzy sets operations and the fuzzy logic systems.
4. To study the applications of AI.

Course Outcomes:
After completion of this course student will be able to
1. Demonstrate basic models of artificial neural network.
2. Analyze and Design an back propagation networks and algorithm.
3. Apply fuzzy Rules in fuzzy logic controllers.
4. Design and Analyze the Genetic algorithms and evolutionary computation, Applications of Genetic Algorithms.
5. Explain the applications of soft computing techniques in Electrical Engineering.

UNIT–I: Artificial Intelligent Systems
Artificial Intelligent systems – Neural Networks, Fuzzy Logic - Artificial Neural Networks – Biological neural networks – Model of an artificial neuron - Comparison between biological neuron and artificial neuron – Basic models of artificial neural network – Learning methods – Activation function and Terminologies of ANN - Mc Culloch Pitts Neuron – Perceptron Networks.

UNIT–II: Back Propagation Networks
Back propagation Networks : Architecture - Multi layer perceptron – Back propagation Learning – Input layer - Hidden Layer - Output Layer computations - Calculation of error - Training of ANN - Back propagation Algorithm - Selection of various parameters in BP networks.

UNIT–III: Classical and Fuzzy Sets
Fuzzy verses crisp sets – Crisp sets – Operations and properties of crisp sets - Partition and covering - Fuzzy sets - Membership function – Operation and properties of fuzzy sets - Crisp relations - Fuzzy Logic System Components - Fuzzy rule base system – Defuzzification - Types of Defuzzification - Fuzzy logic controller - Components of FLC.

UNIT–IV: Genetic Algorithms
Genetic Algorithms - Basic Concepts - Creation of off – springs - Working Principle – Encoding - Fitness function - Reproduction- Roulette - Wheel Selection, Boltzmann Selection - Tournament selection - Rank Selection - Cross Over - Inversion and deletion - Mutation Operator - Bitwise operators.

UNIT–V: Applications to Electrical Engineering
Speed control of D.C and A.C motors - Reactive Power Control - Load Frequency Control - Economic load dispatch - load flow studies - Load forecasting.

Text books:
1. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley India Pvt.Ltd. [Module I& III].
2. R.Rajasekharan and G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms- Synthesis and Applications, Prentice Hall of India. [Module II, & IV].

Reference books:

1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
2. S. Haykins, Neural Networks – A Comprehensive Foundation, Prentice Hall 2002.
3. L. Fausett, Fundamentals of Neural Networks, Prentice Hall 1994.
4. T.Ross, Fuzzy Logic with Engineering Applications, Tata McGraw-Hill, New Delhi 1995.
5. D.E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Addison Wesley MA, 1989.
6. John Yen, Reza Lengari, Fuzzy Logic- Intelligence, Control and Information, Pearson Education.

IV Year – I SEMESTER	OPEN ELECTIVE-III EMBEDDED CONTROL OF ELECTRIC DRIVES	L	T	P	C
		3	0	0	3

Course Objectives:
1. To understand the basic of MC68HC11 microcontroller.
2. To know the basic of various peripherals connected to MC68HC11.
3. To study the basic of PIC16C7X microcontroller.
4. To study the basic of various peripherals connected to PIC16C7X.
5. To know basic of designing a microcontroller based system.

Course Outcomes:
After completion of this course student will be able to
1. Illustrate the architecture, instruction set, various peripherals of MC68HC11.
2. Analyse MC68HC11 for simple arithmetic operation and comparing.
3. Develop the architecture, instruction set, various peripherals of PIC16C7X.
4. Model PIC16C7X for simple arithmetic operation.
5. Design a microcontroller based system.

UNIT–I: MC68HC11 Microcontroller Architecture memory organization - addressing modes - instruction set - programming techniques - simple programs

UNIT–II: Peripherals of MC68HC11 I/O ports - handshaking techniques - reset and interrupts - serial communication interface - serial peripheral interface - programmable timer - analog / digital interfacing - cache memory.

UNIT–III: PIC 16C7X Microcontroller Architecture - memory organization - addressing modes - instruction set - programming techniques - simple operation.

UNIT–IV: Peripheral of PIC 16C7X Microcontroller Timers - interrupts - I/O ports - I2C bus for peripheral chip access - A/D converter – UART.

UNIT–V: System Design Using Microcontrollers Interfacing LCD display - Keypad interfacing - AC load control - PID control of DC motor - stepper motor control - brush less DC motor control.

Text books:
1. John B.Peatman, 'Design with PIC Microcontrollers, ‘Pearson Education, Asia 2004.

Reference books:
1. Michael Khevi, 'The M68HC11 Microcontroller Applications in control, Instrumentation and communication', Prentice Hall, New Jersey, 1997.

IV Year – I SEMESTER	OPEN ELECTIVE-IV CONCEPTS OF POWER QUALITY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn different types of power quality phenomena.
2. To identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
3. To describe power quality terms and know the power quality standards.
4. To learn the principle of voltage regulation and power factor improvement methods.
5. To explain the relationship between distributed generation and power quality.
6. To understand the power quality monitoring concepts and the usage of measuring instruments.

Course Outcomes:

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

1. Differentiate between different types of power quality problems.
2. Explain the sources of voltage sag - voltage swell - interruptions - transients – long duration over voltages and harmonics in a power system.
3. Explain the principle of voltage regulation and improvement methods.
4. Analyse voltage distortion and current distortion and their indices.
5. Know the concepts of distributed generation technologies and power quality monitoring.

UNIT – I

Introduction - Terms & Definitions

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations – Voltage Sags – Voltage Swell.

UNIT - II

Transient Over Voltages

Sources of Transient Over voltages - Principles of Over voltage protection- Devices for Over voltage protection – Utility Capacitor Switching Transients - Utility System Lightning Protection – Managing Ferro resonance – Switching Transient Problems with Loads.

UNIT - III

Long – Duration Voltage Variations

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker.

UNIT - IV

Harmonic distortion and solutions

Voltage distortion vs. Current distortion –Harmonic indices: THD - TDD and True Power Factor– Sources of harmonics – Effect of harmonic distortion – Impact on capacitors - transformers – motors and meters – Concept of Point of common coupling – Passive and active filtering – Numerical problems.

UNIT - V

Distributed Generation and Monitoring

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks. Monitoring Power

quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data.

Textbooks:

1. Electrical Power Systems Quality - Dugan R C - McGranaghan M F - Santoso S - andBeaty H W - Second Edition - McGraw–Hill - 2012 - 3rd edition.
2. Electric power quality problems –M.H.J.Bollen IEEE series-Wiley india publications - 2011.
3. Power Quality Primer - Kennedy B W - First Edition - McGraw–Hill - 2000.

Reference Books:

1. Understanding Power Quality Problems: Voltage Sags and Interruptions - Bollen M HJ - First Edition - IEEE Press; 2000.
2. Power System Harmonics - Arrillaga J and Watson N R - Second Edition - John Wiley & Sons - 2003.
3. Electric Power Quality control Techniques - W. E. Kazibwe and M. H. Sendaula – Van Nostrad Reinhold - New York.
4. Power Quality c.shankaran - CRC Press - 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa–CRC Press (Taylor & Francis)
6. Power Quality in Power systems and Electrical Machines–EwaldF.fuchs – Mohammad A.S.Masoum–Elsevier.

Online Learning Resources:

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

IV Year – I SEMESTER	OPEN ELECTIVE-IV NON-CONVENTIONAL ENERGY RESOURCES	L	T	P	C
		3	0	0	3

Course Objectives:

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

Course Outcomes:

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

CO1: Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.

CO2: Illustrate the components of wind energy systems.

CO3: Illustrate the working of biomass, Geothermal plants and Thermal electric power.

CO4: Demonstrate the principle of Energy production from OTEC, Tidal and Waves.

CO5: Evaluate the concept and working of Fuel cells & MHD power generation.

UNIT–I

Solar Energy

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

UNIT–II

Wind Energy

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

UNIT–III

Biomass, Hydel and Geothermal Energy

Biomass: Introduction - Biomass conversion technologies- Photosynthesis. Factors affecting Bio digestion.

Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmental problems.

Thermal Electric Power: Thermo electric power generation- See-beck, Peltier, Thomson effects- Thermo electric power generation- Thermo electric materials- Selection of materials.

UNIT–IV

Energy From oceans, Waves & Tides:

Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India.

Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.

Tides: Basic principle of Tide Energy -Components of Tidal Energy.

UNIT–V

Chemical Energy Sources:

Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.

Magneto Hydro Dynamic (MHD) Power generation: Principle of MHD power generation- MHD Systems- Open cycle and closed cycle, Systems- Advantages of MHD Systems- International Status of MHD power generation and its future prospects.

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell& Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

Reference Books:

1. S.P.Sukhatme&J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. ShobaNath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

Online Learning Resources:

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

IV Year – I SEMESTER	OPEN ELECTIVE-IV FUNDAMENTALS OF UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To study the various types of Illumination equipment, measurement of Illumination, Illumination techniques.
2. To know the various technologies used for heating applications using electrical energy.
3. To understand the various welding techniques and operations of welding equipment and comparison.
4. To know the various systems of traction, equipment used for traction.
5. To understand the importance and operation of various Energy storage systems and comparison & applications.

Course Outcomes:

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

1. Know the concepts of illumination and various illumination methods.
2. Know about the resistance - induction and dielectric heating.
3. Learn about the resistance and arc welding and welding equipment
4. Know about the mechanisms - equipment and technology used in the electric traction.
5. Differentiate the importance of various energy storage systems

UNIT - I Illumination fundamentals Introduction - terms used in illumination–Laws of illumination–Lux meter–Sources of light. Various Illumination Methods Tungsten filament lamps and fluorescent lamps - Comparison –Basic principles of light control– Types and design of lighting and flood lighting–LED lighting - Energy conservation.

UNIT - II Electric Heating Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

UNIT - III Electric Welding Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

UNIT - IV Electric Traction System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves. Calculations of tractive effort– power Specific energy consumption for given run–Effect of varying acceleration and braking retardationAdhesive weight and braking retardation adhesive weight and coefficient of adhesion.

UNIT - V Introduction to Energy Storage Systems Need for energy storage - Types of energy storage-Thermal - electrical - magnetic and chemical storage systems - Comparison of energy storage technologies-Applications.

Text Books:

1. Electrical Power Systems(Generation, Transmission, Distribution, Protecection and Utilization of Electrical Energy) – Dr. S.L.Uppal and Prof. Sunil S.Rao – Khanna Publisher, 15th edition, 1987.
2. Electric Power Distribution – A S Pabla – McGrawHill.

Reference Books:

1. Generation Distribution and Utilization of Electrical Energy – C.L.Wadhwa- New Age International Publishers- revised third edition.

IV Year – I SEMESTER	OPEN ELECTIVE-IV INDIAN ELECTRICITY ACT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To acquire knowledge on national policy, plan and joint responsibilities of state and central governments.
2. To understand the licensing procedures in transmission and distribution companies.
3. To learn the regulatory body rules and protocols.
4. To understand the offences and penalties related issues with respect to different tribunals.
5. To learn the legal related issues and their resolutions.

Course Outcomes:

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

1. Learn the national policy and plan and the joint responsibilities of state and central governments.
2. Analyze the licensing and the provisions related to transmission and distribution of electricity.
3. Remember the composition and powers of Regulatory commissions and CEA.
4. Learn the functions of Appellate Tribunal for electricity.
5. Know the constitution procedure and provisions in Special courts and dispute resolutions.

UNIT – I National Electricity Policy and Plan - Generation of Electricity Electricity Act: commencement - definitions - comments; national policy on standalone systems - nonconventional energy systems - electrification and local distribution for rural areas; joint responsibilities of state and central governments in rural electrification - requirement for setting up of generating station - hydro-electric generation - captive generation; duties of generating companies.

UNIT – II Licensing -Transmission and Distribution Of Electricity Licensing: powers - procedures - conditions - amendments - revocation - provisions - directions - suspension and sale; inter-state and intra-state transmission; other provisions relating to transmission; provisions with respect to distribution licenses - electricity traders - supply generally; consumer protection: standard performance. Electrical Wiring, Estimation & Costing

UNIT – III Tariff - CEA and Regulatory Commissions Works of licenses - provisions relating to overhead lines; Constitution and functions of Central Electricity Authority (CEA) - directions and certain powers; Constitution - powers and functions of state and central commissions - other provisions - proceedings and powers of Appropriate commission - Grants - Fund - Accounts Audit and Report.

UNIT – IV Appellate Tribunal - Reorganisation of Boards - Offences and Penalty Appellate Tribunal for electricity; investigation and assessment; reorganisation of boards; Offences and penalties.

UNIT – V Special Courts - Dispute Resolution - Other Provisions and Miscellaneous Constitution of special courts - procedures - powers - appeal - revision; arbitration; protective clauses; miscellaneous and enactments.

Text Books:

1. The Electricity Act - 2003 {Act 36 of 2003 - dt.2-6-2003 - w.e.f. 10-6-2003 vide S.O. No. 669(E) - dt. 10-6-2003] published by Commercial Law Publishers (I) Pvt. Ltd.