PRASAD V POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)

ACADEMIC RULES &REGULATIONS (PVP20)
and
B.Tech Course Structure, Syllabus

Applicable for the batch of students admitted from the Academic Year 2020-2021

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)
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w.e.f. A.Y 2020 – 2021

PREFACE

PVP Siddhartha Institute of technology, established in 1998, is one of the seventeen educational institutions sponsored and run by Siddhartha Academy of General & Technical Education. The 250 members of the Academy are a group of industrialists, educationists, auditors and philanthropists with vast experience in their respective fields and above all with an ardent desire to spread quality Education. All the academic organizations of Siddhartha Academy stand symbolic of the pragmatic vision of its founders. PVP Siddhartha Institute of Technology has the advantage of inheriting the higher academic standards. The college is approved by AICTE and is permanently affiliated to JNTUK. It is certified by ISO 9001-2015 for its quality standard. All the UG Programs are accredited by the National Board of Accreditation and NAAC with A^{+} grade. It is an Autonomous institute.

The curriculum is revised continuously to address the challenges of industry and academia and to foster the global competencies among the students. The curriculum is revised thrice since 2012. The present curriculum(PVP20) is designed incorporating the features such as outcome based approach, encouraging self-learning through MOOCs platforms i.e., Swayam, COURSERA, EDX, NPTEL, etc., Transformation of creative ideas into a prototype through Internship & Project, enhancing depth & breadth by introducing more number of programs, open electives in core and multi-disciplinary areas, offering courses by industry experts to improve Industry Institute Interaction in addition to internships at industry and introduction of wide range of value added courses beyond curriculum to choose according to their interest to enhance their employability skills.

Institute Vision

To provide rich ambience for Academic and Professional Excellence, Research, Employability skills, Entrepreneurship and Social responsibility.

Institute Mission

To empower the students with Technical knowledge, Awareness of up-to-date technical trends, Inclination for research in the areas of human needs, Capacity building for Employment / Entrepreneurship, Application of technology for societal needs.

Quality Policy

At PVPSIT, We commit ourselves to offer Quality professional education in engineering & Management by adhering to applicable statutory and regulatory requirements and through continuous improvement in the Quality of our services by,

- Regular up gradation of knowledge and skills of faculty
- Improving the teaching methods and strategies
- Providing state of art infrastructure
- Recruiting competent faculty and maintaining prescribed Teacher Student ratio
- Improving the employability of students
- Enhanced Collaboration with industry and institutions of National Repute

DEPARTMENT VISION

To mould young and fresh minds into well-disciplined and competent engineers to excel in the field of Electrical & Electronics Engineering to cater the industrial/ societal needs and compete at global level.

DEPARTMENT MISSION

- To produce competent and quality technical professionals with strong basics of electrical engineering principles and techniques.
- To facilitate the students to work with modern tools, state of art technologies, innovative research capabilities besides inculcating leadership abilities and ethical values.

Program Outcomes

- **PO-1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO-2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO-3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO- 4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO-5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO-6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO-7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO-8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- **PO-9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **PO-10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO-11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- **PO-12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Objectives

PSO1: Apply the allied engineering knowledge, technical skills to analyse and solve the challenges in electrical and electronics engineering.

PSO2: Demonstrate the technical competence in development of innovative and environmental conscious technologies for industry and societal needs.

Program Educational Objectives

PEO I : Have a strong foundation in engineering fundamentals, mathematics, basic sciences, humanities and modern software tools with ability to apply them to conceive, analyze, design and implement solutions to problems in electrical engineering field.

PEO II: Have a broad based background to practice electrical engineering in the areas of control systems, machines, measurements, power systems, power electronics and their applications in industry and government sectors meeting the growing expectations of stake holders.

PEO III: Have requisite skills to excel in a multidisciplinary engineering environment with awareness of contemporary issues, professional responsibility, impact of technology on society, and the need for life-long learning.

PEO IV: Have an ability to pursue higher studies to meet the needs of global standards and participate in team oriented, open ended activities both as team members and as leaders with professional communication skills to compete in global scenario.

CONTENTS

Engineering UG Programmes

Introduction

The redesigned curriculum focused on up skilling the graduates on the skills relevant to the need and demands of the industry. The curriculum mandates students to take up five skill courses which are relevant to the industry from second year onwards, two basic level skill courses, one on soft skills and other two on advanced level skill courses. The students are also given the option of choosing between skill courses offered by the Institute and a certificate course offered by industry, a professional body, APSSDC or any other accredited body.

Another major change brought in the curriculum is the introduction of B.Tech. with Honors or a B.Tech with a Minor. This is to give an opportunity for the fast learners to earn additional credits either in the same domain or in a related domain, making them more proficient in their chosen field of discipline or be a graduate with multidisciplinary knowledge and job ready skills.

Mandatory Internship, both industry and social, is included in the revised curriculum that aims at making engineering graduates connect with the needs of the industry and society at large. It will be mandatory for the students to intern in the industry/field for four to six weeks during the summer vacation and also in the final semester to acquire the skills required for job.

The redesigned curriculum offers academic flexibility by introducing a pool of inter-disciplinary and job-oriented skill courses which are integrated in to the curriculum of each branch of engineering, from which a student can pick his choice. Flexibility is not only given to students in the choices of courses, but flexibility is given in choosing courses either from the pool of courses offered by the concerned department or in choosing the courses offered by APSSDC or by any other reputed organization/professional body which offers with certification, as decided by respective BoS. Hence, the students are given wide choice and flexibility to undertake courses, while at the same time offering relevance to the interest of individual student in their own context. The curriculum also gives flexibility to the institution in offering a variety of courses to the students of a particular discipline. The Board of Studies is empowered to identify as many tracks and pools as possible in emerging technologies and industrial relevance, and also in humanities and sciences.

1. SHORT TITLE AND COMMENCEMENT

a. The regulations listed under this head are common for all degree level undergraduate programmes (B.Tech.), offered by the college with effect from the academic year 2020-21 and they are called as “PVP20” regulations.

b. The regulations here under are subjected to amendments as may be made by the Academic Council of the college from time to time, keeping in view of the recommendations of the Board of Studies. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the programme, as may be decided by the Academic Council.

2. DEFINITIONS

a. “**Commission**” means University Grants Commission(UGC);

b. “**Council**” means All India Council for Technical Education(AICTE);

c. “**University**” means Jawaharlal Nehru Technological University Kakinada(JNTUK);

d. “**College**” means Prasad V Potluri Siddhartha Institute of Technology, Vijayawada;

e. An **Academic Programme** means any combination of courses and/or requirements leading to award of a degree.

f. “**Course**” means a subject either theory or practical identified by its course title and code number and which is normally studied in a semester.

g. “**Degree**” means an academic degree conferred by the university upon those who complete the under graduate curriculum.

h. “**MOOC**” means Massive Open Online Course

i. “**Regular Students**” means students enrolled into the four year programme in the first year.

j. “**Lateral Entry Students**” means students enrolled into the four year programme in the second year.

3. ACADEMIC PROGRAMMES

3.1 Nomenclature of Programmes

3.1.1 The nomenclature and its abbreviation given below, shall continue to be used for the Degree programmes under the University, as required by the Council and the Commission:

Bachelor of Technology (B. Tech)

Besides, the name of specialization shall be indicated in brackets after the abbreviation, for example, engineering degree in Mechanical

Engineering programme is abbreviated as B.Tech (Mechanical Engineering).

3.1.2 Bachelor of Technology (B. Tech.) degree programme is offered in:

1. Civil Engineering(CE)
2. Computer Science and Engineering(CSE)
3. Computer Science and Engineering(AI & ML)
4. Computer Science and Engineering(Data Science)
5. Electronics and Communication Engineering(ECE)
6. Electrical and Electronics Engineering(EEE)
7. Information Technology(IT)
8. Mechanical Engineering(ME)

4. DURATION OF THE PROGRAMMES

4.1 Normal Duration

4.1.1. The duration of an academic programme shall be four years consisting of eight semesters.

4.1.2. The duration of the programme for lateral entry students who are admitted in II year shall be three years that consists of six semesters.

4.2 Maximum Duration

4.2.1 The maximum period for which a student can take to complete a full time academic programme shall be double the normal duration of the programme, i.e., for regular students eight years, for lateral entry students six years.

4.3 Minimum Duration of a Semester

Each semester consists of a minimum of 90 instruction days with about minimum 20 and maximum 33 contact hours per week.

5. ADMISSION CRITERIA

The eligibility criteria for admission into UG Engineering programmes are as per the norms approved by Government of Andhra Pradesh from time to time. The sanctioned seats in each programme in the college are classified into CATEGORY-A, and CATEGORY-B at I year level and only CATEGORY-A at Lateral Entry II year level.

The percentages of Category–A, Category-B and Lateral Entry Seats are decided from time to time by the Government of Andhra Pradesh.

5.1 CATEGORY – A Seats

Category - A seats are filled as per the norms approved by the Government of Andhra Pradesh.

5.2 CATEGORY – B Seats

Category - B seats are filled by the College as per the norms approved by the Government of Andhra Pradesh.

5.3 CATEGORY - Lateral Entry Seats

Lateral entry candidates shall be admitted into the III semester directly as per the norms approved by Government of Andhra Pradesh.

6. CREDIT SYSTEM AND GRADE POINTS

6.1 Credit Definition

'Credit' means quantified and recognized learning. Credit is measured in terms of contact hours per week in a semester. Typically one credit is given to:

(a) Theory/Tutorial course conducted for one contact period.

(b) Laboratory course conducted for two contact periods.

Each course is assigned a certain number of credits depending upon the number of contact hours (Lectures/Tutorials/Practical) per week.

The curriculum of the eight semesters B.Tech program is designed to have a total of 160 credits for the award of B.Tech degree.

For lateral entry students, the curriculum of six semesters B.Tech program is designed to have a total of 121 credits for the award of B.Tech degree.

6.2 Semester Course Load

The average course load shall be fixed at 20 credits per semester with its minimum and maximum limits being set at 12 and 23 credits.

6.3 Grade Points and Letter Grade for a Course

The grade points and letter grade will be awarded to each course based on student's performance as per the grading system shown in the Table.

Table: Grading System for B. Tech Programme (PVP20 Regulations)

Grades and Grade Points (PVP20 Regulations)

Theory / Drawing (Max-100)	Laboratory/ Mini Project/ Internship etc. (Max – 50)	Level	Grade Point	Letter Grade
≥ 90	≥ 45	Outstanding	10	A+
≥ 80 to ≤ 89	≥ 40 to ≤ 44	Excellent	9	A
≥ 70 to ≤ 79	≥ 35 to ≤ 39	Very Good	8	B
≥ 60 to ≤ 69	≥ 30 to ≤ 34	Good	7	C
≥ 50 to ≤ 59	≥ 25 to ≤ 29	Fair	6	D
≥ 40 to ≤ 49	≥ 20 to ≤ 24	Satisfactory	5	E
< 40	< 20	Fail	0	F (FAIL)
ABSENT	ABSENT	ABSENT	0	AB

* For Major Project same (%) percentages will be followed for grading

6.4 Semester Grade Points Average(SGPA)

The performance of each student at the end of each semester is indicated in terms of SGPA calculated as shown in equation (1)

$$\text{SGPA} = \frac{\sum (CR \times GP)}{\sum CR \text{ (for all courses offered in the semester)}} \quad \text{-- (1)}$$

Where CR= Credits of a course

GP = Grade points awarded for a course

$\sum CR$ = Summation of all the courses offered in the semester

6.5 Cumulative Grade Point Average (CGPA)

The Cumulative Performance of each student at the end of each semester is indicated in terms of CGPA which is calculated as shown in equation (2).

$$CGPA = \frac{\sum CR \; X \; GP}{\sum CR (for\ all\ courses\ offered\ upto\ that\ semester/entire\ program)} \quad \text{-- (2)}$$

Where CR = Credits of a course

GP = Grade points awarded for a course

Percentage equivalent of CGPA = (CGPA – 0.75) * 10

7.CURRICULUM FRAMEWORK

7.1. Regular and Honors B.Tech Programmes of all Branches

1. Award of the Degree: A student will be declared eligible for the award of

   B. Tech. degree if he/she fulfils the following:

   i. Pursues a course of study in not less than four and not more than eight academic years.

   ii. After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.

   iii. Registers for 160 credits and must secure all the 160 credits.

   iv. A student shall be eligible for the award of B.Tech degree with Honors or Minor if he / she earns 20 credits in addition to the 160 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.

2. Structure of the Undergraduate Engineering program:

Every course of B.Tech. Program shall be placed in one of the nine categories as listed in table below:

S. No.	Category	Code	Suggested breakup of Credits (APSCHE)	Suggested breakup of Credits (AICTE)
1	Humanities and social science including Management courses	HSMC	10.5	12
2	Basic Science courses	BSC	21	25
3	Engineering Science courses	ESC	24	24
4	Professional core Courses	PCC	51	48
5	Open Elective Courses	OEC	12	18
6	Professional Courses Elective	PEC	15	18
7	Internship, project work seminar, Community Service Project	PROJ	16.5	15
8	Mandatory courses	MC	Non-credit	Non-credit
9	Skill Oriented Courses	SC	10	-
Total Credits			160	160

3. Assigning of Credits:

   1 Hr. Lecture (L) per week - 1 credit

   1 Hr. Tutorial (T) per week - 1 credit

   1 Hr. Practical (P) per week - 0.5 credits

   2 Hours Practical (Lab)/week - 1 credit

4. There shall be mandatory student induction program for fresher's, 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., shall be included in the guidelines issued by AICTE

5. All undergraduate students shall register for NCC/NSS activities. A student will be required to participate in an activity for two hours in a week during second and third semesters. Grade shall be awarded as Completed or Not Completed in the mark sheet on the basis of participation, attendance, performance and behavior, and it is treated as student practice course . If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the

degree requirements.

6. Courses like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

7. Institution may swap some of the courses between first and second semesters to balance the workload.

8. The concerned Board of studies can assign tutorial hours to such courses wherever it is necessary, but without change in the total number of credits already assigned for semester.

9. There shall be 05 Professional Elective courses and 04 Open Elective courses. All the Professional & Open Elective courses shall be offered for 03 credits, wherever lab component is involved it shall be (2-0-2) and without lab component it shall be (3-0- 0). If a course comes with a lab component, that component has to be cleared separately. The concerned BOS shall explore the possibility of introducing virtual labs for such courses with lab component.

10. All Open Electives are offered to students of all branches in general. However, a student shall choose an Open Elective from the list in such a manner that he/she has not studied the same course in any form during the Programme.

11. A student shall be permitted to pursue up to a maximum of two elective courses under MOOCs during the Programme. Each of the courses must be of minimum 12 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to pursue and acquire a certificate for a MOOC course only from the organizations/agencies approved by the BoS in order to earn the 3 credits. The Head of the department shall notify the list of such courses at the beginning of the semester.

12. The college shall invite registration forms from the students at the beginning of the semester for offering professional and open elective courses. There shall be a limit on the minimum and maximum number of registrations based on class/section strength.

13. Students shall undergo mandatory summer internships for a minimum of four to six weeks duration at the end of second and third year of the Programme. There shall also be mandatory full internship in the final semester of the Programme along with the project work.

14. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain courses and the remaining one shall be a soft skills course.

15. Under graduate Degree with Honors / Minor shall be issued by the institute to the students who fulfil all the academic eligibility requirements for the B. Tech program and Honors / Minor program. The objective is to provide additional learning opportunities to academically motivated students.

16. Assessment: The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 50 marks for practical subject. The

distribution shall be 30 marks for Internal Evaluation and 70 marks for the End Semester Theory Examinations. 15 marks for Internal Evaluation and 35 marks for the End Semester practical Examinations A student has to secure not less than 35% of marks in the end semester examination and minimum 40% of marks in the sum total of internal and end semester examination marks to earn the credits allotted to each course. Detailed guidelines for continuous evaluation shall be planned by concerned combined BOS of the Universities.

17. **Attendance Requirements**:

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

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

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

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

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

vi. A stipulated fee shall be payable towards condonation of shortage of attendance to the college. A student is eligible to write the semester end examinations if he acquires 75% of attendance in aggregate of all the subjects.

7.2 General Issues

7.2.1 Curriculum framework is important in setting the right direction for a degree programme as it takes into account the type and quantum of knowledge necessary to be acquired by a student in order to qualify for the award of degree in his/her chosen branch or specialization.

7.2.2 Besides, this also helps in assigning the credits for each course, sequencing the courses semester-wise and finally arriving at the total number of courses to be studied and the total number of credits to be earned by a student in fulfilling the requirements for conferment of degree.

7.2.3 Each theory course shall consist of five units.

7.3 Curriculum Structure

The curriculum is designed to facilitate B. Tech (Honors) and B.Tech (Major, Minor) incorporates courses required to attain the expected knowledge, skills and attitude by the time of graduation as per the needs of the stakeholders. The curriculum structure consists of various course categories (as described in 7.3.1 to7.3.5) to cover the depth and breadth required for the programme and for the attainment of programme outcomes of the corresponding programme.

7.3.1 Institutional Core

Institutional Core consists of the courses required for all UG Engineering Programmes offered in this college. The courses offered under this category cover the required knowledge in the following areas:

a) Basic Sciences:

Basic Science courses include Engineering Physics, Applied Physics, Engineering Physics Lab, Applied Physics Lab Engineering Chemistry, Engineering Chemistry Lab, and Engineering Mathematics, etc.

b) Engineering Sciences:

Engineering Science courses include Problem Solving and Programming, AI Tools, Internet of Things, Design Thinking, Basic Electrical and Electronics Engineering, Engineering Graphics, Problem Solving & Programming Lab, Basic Electrical & Electronics Engineering Lab, AI Tools Lab, Internet of Things Lab, Design Thinking Lab and Basic Workshop, etc.

c) Humanities and Social Sciences:

Humanities and Social Science Courses consist of Communicative English I, Communicative English II, HS Elective, Communicative English-I Lab and Communicative English-II Lab, etc.

7.3.2 Elective Courses

Elective courses are offered across the programmes to enhance the knowledge breadth and professional competency of the students.

Courses	Branch Specific	Compulsory
Elective courses	Professional Electives	Supportive to the discipline courses with expanded scope in a chosen track of specialization or cross track courses
	HS Management Elective	Nurture the student interests in management courses.
	Open Electives	Common to all disciplines that helps general interest of a student

7.3.3 Professional Core

The Professional core consists of set of courses considered which are necessary for the students of the specific programme. The courses under this category satisfy the Programme Specific Criteria prescribed by the appropriate professional societies.

7.3.4 Project

In the final semester, the student should mandatorily undergo internship and in parallel he/she should work on a project with well-defined objectives.

7.3.5 Mandatory Learning Courses

According to the guidelines given by statutory bodies, Courses on Environmental Science, Constitution of India and Engineering Ethics, Life Sciences for Engineers and Life Sciences for Engineers Lab shall be offered. Induction program shall be offered in I semester for all the branches.

7.3.6 Honors Programme

In order to obtain honors degree students shall earn additional 20 credits in addition to the 160 credits for obtaining the UG degree. Students can register for additional courses by satisfying the pre-requisite course(s) to a maximum of 8 credits in each of the semesters from IV semester onwards along with the regular semester courses as prescribed. There is no minimum limit to the credits for taking additional courses.

1. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.

    - A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 CGPA up to the end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 CGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.
    - An SGPA and CGPA of 8.0 and above has to be maintained in the subsequent semesters in major degree without any backlogs in order to keep the Honors degree registration active.
    - Should both the SGPA and CGPA of major degree fall below 8.0 in major degree at any point after registering for the Honors; the Honors degree registration will cease to be active.

2. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.
3. In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
4. Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.
5. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
6. The concerned BOS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BOS.
7. Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BOS shall explore the possibility of introducing virtual labs for such courses with lab component.
8. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies

approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the Institute/academic council.

9. The concerned BOS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

10. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: The courses which were not done under the dropped Honors will not be shown in the transcript.

11. In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

12. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

7.4 Minor Programme:

In order to obtain Minor degree students shall earn additional 20 credits in addition to the 160 credits for obtaining the UG degree. Students can register for additional courses by satisfying the pre-requisite course(s) to a maximum of 8 credits in each of the semesters from IV semester onwards along with the regular semester courses as prescribed. There is no minimum limit to the credits for taking additional courses.

A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 7.75 CGPA (Cumulative Grade point average) up to the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 7.75 CGPA up to 3rd semester or failed in any of the courses, his registration for Minors program shall stand cancelled.

- An SGPA and CGPA of 7.75 and above has to be maintained in the subsequent semesters in major degree without any backlogs in order to keep the minor registration active.
- Should both the SGPA and CGPA fall below 7.75 in major degree at any point after registering for the minor; the minor registration will cease to be active.

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

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

2. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CE, EEE, ME, ECE, CSE, AND IT etc., or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, VLSI etc.

3. The list of disciplines / branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BOS.

4. There shall be no limit on the number of programs offered under Minor. The Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.

5. Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BOS along with prerequisites. It is the responsibility of the student to acquire / complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he / she has not studied in any form during the Programme.

6. The concerned BOS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BOS.

7. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160credits).

8. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4credits.If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the Institute/academic council.

9. Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BOS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.

10. A committee should be formed at the level of College / Universities / department to evaluate the grades / marks given by external agencies to a student which are approved by concerned BOS. Upon completion of courses the departmental committee should convert the obtained grades / marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.

11. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass(P)" grade and also choose to omit the mention of the course as for the following: The courses which were not done under the dropped Minors will not be shown in the transcript.

12. In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

13. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he / she has already earned bachelor's degree.

7.6 Industrial Collaboration (Case Study)

Institute - Industry linkages refer to the interaction between firms and universities or public research centers with the goal of solving technical problems, working on R&D, innovation projects and gathering scientific as well as technological knowledge. It involves the collaboration of Industries and Institutes in various areas that would foster the research ecosystem in the country and enhance growth of economy, industry and society at large.

The Institution is permitted to design any number of Industry oriented minor tracks as the respective BoS feels necessary. In this process the Institution can plan to have industrial collaborations in designing the minor tracks and to develop the content and certificate programs. Industry giants such as IBM, TCS, WIPRO etc., may be contacted to develop such collaborations. The Universities / Institutions shall also explore the possibilities of collaborations with major Industries in the core sectors and professional bodies to create specialized domain skills.

7.7 Mandatory Internships

1. Two summer internships each with a minimum of six weeks duration, done at the end of second and third years, respectively are mandatory. The internship can be done by the students at local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs.

2. A supervisor/mentor/advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the Institute.

3. 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 consisting of an external examiner; Head of the Department; supervisor of the internship and a senior faculty member of the department. The report and the oral presentation shall carry 40% and 60% weightages respectively.

4. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship.

5. In the final semester, the student should mandatorily undergo internship 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.

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

7.8 Skill Oriented Courses

1. For skill oriented / skill advanced course, one theory and 2 practical hours or two theory hours may be allotted as per the decision of concerned BOS.

2. Out of the five skill courses two shall be skill-oriented courses from the same domain and shall be completed in second year. Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or Job oriented skill courses, which can be of inter disciplinary nature.

3. A pool of interdisciplinary skill oriented courses shall be designed by a common Board of studies by the participating departments / disciplines and the syllabus along with the pre requisites shall be prepared for each of the laboratory infrastructure requirements. The list of such courses shall be included in the curriculum structure of each branch of Engineering, so as to enable the student to choose from the list.

4. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries / Professional bodies / APSSDC, COURSERA or any other accredited bodies as approved by the concerned BOS.

5. The Board of studies of the concerned discipline of Engineering shall review the skill advanced courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest courses based on industrial demand.

6. If a student chooses to take a Certificate Course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the Department, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency / professional bodies

as approved by the Board of studies.

7. 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 concerned Board of Studies, the student is deemed to have fulfilled the attendance requirement of the course and acquire the credits assigned to the course.

8. A committee shall be formed at the level of the college to evaluate the grades / marks given for a course by external agencies and convert to the equivalent marks / grades. The recommended conversions and appropriate grades / marks are to be approved by the Institute / Academic Council.

9. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner (course instructor or mentor). There are no internal marks for the skill oriented courses.

7.9 Course Numbering Scheme

The Course code consists of Eight / Nine characters. The following is the structure of the course Code (Figure 1).

Course Numbering Scheme (PVP20)

<table>
<tr><td>2</td><td>0</td><td>C</td><td>S</td><td>3</td><td>2</td><td>0</td><td>1</td><td>A</td></tr>
<tr><td colspan="2">Regulation</td><td colspan="2">Course Category</td><td>Kind of course</td><td>Semester</td><td>Type</td><td>Course Number</td><td>[Elective code]</td></tr>
<tr><td colspan="2" rowspan="8">Last two digits of Regulation offered(i.e. 20 for PVP20 regulations)</td><td colspan="2">HS-Humanities and Social Sciences including Management courses
BS-Basic Science courses
ES-Engineering Science
MC- Mandatory Courses</td><td>1. Institutional Core(i.e. HS,BS,ES,MC)</td><td rowspan="8">1-First
2-Second
3-Third
4-Fourth
5- Fifth
6-Sixth
7-Seventh
8-Eigth</td><td rowspan="6">0-Theory
1-Theory studied in MOOCS Mode
2-Integrated Course (Theory+Lab)
4- NCC/NSS
5- Practical
6-Project Work
7-Seminar</td><td rowspan="8">i.e. Course sequence Number in that semester</td><td rowspan="6">In case if the course is Elective then this field will specify the elective code (i.e A,B,C...)</td></tr>
<tr><td colspan="2">Respective Handling department code is placed</td><td>2. Open Elective/ Job Oriented Elective</td></tr>
<tr><td colspan="2">In case of Professional Core/ Professional Elective courses department code is placed:
CE-Civil Engineering
EE- Electrical & Electronics Engineering
ME- Mechanical Engineering
EC- Electronics and Communication Engineering
CS- Computer Science & Engineering
IT- Information Technology
AM-CSE(Artificial Intelligence & Machine Learning)
DS-CSE(Data Science)</td><td>3. Professional Core
4. Professional Elective</td></tr>
<tr><td colspan="2">Respective chosen minor department code is placed</td><td>5. Minor Course</td></tr>
<tr><td colspan="2">Respective department code is placed</td><td>6. Honors Course</td></tr>
<tr><td colspan="2">Respective Handling department code is placed</td><td>7. Humanities and Social Science Elective</td></tr>
<tr><td colspan="2" rowspan="2">SO- Skill Oriented Course
SA- Skill Advanced Course
SS- Soft Skill Course</td><td rowspan="2">8. Skill Oriented/ Skill Advanced/ Soft Skill Course</td><td>8. Summer/ Industrial/ Research Internship</td><td>A - Summer
B – Industrial
C - Research</td></tr>
<tr><td>9. Community Service Project</td><td></td></tr>
</table>

Figure 1: Course numbering scheme

7.10 Medium of Instruction and Examination

The medium of instruction and examinations shall be English.

7.11 Registration

Every student has to register himself/herself for the courses in each semester individually at the time as specified in academic calendar.

8. Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) shall be introduced with effect from 2019-20 academic years, based on guidelines of the statutory bodies in order to promote:

- Activity based learning
- Student centered learning
- Students to choose courses of their choice
- Learning at their own pace

Flexibility is extended to the fast learning students to take the courses of higher semesters in advance as per their convenience to concentrate on their placement activity/ project work, etc., during the VII/VIII semesters.

8.1 CBCS Course Registration Policy

Fast learning students can register for additional courses from higher semesters by satisfying the pre-requisite course(s) to a maximum of 8 credits in each of the semesters from III semester onwards along with the regular semester courses as prescribed. There is no minimum limit to the credits for taking additional courses.

Eligibility for choosing CBCS flexibility:

- **Regular Students (4 Year duration),** entering the nth semester with no backlog courses up to (n-1)th semester, are only eligible to opt for this flexibility.
- **Lateral entry students (3 year duration)** with 70% Marks in their Diploma are eligible to opt for this flexibility during III and IV Semesters. Those students entering into V/ VI /VII semester with no backlog courses up to (n-1)th semester, are only eligible to opt for this flexibility.

  The list of additional courses offered in the even & odd semesters, registration dates will be notified by the respective departments well in advance.

  A student can withdraw from the respective course within 15 days after the commencement of the course.

  The choice of utilizing this flexibility is purely optional to the students.

  A minimum number of students required to register for an additional course shall be twenty (20). In case, the registered strength for the additional course is less than twenty (20), the course may be offered on the recommendation of the Head of the Department and subsequent approval of the Principal.

8.2 Continuous Internal Evaluation (CIE) for CBCS opted Courses

The contact hours, continuous assessment pattern, eligibility criteria to write end semester examinations and revaluation scheme for these additional courses will be as per the current academic regulations [PVP20].

8.3 Eligibility to appear CBCS registered courses for Semester End Examinations

The registered additional courses will be dealt separately as individual courses for the calculation of attendance and continuous assessment of marks for assessing the eligibility to write the end semester examinations for these courses.

The performance of the student in the registered additional courses will be separately mentioned in the semester end grade card and it will not be taken into account for the calculation of the SGPA for that semester.

The performance of the student in the registered additional courses will be taken into account in the corresponding semesters.

8.4 CBCS Course Detention

8.4.1 In case, the student is detained for want of minimum specified attendance and continuous assessment marks criterion either in the regular semester or in the additional courses, he/she will forfeit the eligibility for registering additional courses from that semester onwards. However, the additional courses completed by the students in the earlier semesters will be valid and taken into consideration.

8.4.2 In case, the student is detained for want of minimum specified attendance and continuous assessment marks criterion in the regular semester but meets minimum specified attendance and continuous assessment marks criterion in the registered additional courses, he/she shall write the end semester examinations for these additional courses along with the regular students in the corresponding semester only.

8.4.3 In case, the student fails / is absent in the end semester examinations of the registered additional courses or in the regular semester courses in a particular semester, he will forfeit the eligibility for registering additional courses from that semester onwards. However, the additional courses completed by the students in the earlier semesters will be valid and taken into consideration. They can write the end semester examinations for additional courses in which they failed/were absent, along with regular students in the corresponding semesters only.

8.4.4 The criterion for the promotion to higher semesters will be as per PVP20 regulations, taking only the regular semester courses into consideration for the fast learners.

8.4.5 Additional courses, in which the fast learning student fails, will not be considered as backlogs for them.

8.4.6 The fast learning students shall register for all the courses of a regular semester excluding the courses completed in the previous semesters.

8.4.7 The credits scored by students through CBCS subjects shall not be considered for credit promotion from II year to III year or from III year to IV year B.Tech.

8.4.8 The student opting for the said flexibility will be considered for the award of the division on par with other regular students.

8.4.9 The students who have earlier history of indulging in malpractices in semester end examinations are not eligible for opting CBCS.

8.4.10 If the student fails to register for opted CBCS courses for semester end examination, he/she will forfeit the eligibility for registering additional courses from that semester onwards and marks secured through continuous assessment will not be considered.

8.4.11 The choice of utilizing this flexibility is purely optional to the students.

8.4.12 If a student fails/absent in a CBCS course, he/she is bound to appear in the same course when studied in regular semester.

9 EXAMINATIONS & SCHEME OF EVALUATION

9.1 Description of Evaluation

1. **Continuous Internal Evaluation (CIE):** The performance of the student in each course is evaluated by the faculty/course coordinator all through the semester; with mid-term tests (sessional-1and sessional-2), assignments, project reviews, viva-voce, laboratory assessment and other means covering the entire syllabus of the course.

2. **Semester End Examination (SEE):** It shall be conducted by chief controller of examinations at the end of each semester, as per the academic calendar and with a written examination for theory courses and practical/project examination with built-in oral part for laboratory/project.

9.2 Continuous Internal Evaluation (CIE)

9.2.1 Theory Courses

a) For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one objective examination (20 multiple choice questions) for 10 marks for duration of 20 minutes (ii) one descriptive examination (3 full questions for 5 marks each) for 15 marks for duration of 90 minutes and (iii) one assignment for 5 marks. Mid-1 shall be conducted from first 50% of the syllabi.

b) In the similar lines, the second objective, descriptive examinations, assignment shall be conducted on the rest of the 50% syllabus.

c) The total marks secured by the student in each mid-term examination are evaluated for 30 marks. The first mid marks (Mid-1) consisting of marks of objective examination, descriptive examination and assignment shall be submitted by the concerned teacher to the department examination section within one week after completion of first mid examination.

d) The mid marks submitted to the department examination section shall be displayed in the concerned department notice boards for the benefit of the students.

e) If any discrepancy found in the submitted Mid-1 marks, it shall be brought to the notice of Head of the department within one week from the submission.

f) Second mid marks (Mid-2) consisting of marks of objective examination, descriptive
Examination and assignment shall also be submitted by the concerned teacher to the department examination section within one week after completion of second mid examination and it shall be displayed in the notice boards. If any discrepancy found in the submitted mid-2 marks, it shall be brought to the notice of Head of the department within one week from the submission.

g) Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for other mid exam.

Example:

Mid-1 marks = Marks secured in (Objective-1+Descriptive examination-1 +Assignment-1)

Mid-2 marks = Marks secured in (Objective-2+Descriptive examination-2 +Assignment-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8
+ Least of (Mid-1/Mid-2) marks x 0.2)

h) With the above criteria, concerned departments have to display the consolidated marks obtained by the students in the department notice boards. If any discrepancy found, it shall be brought to the notice of Head of the department through proper channel within one week with all proofs.

9.2.2 Mandatory Learning Courses

Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, Life Sciences for Engineers, etc. non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the college internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

9.2.3 Drawing Based Courses:

For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester for 15 marks each and final marks can be calculated with 80% weightage for better of the two tests and 20% weightage for other test and these are to be added to the marks obtained in day to day work.

9.2.4 Laboratory Courses

For practical subjects there shall be continuous evaluation during the semester for 15 internal marks and 35 end examination marks. The internal 15 marks shall be awarded as follows: day today work - 5 marks, Record-5 marks and the remaining 5 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner appointed.

Table: Distribution of Marks (CIE)

S. No.	Criterion	Marks
1	Day to Day Evaluation	5
2	Record	5
3	Internal Examination	5

9.2.5 MOOCs Courses

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student’s assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall pass.

9.3 Semester End Examination (SEE)

9.3.1 Theory Courses:

a) The semester end examinations will be for 70 marks consisting of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an “either” “or” choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b) The job oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner (course instructor or mentor). There are no internal marks for the job oriented skill courses.

9.3.2 Laboratory Courses: 35 marks

i. The Semester end examination for laboratory courses shall be conducted with three hour duration at the end of semester for 35 marks as given below:

Table : Distribution of Marks (SEE)

S.No.	**Criterion**	**Marks**
1	Procedure	5
2	Experiment / Programme Execution	15
3	Result	10
4	Viva-Voce	5

ii. Each Semester end Laboratory Examination shall be conducted by an External Examiner along with the Internal Examiner.

9.3.3 Internship: 50 Marks (Only External marks)

Evaluation of the summer internships: It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme. Students shall pursue this course during summer vacation just before its offering as per course structure. The minimum duration of this course is at least 6 weeks. The student shall register for the course as per course structure after commencement of academic year. A supervisor / mentor / advisor have to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the Institute. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner; Head of the Department; supervisor of the internship and a senior faculty member of the department. A certificate from industry / skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. 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 Institute.

9.3.4 Community Service Project (CSP): 100 Marks

Report on CSP should be submitted by each student. An internal Viva shall also be conducted by a Committee constituted by the principal of the college. The assessment is to be conducted for **100 marks**. The number of credits assigned is 4. Later the marks are converted into grades and grade points to include finally in the SGPA and CGPA. 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 Institute. The students must do the community service project in the vacation period after I-II.

The weightings shall be:

Activity Log 20% CSP Implementation 30%

Report 25% Presentation 25%

For Complete details: https://www.jntuk.edu.in/jntuk-dap-community-service-project-guidelines-reg/

9.3.5 Major Project

(Project - Project work, seminar and internship in industry):

In the final semester, the student should mandatorily register and undergo internship 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.

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

9.4 Conditions for Pass Marks

I. Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the Institution Examination section from time to time.

II. To maintain the quality, external examiners and question paper setters shall be selected from premier institutes and Universities, NITs, Autonomous colleges.

III. For non-credit mandatory courses, like Life sciences for Engineers, Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

IV. A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/ project etc by securing not less than 35% of marks in the end semester exam and minimum 40% of marks in the sum total of the internal marks and end semester examination marks together.

V. **Distribution and Weightage of marks**:

The assessment of the student's performance in each course will be as per the details given

SNo	Component	Internal	External	Total
1	Theory	30	70	100
2	Lab	15	35	50
3	Mandatory	30	70	100
4	Drawing	30	70	100
5	Project	60	140	200
6	Mini Project/Internship/Industrial Training / Skill Development Programs/Research Project	-	50	50

9.5 Revaluation

9.5.1 Continuous Internal Evaluation

The continuous Evaluation scripts shall be shown to the students before finalizing the marks. However, if the student has any concern, not addressed before the finalization of marks, he/she may submit the application for revaluation to the concerned head of the department. The Head of the Department may constitute a two-member committee for re-evaluating the script. The evaluation of the committee is final and binding.

9.5.2 Semester End Examination

1. As per the notification issued by the Controller of Examinations, the students can submit the applications for revaluation, along with the requisite fee receipt for revaluation of his/her answer script(s) of theory course(s), if he/she is not satisfied with the marks obtained.
2. The Controller of Examinations shall arrange for re-evaluation of those answer script(s).
3. A new external examiner, other than the first examiner, shall re-evaluate the answer script(s).
4. Revaluation marks will be taken into consideration only if the difference between the two valuations is more than or equal to 15%. Better marks between the two shall be taken into consideration.

However, if the revaluation marks facilitates passing of the candidate, then the revaluation marks will be considered even if the difference of marks is less than 15%.

5. If the difference of marks between the two valuations is more than 20%, the answer script will be referred to third valuation. The average of nearest two marks will be awarded.

9.6 Withholding of Results

If the student has not paid the dues to the college, or if any case of malpractice or indiscipline is pending against him, the result of the student will be kept as withheld and he/she will not be allowed to enter the next semester. His/her degree shall be considered as withheld in such cases.

10 CRITERIA TO ATTEND SEMESTER END EXAMINATION AND PROMOTION TO HIGHER SEMESTER

10.1 Eligibility for Semester End Examinations

10.1.1 Students shall put in a minimum average attendance of 75% in the courses. computed by totalling the number of periods of lectures, tutorials, drawing, practical and project work as the case may be, held in every course as the denominator and the total number of periods attended by the student in all the courses put together as the numerator, to be eligible to write semester end examinations.

10.1.2 Condonation of shortage in attendance may be recommended by respective Heads of Departments on genuine medical grounds, provided the student puts in at least 65% attendance as calculated above and provided the Principal is satisfied with the genuineness of the reasons and the conduct of the student.

10.1.3 Students, having more than 65% and less than 75% of attendance, shall have to pay requisite fee towards condonation.

10.2 Promotion Rules

1. A student shall be promoted from first year to second year if he fulfills the minimum attendance requirements.

2. A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

3. A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

11. SUPPLEMENTARY EXAMINATIONS

1. General

Semester end Supplementary examinations shall be conducted along with regular semester end examinations.

2 Advanced Supplementary Exams

Candidate(s), who fails in Theory or Laboratory courses of VIII semester, can appear for advanced supplementary examination conducted within one month after declaration of the revaluation results. However, those candidates who fail in the advanced supplementary examinations of VIII semester shall appear for subsequent examinations along with regular candidates conducted at the end of the respective academic year.

12. READMISSION CRITERIA

A candidate, who is detained in a semester due to lack of attendance/credits, has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying an administrative fee of **Rs. 1,000/-**

Rules for calculation of attendance for readmitted students

a) Number of classes conducted shall be counted from the commencement day of the semester concerned, irrespective of the date of payment of tuition fee.

b) They shall submit a written request to the principal of the college, along with a challan paid towards tuition and other fee, for readmission before the commencement of the class work.

c) They can get the information regarding date of commencement of class work for each semester that will be made available in the college notice boards/website from time to time.

13 BREAK IN STUDY

Student, who discontinues the studies for valid reason permitted by the principal, shall get readmission into appropriate semester of B.Tech. programme after break-in study, with the prior permission of the Principal and following the transitory regulations applicable to such batch in which he/she joins. An administrative fee of **Rs**. 1**000/-**per each year of break in study, in addition to the prescribed tuition and special fee has to be paid by the candidate to condone his/her break in study.

14 GAP YEAR

Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at Institution level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

15 TRANSITORY REGULATIONS

A candidate, who is detained or discontinued in a semester, on re-admission, the academic regulations under which he/she has originally admitted will continue to be applicable to him/her on re-admission.

16 ELIGIBILITY FOR AWARD OF B.TECH DEGREE

1. The B.Tech. Degree shall be conferred on a candidate who satisfies the following requirements.

   a) A Regular student (four year programme) shall register and secure himself/herself for **160** Credits

   b) A Lateral Entry student (three year programme) shall register and secure himself/herself for**12**1 credits

2. **Award of Division**

   The criteria for award of division, after successful completion of programme are as shown in Table:

Table : Criteria for Award of Division

Class Awarded	CGPA to be secured	Remarks
First class with distinction	≥7.75 (Without any supplementary appearance)	From the CGPA secured from 160 credits
First class	≥6.75	
Second class	≥5.75 to <6.75	
Pass Class	≥5.00 to <5.75	

- Awarded only if all the courses prescribed are cleared in single attempt within four years for regular candidates and three years for lateral entry candidates
- Detained and break-in study candidates are not eligible for the award of First Class with Distinction
- The cases of students who are absent for semester end examination only once in his/her duration of B.Tech. Programme on valid medical

grounds/humanitarian grounds shall also be considered for the award of First class with Distinction subject to the recommendations of the committee constituted by the Principal.

For the purpose of awarding First, Second and Pass Class CGPA obtained in the examinations appeared within the maximum period allowed for the completion of the programme shall be considered.

Consolidated Grade Card

A consolidated grade card containing credits & grades obtained by the students will be issued after successful completion of the four year B.Tech Programme.

17 CONDUCT AND DISCIPLINE

1. Students shall conduct themselves within and outside the premises of the Institute in a manner befitting the students of our Institution.

2. As per the order of Honorable Supreme Court of India and AICTE guidelines, ragging in any form is considered a criminal offence and is banned. Ragging within or outside any educational institution is prohibited. Ragging means doing an act, that causes or is likely to cause insult or annoyance or fear of apprehension or threat or intimidation or outrage of modesty or injury to a student. Any form of ragging will be severely dealt with as per AP Prohibition of Ragging Act-1997 section-4.

Table : Punishments for Ragging

Nature of ragging	Punishment
Teasing, embarrassing and humiliating	Imprisonment up to 6 months or fine up to Rs.1,000/- or both
Assaulting or using criminal force or criminal intimidation	Imprisonment up to 1 year or fine up to Rs.2,000/- or both
Wrongfully restraining or confining or causing hurt	Imprisonment up to 2 years or fine up to Rs.5,000/- or both
Causing grievous hurt kidnapping or raping or committing unnatural offence	Imprisonment up to 5 years and fine up to Rs.10,000/-
Causing death or abetting suicide	Imprisonment up to 10 years and fine up to Rs.50,000/-

3. A student who is convicted of an offence and punished with imprisonment for a term of more than six months shall not be admitted into the institution.

4. Whenever any student complains of ragging to the head or manager of an educational institution, such head or manager should inquire into the complaint and if the complaint is prima-facie found true, should suspend the student or students complained against.

5. If the head or manager of an educational institution fails or neglects to

take action in the manner specified in the Act, the person shall be deemed to have abetted the offence and shall be punished with the punishment provided for the offence.

6. If a student commits suicide due to or in consequence of ragging, the person who commits such ragging shall be deemed to have abetted such suicide.

7. The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures.

i. Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus

ii. Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.

The following activities are not allowed within the campus:

- Mutilation or unauthorized possession of library books.
- Noisy and unseemly behaviour, disturbing studies of fellow students.
- Hacking computer systems (such as entering into other person's areas without prior permission, manipulation and/or damage of computer hardware and software or any other cybercrime etc.)
- Use of mobile phones.
- Plagiarism of any nature.
- Any other act of gross indiscipline as decided by the Institute from time to time.
- Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute/ hostel, debarment from a examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.
- For an offence committed in (i) a hostel, (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Principal, respectively, shall have the authority to reprimand or impose fine.
- Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Principal for taking appropriate action.
- Unauthorized collection of money in any form is strictly prohibited.
- Detained and break-in-study candidates are allowed into the campus for academic purposes only with the permission from authorities.
- Misconduct committed by a student outside the Institute campus but having the effect of damaging, undermining & tarnishing the image & reputation of the institution will make the student concerned liable for disciplinary action commensurate with the nature and gravity of such misconduct.

- The disciplinary action committee constituted by the Principal, shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.
- Grievance redressal committee, constituted by the Principal, shall deal with all grievances pertaining to the academic/ administrative and disciplinary matters.
- All the students must abide by the code and conduct rules of the Institute.

18 MALPRACTICES

The Principal shall refer the cases of malpractices by students in internal assessment tests and end semester examinations, to a malpractice enquiry committee constituted for the purpose. The committee shall follow the approved scales of punishment.
The committee consists of:

1. Heads of Department (Three)
2. Controller of Examinations
3. Assistant Controller of Examinations

Table – 10: Disciplinary action for malpractices/improper conduct in examinations

	Nature of Malpractices/Improper conduct	**Punishment**
1 (a)	If the candidate possesses or keeps accessible, any paper, note book, programmable calculators, mobile phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in the examination hall but has not made use of (material shall include any marks on the student's body that 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.
(b)	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through mobile 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	If the candidate 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. He shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the candidate is to be cancelled.

3	If the candidate 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 project work) already appeared and shall not 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 University 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	If the candidate smuggles in an 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 other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	If the candidate 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	If the candidate 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	In case of students of the Institute, 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.

	written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the Institute 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	If the candidate 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 other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the candidate possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects 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 Institute, who is not a candidate for the particular examination or any person not connected with the Institute indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the Institute: 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. He 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 Institute: Will be handed over to police and a police case will be registered against them.

10	If the candidate 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. He 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 awarded suitable punishment.	

Note: Special squads may be formed to oversee the proper conduct of examinations.

19 OTHER MATTER

19.1 Scribe facility is extended to B Tech students strictly following the guidelines issued under F. No. 16-110/2003-DD.III Dt. 26-02-2013 by the Ministry of Social Justice and Empowerment, Department of Disability Affairs, Govt. of India.

19.2 Students who are suffering from contagious diseases are not allowed to appear either continuous internal assessment or semester end examinations

19.3 The students who participate in coaching/tournaments held at State/National/International levels through University/Indian Olympic Association during semester end examination period will be promoted to subsequent semesters till the entire programme is completed as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated18-08-1994.

19.4 Based on the recommendations of HOD & Principal, exemption from attending the class work shall be given to those students who secure placement and intend to join as the employer in VIII semester of B.Tech. Special Continuous Internal Evaluation (Assignment Tests, Sessional, etc.,) will be arranged to such candidates separately if necessary. However, they shall appear for Semester End Examinations as per the Academic Calendar

19.5 The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved in the Heads of the Departments Meetings, shall be reported to the academic council for ratification.

20 GENERAL

1 Wherever the words “he”, “him”, “his”, occur in the regulations, they may include “she”, “her”, “hers”.
2 The academic regulations should be read as a whole for the purpose of any interpretation.
3 In case of any doubt or ambiguity in the interpretation of above rules, the decision of the principal is final.

21 INSTITUTE RULES AND REGULATIONS

1 Use of **Mobile phones** is strictly prohibited inside the Institute academic area.

2 Students should come to Institute in **proper dress**.

3 All students should wear **Identity cards** in the Institute premises.

4 Students should be present in their respective classrooms **before the commencement of class sharply**.

5 Students should not leave the Institute premises without prior permission of their respective Heads of the departments during Institute working hours.

6 Students should maintain silence in the class rooms during working periods.

7 Sitting / wandering of the students at the stair cases, corridors, cycle stands or the areas within the Institute premises is strictly prohibited.

8 Usage of Vehicle horn inside the Institute premises is prohibited.

22 AMENDMENTS TO REGULATIONS

The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and/or syllabi.

Oratory

PRINCIPAL

B.TECH.

COURSE STRUCTURE

ELECTRICAL AND ELECTRONICS ENGINEERING

I B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20HS1101	Communicative English I	3	3	0	0	30	70	100
20BS1101	Calculus and Linear Algebra	3	3	0	0	30	70	100
20BS1102	Engineering Chemistry	3	3	0	0	30	70	100
20ES1102	Problem Solving & Programming with Python	3	3	0	0	30	70	100
20ES1104	Engineering Graphics	3	1	0	4	30	70	100
20HS1151	Communicative English I Lab	1.5	0	0	3	15	35	50
20BS1151	Engineering Chemistry Lab	1.5	0	0	3	15	35	50
20ES1152	Problem Solving & Programming with Python Lab	1.5	0	0	3	15	35	50
20MC1101	Life Sciences for Engineers	0	2	0	2	30	70	100
Total		**19.5**	**15**	**0**	**15**	**225**	**525**	**750**

L – Lecture T – Tutorial P – Practical

I B.Tech., II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20HS1201	Communicative English II	3	3	0	0	30	70	100
20BS1201	Differential Equations and Vector Calculus	3	3	0	0	30	70	100
20BS1203	Engineering Physics	3	3	0	0	30	70	100
20ES1201	Basic Electrical & Electronics Engineering	3	3	0	0	30	70	100
20HS1251	Communicative English II Lab	1.5	0	0	3	15	35	50
20BS1252	Engineering Physics Lab	1.5	0	0	3	15	35	50
20ES1251	Basic Electrical & Electronics Engineering Lab	1.5	0	0	3	15	35	50
20ES1252	Basic Workshop	3	1	0	4	15	35	50
20MC1241A /20MC1241B	NSS / NCC	0	0	0	2	Completed / Not completed		
Total		**19.5**	**13**	**0**	**15**	**180**	**420**	**600**

L – Lecture T – Tutorial P – Practical

II B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20BS1302	Numerical Methods & Complex Variables	3	3	0	0	30	70	100
20ES1302	Circuit Theory	3	3	0	0	30	70	100
20EE3301	Electronic Devices & Amplifier Circuits	3	3	0	0	30	70	100
20EE3302	Signals and Systems	3	3	0	0	30	70	100
20EE3303	Electrical Machines-I	3	3	0	0	30	70	100
20ES1352	Circuit Theory Lab	1.5	0	0	3	15	35	50
20EE3351	Electronic Devices & Amplifier Circuits Lab	1.5	0	0	3	15	35	50
20EE3352	Electrical Machines-I Lab	1.5	0	0	3	15	35	50
20SO8352	Electrical Workshop	2	1	0	2	0	50	50
20MC1341A /20MC1341B	NSS / NCC	-	0	0	2	-	-	-
20EE3391	Community Service Project	4	0	0	-		100	
Total		**25.5**	**16**	**0**	**13**			

L - Lecture T - Tutorial P – Practical

II B.Tech., II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20ES1401	Programming with C	3	3	0	0	30	70	100
20BS1401	Electromagnetic Field Theory	3	3	0	0	30	70	100
20EE3401	Measurements and Instrumentation	3	3	0	0	30	70	100
20EE3402	Electrical Machines –II	3	3	0	0	30	70	100
20EE3403	Digital and Analog Circuits	3	3	0	0	30	70	100
20ES1451	Programming with C Lab	1.5	0	0	3	15	35	50
20EE3452	Digital and Analog Circuits Lab	1.5	0	0	3	15	35	50
20EE3451	Electrical Machines –II Lab	1.5	0	0	3	15	35	50
20SO8452	Data Structures	2	1	0	2	0	50	50
20MC1402	Environmental Science	-	2	0	0	-	-	-
Total		**21.5**	**18**	**0**	**11**			

L - Lecture T - Tutorial P – Practical

HONORS -I								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE6401A	Battery Management System	4	3	1	0	30	70	100
20EE6401B	Digital System Design with FPGAs	4	3	1	0	30	70	100
20EE6401C	Modern Control Systems	4	3	1	0	30	70	100
20EE6401D	Distributed Generation and Microgrids	4	3	1	0	30	70	100

L - Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks	Minor in
20CS5401	Computational Thinking	4	4	0	0	30	70	100	CSE
20IT5401	Operating Systems	4	4	0	0	30	70	100	IT
20EC5401	Analog Systems	4	3	1	0	30	70	100	ECE
20EC5402	Microcontrollers and Interfacing	4	3	1	0	30	70	100	IoT
20ME5401	Automobile Engineering	4	3	1	0	30	70	100	Automobile Engineering
20ME5402	Additive Manufacturing	4	3	1	0	30	70	100	Digital Manufacturing
20CE5401A	Solid Mechanics	4	3	1	0	30	70	100	Civil
20CE5401B	Soil Mechanics	4	3	1	0	30	70	100	Civil

L – Lecture T - Tutorial P – Practical

III B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE3501	Control Systems	3	3	0	0	30	70	100
20EE3502	Power Electronics	3	3	0	0	30	70	100
20EE3503	Electrical Power Generation, Transmission and Distribution	3	3	0	0	30	70	100
	Open Elective -I	3	3	0	0	30	70	100
20EE4501	Professional Elective-I	3	3	0	0	30	70	100
20EE3551	Control Systems Lab	1.5	0	0	3	15	35	50
20EE3552	Power Electronics Lab	1.5	0	0	3	15	35	50
20SA8552	JAVA Programming	2	1	0	2	-	50	50
20MC1502	Universal Human Values	0	2	0	0	30	70	100
20EE3581A	Summer Internship	1.5	0	0	0	-	-	-
Total		**21.5**	**18**	**0**	**8**			

L - Lecture T - Tutorial P – Practical

Professional Elective-I								
Course Code	**Title**	**Cre dits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4501A	Utilization of Electrical Energy	3	3	0	0	30	70	100
20EE4501B	Electrical Machine Design	3	3	0	0	30	70	100
20EE4501C	Renewable Energy Resources	3	3	0	0	30	70	100
20EE4501D	High Voltage Engineering	3	3	0	0	30	70	100
20EE4501E	Computer Organization & Architecture	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Open Elective -I								
Course Code	**Title**	**Cre dits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2501A	Air Pollution and Control	3	3	0	0	30	70	100
20EC2501A	Sensor Technology	3	3	0	0	30	70	100
20EC2501B	Electronic Instrumentation	3	3	0	0	30	70	100
20EE2501A	Electrical Safety	3	3	0	0	30	70	100
20IT2501A	Cyber Laws	3	3	0	0	30	70	100
20ME2501A	Design Thinking	3	3	0	0	30	70	100
20ME2501B	Logistic and Supply Chain Management	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HONORS -II								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE6501A	Computer Aided Power Systems Analysis	4	3	1	0	30	70	100
20EE6501B	Reactive Power Control in Electric Systems	4	3	1	0	30	70	100
20EE6501C	Power Systems Dynamics and Control	4	3	1	0	30	70	100
20EE6501D	EHVAC Transmission	4	3	1	0	30	70	100

L – Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks	Minor in
20CS5501	Data Structure and Algorithms using Java	3	3	0	0	30	70	100	CSE
20CS5551	Data Structure and Algorithms using Java Lab	1	0	0	2	15	35	50	CSE
20IT5501	Computer Networks	4	4	0	0	30	70	100	IT
20EC5501	Digital Design Using Verilog HDL	4	3	1	0	30	70	100	ECE
20EC5502	Sensors and Actuator Devices for IoT	4	3	1	0	30	70	100	IoT
20ME5501	Automotive Transmission System	4	3	1	0	30	70	100	Automobile Engineering
20ME5502	Basic manufacturing processes	4	3	1	0	30	70	100	Digital Manufacturing
20CE5501A	Analysis of Structures	4	3	1	0	30	70	100	Civil
20CE5501B	Transportation Engineering	4	3	1	0	30	70	100	Civil

L - Lecture T - Tutorial P – Practical

III B.Tech., II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE3601	Switchgear & Protection	3	3	0	0	30	70	100
20EE3602	Microprocessors and Microcontrollers	3	3	0	0	30	70	100
20EE3603	Power Systems Analysis	3	3	0	0	30	70	100
20EE4601	Professional Elective-II	3	3	0	0	30	70	100
	Open Elective -II	3	3	0	0	30	70	100
20EE3651	Power Systems Lab	1.5	0	0	3	15	35	50
20EE3652	Microprocessors and Microcontrollers Lab	1.5	0	0	3	15	35	50
20EE3653	Electrical Simulation Lab	1.5	0	0	3	15	35	50
20SS8651	Soft skills	2	1	0	2	-	50	50
20MC1601	Constitution of India	0	2	0	0	30	70	100
Total		**21.5**	**18**	**0**	**11**			

L - Lecture T - Tutorial P – Practical

Professional Elective-II								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4601A	Distribution System Planning & Automation	3	3	0	0	30	70	100
20EE4601B	Electrical Drives	3	3	0	0	30	70	100
20EE4601C	Digital Signal Processing	3	3	0	0	30	70	100
20EE4601D	Optimization Techniques	3	3	0	0	30	70	100
20EE4601E	Computer Networks	3	3	0	0	30	70	100

L – Lecture T - Tutorial P – Practical

Open Elective -II								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2601A	Ecology and Environment	3	3	0	0	30	70	100
20EC2601A	MAT Lab Programming	3	3	0	0	30	70	100
20EC2601B	TV Engineering	3	3	0	0	30	70	100
20EE2601A	Energy Management	3	3	0	0	30	70	100
20IT2601A	Introduction to Data Mining	3	3	0	0	30	70	100
20ME2601A	Value Engineering	3	3	0	0	30	70	100
20ME2601B	Human Factors in Engineering	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HONORS -III								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE6601A	Industrial Automation & Robotics	4	3	1	0	30	70	100
20EE6601B	Advanced Power System Protection	4	3	1	0	30	70	100
20EE6601C	Power System Reliability	4	3	1	0	30	70	100
20EE6601D	Restructured Power Systems	4	3	1	0	30	70	100

L - Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**	**Minor in**
20CS5601	Web Technologies	3	3	0	0	30	70	100	CSE
20CS5651	Web Technologies Lab	1	0	0	2	15	35	50	CSE
20IT5601	Software Engineering	4	4	0	0	30	70	100	IT
20EC5601	Circuit Analysis	4	3	1	0	30	70	100	ECE
20EC5602	Industrial and Medical IoT	4	3	1	0	30	70	100	IoT
20ME5601	Modern Technology in Automobile Engineering	4	3	1	0	30	70	100	Automobile Engineering
20ME5602	Design for Additive Manufacturing	4	3	1	0	30	70	100	Digital Manufacturing
20CE5601A	Basic Mechanics of Fluids	4	3	1	0	30	70	100	Civil

L – Lecture T - Tutorial P – Practical

IV B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE4701	Professional Elective-III	3	3	0	0	30	70	100
20EE4702	Professional Elective-IV	3	3	0	0	30	70	100
20EE4703	Professional Elective -V	3	3	0	0	30	70	100
20HS7701	Humanities and Social Sciences Elective	3	3	0	0	30	70	100
	Open Elective -III	3	3	0	0	30	70	100
	Open Elective- IV	3	3	0	0	30	70	100
20SA8752	IOT Applications to Electrical Engineering	2	1	0	2	-	50	50
20EE3781B/C	Industrial/Research Internship	3	0	0	0	-	-	-
Total		**23**	**19**	**0**	**2**			

L - Lecture T - Tutorial P – Practical

Professional Elective-III								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4701A	Power System Operation and control	3	3	0	0	30	70	100
20EE4701B	Energy Conservation and Audit	3	3	0	0	30	70	100
20EE4701C	Power Quality	3	3	0	0	30	70	100
20EE4701D	VLSI Design	3	3	0	0	30	70	100
20EE4701E	Operating Systems	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Professional Elective-IV								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4702A	Real Time Control of Power Systems	3	3	0	0	30	70	100
20EE4702B	Electrical Vehicles	3	3	0	0	30	70	100
20EE4702C	Digital Control Systems	3	3	0	0	30	70	100
20EE4702D	Embedded Systems	3	3	0	0	30	70	100
20EE4702E	Database Management Systems	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Professional Elective-V								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4703A	Smart Grid Technologies	3	3	0	0	30	70	100
20EE4703B	AI Techniques in Electrical Engineering	3	3	0	0	30	70	100
20EE4703C	HVDC and FACTS	3	3	0	0	30	70	100
20EE4703D	Switched Mode Power Conversion	3	3	0	0	30	70	100
20EE4703E	Machine Learning	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HUMANITIES AND SOCIAL SCIENCES ELECTIVE COURSES								
Course Code	**Title**	**Cre dits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20HS7701A	Managerial Economics and Financial Accountancy	3	3	0	0	30	70	100
20HS7701B	Human Resource Management	3	3	0	0	30	70	100
20HS7701C	Entrepreneurship Management	3	3	0	0	30	70	100
20HS7701D	Organizational Behavior	3	3	0	0	30	70	100
20HS7701E	Construction Management	3	3	0	0	30	70	100
20HS7701F	Industrial Engineering Management	3	3	0	0	30	70	100
20HS7701G	Project Management	3	3	0	0	30	70	100

L - Lecture   T - Tutorial   P – Practical

Open Elective -III								
Course Code	**Title**	**Cre dits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2701A	Disaster Management and Preparedness	3	3	0	0	30	70	100
20EC2701B	Embedded and Real time Systems	3	3	0	0	30	70	100
20EC2701C	Research Methodology	3	3	0	0	30	70	100
20EC2701B	E-Waste Management	3	3	0	0	30	70	100
20IT2701A	Fundamentals of Data Science	3	3	0	0	30	70	100
20ME2701A	Operations Research	3	3	0	0	30	70	100
20ME2701B	Management Information Systems	3	3	0	0	30	70	100

L - Lecture   T - Tutorial   P – Practical

Open Elective -IV								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2702A	Environmental Management & Audit	3	3	0	0	30	70	100
20CS2702A	Data Base Management Systems	3	3	0	0	30	70	100
20EC2702A	Telecommunications	3	3	0	0	30	70	100
20EC2702B	Satellite Communications	3	3	0	0	30	70	100
20IT2702A	Fundamentals of Artificial Intelligence	3	3	0	0	30	70	100
20ME2702A	Mechatronics	3	3	0	0	30	70	100
20ME2702B	Robotics	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HONORS -IV								
Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE6701A	Advanced Electrical Drives	4	3	1	0	30	70	100
20EE6701B	Grid Integration of Renewable Energy Systems	4	3	1	0	30	70	100
20EE6701C	Special Electrical Machines	4	3	1	0	30	70	100
20EE6701D	Semiconductor Device Modeling	4	3	1	0	30	70	100

L - Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks	Minor in
20CS5701	Cloud Computing	4	4	0	0	30	70	100	CSE
20IT5701	Cloud Computing	4	4	0	0	30	70	100	IT
20EC5701	Communication Systems	4	3	1	0	30	70	100	ECE
20EC5702	IOT Networks	4	3	1	0	30	70	100	IoT
20ME5701	Alternate Fuels and Emission control in Automotive	4	3	1	0	30	70	100	Automobile Engineering
20ME5702	INDUSTRY 4.0 and IIoT	4	3	1	0	30	70	100	Digital Manufacturing
20CE5701A	Basic Surveying	4	3	1	0	30	70	100	Civil

L - Lecture T - Tutorial P – Practical

Minor in CSE (MOOC's)		
S.No	**Title**	**Credits**
1	Introduction to Machine Learning	2
2	Data Science for Engineers	2
3	Introduction to Artificial Intelligence	2

IV B.Tech., II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE3861	Project work	**8**	**0**	0	0	60	140	200
Total		**8**		**0**	0			

L – Lecture T - Tutorial P – Practical

I B.TECH I SEMESTER SYLLABUS

I B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20HS1101	Communicative English I	3	3	0	0	30	70	100
20BS1101	Calculus and Linear Algebra	3	3	0	0	30	70	100
20BS1102	Engineering Chemistry	3	3	0	0	30	70	100
20ES1102	Problem Solving & Programming with Python	3	3	0	0	30	70	100
20ES1104	Engineering Graphics	3	1	0	4	30	70	100
20HS1151	Communicative English I Lab	1.5	0	0	3	15	35	50
20BS1151	Engineering Chemistry Lab	1.5	0	0	3	15	35	50
20ES1152	Problem Solving & Programming with Python Lab	1.5	0	0	3	15	35	50
20MC1101	Life Sciences for Engineers	0	2	0	2	30	70	100
Total		**19.5**	**15**	**0**	**15**	**225**	**525**	**750**

L – Lecture T – Tutorial P – Practical

COMMUNICATIVE ENGLISH I

Course Code	20HS1101	**Year**	I	**Semester**	I
Course Category	Humanities	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	Understand the concept of LSRW and basic grammar (L2)
CO2	Apply grammar to various situations (L3)
CO3	Practice different styles of Reading and Comprehending (L3)
CO4	Illustrate the text to process the information for various purposes. (L4)
CO5	Reframe the text for effective communication. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Reading:** Skimming to get the main idea of a text; Scanning to look for specific pieces of information. **Reading for Writing:** Beginnings and endings of paragraphs - Introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar and Vocabulary:** Content words and function words; Word forms: Verbs, Nouns, Adjectives and Adverbs; Nouns: countable and uncountable; singular and plural; Basic sentence structures; Simple Question form - wh-questions; Word order in sentences.	CO1,CO3, CO5
2	**Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; Mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; Use of articles and zero article; prepositions One word substitutes	CO1,C02, CO5
3	**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 - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. **Grammar and Vocabulary:** Verbs - Tenses; Subject-verb agreement; Direct	CO1,CO3, CO4,CO5

	And Indirect speech, Reporting verbs for academic purposes. Idiomatic expressions	
4	**Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. **Grammar and Vocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; Degrees of comparison; Use of antonyms **Correction of sentences**	CO1,CO2, CO4,CO5
5	**Reading:** Reading for comprehension. **Writing:** Writing structured essays on specific topics using suitable claims and evidences **Grammar and Vocabulary:** Editing short texts – Identifying and correcting common errors in grammar and usage (Articles, Prepositions, Tenses, Subject-verb agreement) **Prefixes/suffixes**	CO1,CO3, CO5

Learning Resources

Text Books

1. Prabhavathy Y, M.Lalitha Sridevi, Ruth Z. Hauzel, "English all Round 1: Communication skills for Undergraduate students", Orient Black Swan, 2019

Reference Books

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012

e- Resources & other digital material

Grammar/Listening/Writing:
1-language.com; http://www.5minuteenglish.com/
https://www.englishpractice.com/

Grammar/Vocabulary:
English Language Learning Online; http://www.bbc.co.uk/learningenglish/
http://www.better-english.com/; http://www.nonstopenglish.com/
https://www.vocabulary.com/; BBC Vocabulary Games
Free Rice Vocabulary Game

Reading:
https://www.usingenglish.com/comprehension/; https://www.englishclub.com/reading/short-stories.htm; https://www.english-online.at/

All Skills:
https://www.englishclub.com/; http://www.world-english.org/
http://learnenglish.britishcouncil.org/

Online Dictionaries:
Cambridge dictionary online; MacMillan dictionary; Oxford learner's dictionaries

CALCULUS AND LINEAR ALGEBRA

Course Code	20BS1101	**Year**	I	**Semester**	I
Course Category	Basic Science	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	**Understand** the basic concepts of calculus and linear algebra.(L2)
CO2	**Apply** the echelon form to obtain the solution of system of linear equations and eigen vectors of a matrix.(L3)
CO3	**Apply** the concepts of calculus to find the series expansion and extremum of a given function ,area enclosed by plane curves and volume of the solids. (L3)
CO4	**Analyse** the solution set of linear system of equations and nature of the quadratic forms. (L4)
CO5	**Analyse** the behaviour of functions using mean value theorems, extremum of the given function and limits of integration. (L4)
CO6	**Apply** the concepts of calculus and linear algebra to the given problem and **submit a report**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													2	1
CO2	3								2	2			2	1
CO3	3								2	2			2	1
CO4		3											2	1
CO5		3											2	1
CO6	3								2	2			2	1

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Matrices-Linear System of Equations:** Rank of a matrix by Echelon form, Normal form, PAQ form, solving system of homogeneous and non-homogeneous linear equations.	CO1,CO2, CO4,CO6
2	**Eigen values and Eigen Vectors:** Eigen values, Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalization of a matrix, quadratic forms and nature of the quadratic forms.	CO1,CO2, CO4,CO6
3	**Mean Value Theorems:** Rolle‘s Theorem, Lagrange‘s mean value theorem, Cauchy‘s mean value theorem, Taylor‘s and Maclaurin‘s theorems with remainders (without proofs).	CO1,CO3, CO5,CO6
4	**Multivariable Calculus:** Functions of several variables, Jacobian, Functional dependence, maxima and minima of functions of two variables, method of Lagrange's multipliers.	CO1,CO3, CO5,CO6
5	**Multiple Integrals:** Double integrals, change of order of integration, double integration in polar coordinates, Triple integrals, change of variables between Cartesian, cylindrical	CO1,CO3, CO5,CO6

	and spherical polar co-ordinates, volume as triple integral. **Application-** Areas enclosed by plane curves.	

Learning Resources
Text Books
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44/e, 2019. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006
Reference Books
1. N.P. Bali and Manish Goyal, A Text book of Engineering Mathematics, Laxmi Publications, 2008.
e- Resources & other digital material
1. https://nptel.ac.in/courses/111/108/111108157/ 2. https://www.nptel.ac.in/courses/111/104/111104125/ 3. https://youtu.be/xDSejIvZmg4 4. http://202.53.81.118/ -> PVPSIT FED-Moodle

ENGINEERING CHEMISTRY

Course Code	20BS1102	**Year**	I	**Semester**	I
Course Category	Basic Science	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	Understand the basic principles related to renewable energy sources, energy systems, metal finishing and materials (L2)
CO2	Apply the knowledge of energy transformation principles to classify and describe the working of electrodes and cells (L3)
CO3	Apply suitable methods for metal finishing and advanced techniques for the characterization of nano materials (L3)
CO4	Analyse the performance of different electrochemical techniques, energy conversion systems, polymers and nano materials in their respective applications (L4)
CO5	Make an effective report on various concepts and technologies related to Engineering chemistry.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	ELECTROCHEMICAL ENERGY SYSTEMS Introduction-Origin of electrode potential, Electrode Potentials, Measurement of Electrode Potentials, Nernst Equation for a single electrode, EMF of a cell, Types of Electrodes or Half Cells-Hydrogen and Calomel electrode, Electrochemical Cell, Galvanic Cell vs Electrolytic Cell, Electrochemical conventions, Types of Ion Selective Electrodes- glass membrane electrode, polymer membrane electrodes, solid state electrodes, gas sensing electrodes (classification only), Concentration Cells.	CO1,CO2, CO4,CO5
2	BATTERY TECHNOLOGY Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, lithium cells-Li Mno2 cell- challenges of battery technology. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane and oxygen fuel cell- Merits of fuel cell.	CO1,CO2, CO4,CO5
3	RENEWABLE SOURCES OF ENERGY Introduction- sources of renewable energy Solar energy – Introduction - Physical and Chemical properties of Silicon- Production of Solar Grade Silicon from Quartz - Doping of Silicon- p and n	CO1,CO2, CO4,CO5

	type semi conductors- PV cell / solar cell- Manufacturing of Photovoltaic Cells using Chemical Vapor Deposition Technique-applications of solar energy	
4	METAL FINISHING Technological importance of metal finishing, methods of metal finishing, manufacturing of electronic components, electrochemical techniques of forming, machining and etching, electrolytic cell, principle of electroplating, nature of electrodeposits, electroplating process, Electroplating of chromium, gold etc. Electroless plating of copper, nickel	CO1,CO3, CO4,CO5
5	POLYMERS & NANOMATERIALS Polymers: Introduction thermoplastic and thermo setting resins, Preparation, properties and uses of polystyrene and Polyphosphazines., differences between Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM).	CO1,CO3, CO4,CO5

Learning Resources

Text Books

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, DhanapatRai& Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill (2009).

Reference Books

1. Sashichawla, A Textbook of Engineering Chemistry, DhanapathRai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand& Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, M murthyPublications (2014).
5. K. SeshaMaheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

e- Resources & other digital material

1. https://nptel.ac.in/courses/105105178/
2. http://202.53.81.118/course/view.php?id=82

PROBLEM SOLVING AND PROGRAMMING WITH PYTHON

Course Code	20ES1102	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	Understand the principles of structured programming and C constructs for solving problems. (L2)
CO2	Apply suitable control constructs and array concepts to solve problems. (L3)
CO3	Apply the concept of pointers, user defined data types and files to solve problems. (L3)
CO4	Analyze the given problem and use modular programming approach to develop solutions. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Computational Thinking and Visual Programming Concepts** Introduction to computational thinking. Visual programming concepts. Scratch environment: sprites -- appearance and motion, angles and directions, repetition and variation, changing costumes, adding background, Input/output, variables and operators. **Problems** - draw geometrical shapes such as Circle, Triangle, Square and Pentagon, Make a sprite to ask the user to enter two different numbers and an arithmetic operator and then calculate and display the result, make a sprite to ask the user to enter a number to display even and odd numbers.	CO1, CO2
2	**Algorithms and Flowchart design through Raptor** Introduction to the idea of an algorithm, Pseudo code and Flowcharts. Flowchart symbols, Input/output, Assignment, operators, conditional if, repetition, procedure and sub charts. **Problems** - Finding maximum of 3 numbers, Unit converters, Interest calculators, and multiplication tables, GCD of 2 numbers, Fibonacci number generation, and prime number generation. Minimum, Maximum and average of n numbers.	CO1, CO2
3	**Introduction to Python** Features of Python, Writing and Executing First Python Program, Literal Constants, Variables and Identifiers, Reserved Words, Data Types, Input Operation, Operators and Expressions, Operations on Strings, Type Conversion, Conditional statements and iterative statements.	CO1, CO3
4	**Functions and Strings in Python**	CO1, CO3

	Functions: Introduction, Built-in Math Functions, User Defined Functions: Function Call, Variable Scope and Lifetime, The return statement, Lambda Functions, Packages in python. **Strings:** Introduction, Built-in String Functions, Slice Operation, Comparing Strings, Iterating String, Regular Expressions.	
5	**Files and Data Structures in Python** **File Handling:** open, close, read and write operations. **Data Structures:** **Lists:** Accessing values in lists, Nested Lists, Basic List Operations. **Tuples:** Creating Tuple, Accessing values in a tuple, Basic Tuple Operations. **Dictionaries**: Creating and Accessing Dictionaries, Built-in Dictionary functions, List Vs Tuple Vs Dictionary.	CO1, CO3,CO4

Learning Resources

Text Books

1. An introduction to programming and algorithmic reasoning using raptor, Weingart, Dr.Troy, Brown, Dr. Wayne, 2018, CreateSpace (an Amazon.com Company)
2. Core Python Programming, R. Nageswara Rao, 2018, Dreamtech press.

Reference Books

1. Python Programming: Using Problem Solving Approach, Reema Thareja, 2017, Oxford
2. University Press.
3. Programming with python, T R Padmanabhan, 2017, Springer.
4. Python for Data Analysis, Wes McKinney, 2012, O.Reilly.

e- Resources & other digital material

1. http://fusecontent.education.vic.gov.au/9f79537a-66fc-4070-a5ce-e3aa315888a1/scratchreferenceguide14.pdf
2. https://raptor.martincarlisle.com/
3. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf

ENGINEERING GRAPHICS

Course Code	20ES1104	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	1-0-4	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	Construct conic sections and curves used in Engineering practice. (L3)
CO2	Construct orthographic projections of an object when its position is defined with respect to the reference planes. (L3)
CO3	Develop the isometric view for the given orthographic projections and vice versa. (L3)
CO4	Develop the lateral surfaces of solids. (L3)
CO5	Identify the appropriate commands that are used to prepare the given drawing in CAD environment. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Introduction to Engineering Graphics**: Principles of Engineering Graphics and their significance- Conventions in drawing, lettering, dimensioning, BIS conventions. a) **Conic sections**: Construction of ellipse, parabola and hyperbola (general method only) b) **Cycloidal curves**: Cycloid, Epicycloid and Hypocycloid c) **Involutes**: Involute of regular polygons and Circle.	CO1
2	**Projection of points, lines and planes:** Projection of points in different quadrants, lines inclined to one and both the reference planes, finding true length and inclination made by the line. Projections of regular plane surfaces.	CO2
3	**Projections of solids:** Projections of regular solids such as cube, prism, pyramid, cylinder and cone (Treatment limited to solids inclined to one of the reference planes). **Sections of solids**: Section planes and sectional view of right regular Solids- cube, prism, cylinder, pyramid and cone. True shape of the section. (Treatment limited to the solids perpendicular to one of the principal planes)	CO2
4	**Orthographic Views**: Systems of projections, conversion of Isometric view to orthographic view. **Isometric Projections**: Principles of	CO3

	Isometric projection- Isometric scale; **Isometric views**: lines, planes and solids. (Treatment is limited to simple objects only)	
5	**Development of surfaces:** Development of lateral surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts. (Treatment limited to solids perpendicular to one of the principal planes)	CO4
	Introduction to CAD: Basic drawing, editing and dimensioning commands: line, polyline, circle, arc, polygon, ellipse, rectangle, erase, undo, redo, snap, move, copy, rotate, scale, mirror, offset, layer, trim, extend, fillet, chamfer, array, linear and angular dimension.	CO5

Learning Resources

Text Books

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

Reference Books

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill,2009.
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009.
3. K.Venugopal,EngineeringDrawingandGraphics,6/e,NewAgePublishers,2011.
4. K.C. John, Engineering Graphics, 2/e, PHI,2013.
5. Basant Agarwal and C.M. Agarwal, Engineering Drawing, TataMcGrawHill,2008.

e- Resources & other digital material

1. http://www.youtube.com/watch?v=XCWJ XrkWco, Accessed on 01-06-2017.
2. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html#isodrawing, Accessed on 01-06-2017.
3. http://www.slideshare.net, Accessed on 01-06-2017.
4. http://edpstuff.blogspot.in, Accessed on 01-06-2017.

COMMUNICATIVE ENGLISH I LAB

Course Code	20HS1151	**Year**	I	**Semester**	I
Course Category	Humanities	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

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

CO1	Acquire communication skills through various language learning activities (L3)
CO2	Construct meaningful sentences and Paragraphs(L3)
CO3	Analyze the text to develop comprehensive ability (L4)
CO4	Preparation of report based on the activity (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Expt. No.	Syllabus	Mapped CO's
1	Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.	CO1,CO4
2	Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.	
3	Answering a series of questions about main idea and supporting ideas after listening to audio texts.	CO1,CO2, CO4
4	Discussion in pairs/ small groups on specific topics followed by short structured talks.	
5	Listening for global comprehension and summarizing what is listened to.	CO1,CO3, C04
6	Discussing specific topics in pairs or small groups and reporting what is discussed	
7	Making predictions while listening to conversations/transactional dialogues without video; listening with video	CO1,CO4
8	Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.	
9	Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.	CO1,CO4
10	Formal oral presentations on topics from academic contexts -without the use of PPT slides.	

Learning Resources
Text Books
1. Prabhavathy Y, M.Lalitha Sridevi, Ruth Z. Hauzel, "English all Round 1: Communication skills for Undergraduate students", Orient Black Swan, 2019
Reference Books
1. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018. 2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational. 3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012
e- Resources & other digital material
Grammar/Listening/Writing: 1-language.com http://www.5minuteenglish.com/ https://www.englishpractice.com/ **Listening:** https://learningenglish.voanews.com/z/3613; http://www.englishmedialab.com/listening.html **Speaking:** https://www.talkenglish.com/BBC; Learning English – Pronunciation tips Merriam-Webster – Perfect pronunciation Exercises All Skills: https://www.englishclub.com/; http://www.world-english.org/ http://learnenglish.britishcouncil.org/ **Online Dictionaries:** Cambridge dictionary online; MacMillan dictionary; Oxford learner's dictionaries

ENGINEERING CHEMISTRY LAB

Course Code	20BS1151	**Year**	I	**Semester**	I
Course Category	Basic Science	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

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

CO1	Demonstrate the working of instruments such as pH meter and Conduct meter.(L3)
CO2	Apply the acquired knowledge to determine the quantity of metal ions in a given solution(L3)
CO3	Estimate the amount of active chlorine in bleaching powder.(L4)
CO4	Compare the viscosities and surface tension of different liquids(L4)
CO5	Analyze different compounds and examine the preparation of different polymers (L4)
CO6	Make an effective report based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		1				3						1	
CO2	3		1				3						1	
CO3	3		1				3						1	
CO4	3		1				3						1	
CO5	3		1				3						1	
CO6	3		1				3			3			1	

Syllabus

Expt. No.	Syllabus	Mapped CO's
1	Determination of strength of an acid by pH metric method	CO1,CO6
2	Determination of conductance by conducto metric method	
3	Determination of viscosity of a liquid	CO4,CO6
4	Determination of surface tension of a liquid	
5	Determination of chromium (VI) in potassium dichromate	CO2,CO6
6	Determination of Zinc by EDTA method	
7	Estimation of active chlorine content in Bleaching powder	CO3,CO6
8	Preparation of Phenol-Formaldehyde resin	CO5,CO6
9	Preparation of Urea-Formaldehyde resin	
10	Thin layer chromatography(paper chromatography)	

Learning Resources

Text Books

1. N.KBhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, DhanpatRai Publishing Company (2007).

Reference Books

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).

e- Resources & other digital material

1. https://nptel.ac.in/courses/105105178/
2. http://202.53.81.118/course/view.php?id=82

PROBLEM SOLVING AND PROGRAMMING WITH PYTHON LAB

Course Code	20ES1152	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

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

CO1	Apply visual programming concepts, flowchart design techniques and Python programming constructs for solving problems. (L3)
CO2	Conduct experiments as an individual, or team member by using Scratch/Raptor tools and Python programming. (L3)
CO3	Develop an effective report based on various programs implemented. (L3)
CO4	Apply technical knowledge for a given problem and express with an effective oral communication. (L3)
CO5	Analyze outputs generated through Scratch/Raptor tools and Python programming. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	Apply Visual Programming Concepts using Scratch tool.	CO1,CO2, CO3,CO4,CO5
2	Solve various computational problems by designing flowcharts using Raptor tool.	CO1,CO2, CO3,CO4,CO5
3	Python programs on usage of operators.	CO1,CO2, CO3,CO4,CO5
4	Python Programs to demonstrate decision making and branching (Selection)	CO1,CO2, CO3,CO4,CO5
5	Python programs to demonstrate iterative statements.	CO1,CO2, CO3,CO4,CO5
6	Python programs to demonstrate functions	CO1,CO2, CO3,CO4,CO5
7	Python programs to perform operations on strings, regular expressions with built – in functions.	CO1,CO2, CO3,CO4,CO5
8	Python programs to handle file operations.	CO1,CO2, CO3,CO4,CO5
9	Python programs to apply various data structures.	CO1,CO2, CO3,CO4,CO5
10	Installing, importing and accessing numpy and pandas packages.	CO1,CO2, CO3,CO4,CO5

Learning Resources
Text Books
1. An introduction to programming and algorithmic reasoning using raptor, Weingart, 2. Dr. Troy, Brown, Dr. Wayne, 2018, CreateSpace (an Amazon.com Company) 3. Core Python Programming, R. Nageswara Rao, 2018, Dreamtech press.
Reference Books
1. Python Programming: Using Problem Solving Approach, Reema Thareja, 2017, Oxford University Press. 2. Programming with python, T R Padmanabhan, 2017, Springer. 3. Python for Data Analysis, Wes McKinney, 2012, O.Reilly.
e- Resources & other digital material
1. http://fusecontent.education.vic.gov.au/9f79537a-66fc-4070-a5ce-e3aa315888a1/scratchreferenceguide14.pdf 2. https://raptor.martincarlisle.com/ 3. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf

LIFE SCIENCES FOR ENGINEERS

Course Code	20MC1101	Year	I	Semester	I
Course Category	Mandatory	**Branch**	EEE	**Course Type**	Theory
Credits	0	**L-T-P**	2-0-2	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	**Apply** the concepts of biology to create tangible and economically viable engineering goods.((L3)
CO2	**Analyse** new technologies in Genetics biotechnology, pharmaceutical, medical and agricultural fields from the knowledge gained from DNA technology.(L4)
CO3	**Apply** the knowledge of biology to improve the living standards of societies.(L3)
CO4	**Apply** the basic knowledge of genetics and DNA technology for disease diagnostics and therapy.(L3)
CO5	**Analyse** new technologies in biotechnology, pharmaceutical, medical and agricultural fields from the knowledge gained from DNA technology.(L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Introduction to Biology** Comparison of Biological organisms with manmade systems :Eye and Camera ,Flying bird and Aircraft Ultra structure of cell: Prokaryotes and Eukaryotes	CO1
2	**Bio-molecules** Structure and functions of proteins (antibodies) Structure and functions of nucleic acids Industrial applications- Enzymes and Fermentation	CO1 CO2
3	**Bioenergetics and Cellular Respiration** Mechanism of photosynthesis Glycolysis TCA cycle Electron transport chain and Oxidative phosphorylation.	CO3
4	**Genetics** Mendel'slaws Gene mapping Single gene disorders in humans	CO3 CO4
5	**Recombinant DNA Technology** Recombinant vaccines, transgenic microbes, plants and animals. Animal cloning, biosensors, biochips.	CO2 CO5

Expt. No.	Name of the experiment	Mapped CO’s
1	Dissect & mount different parts of plants using Microscope	CO1
2	Estimation of Proteins by using Biuret method	CO2
3	Estimation of enzyme activity.	CO2
4	Estimation of chlorophyll content in some selected plants.	CO3
5	Nitrogen Cycle: Estimation of Nitrates /Nitrites in soil by using Spectrophotometer	CO3
6	Mendal’s laws and gene mapping	CO4, CO5

Learning Resources

Text Books

1. Biology for Engineers-Wiley Editorial
2. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2018.
3. Biotechnology by U.Satyanarayana, Alliedand books Pvt. ltd. Kolkata

Reference Books

1. Alberts et al., The molecular biology of the cell, 6/e, Garland Science, 2014.
2. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012

I B.TECH II SEMESTER SYLLABUS

I B.Tech., II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20HS1201	Communicative English II	3	3	0	0	30	70	100
20BS1201	Differential Equations and Vector Calculus	3	3	0	0	30	70	100
20BS1203	Engineering Physics	3	3	0	0	30	70	100
20ES1201	Basic Electrical & Electronics Engineering	3	3	0	0	30	70	100
20HS1251	Communicative English II Lab	1.5	0	0	3	15	35	50
20BS1252	Engineering Physics Lab	1.5	0	0	3	15	35	50
20ES1251	Basic Electrical & Electronics Engineering Lab	1.5	0	0	3	15	35	50
20ES1252	Basic Workshop	3	1	0	4	15	35	50
20MC1241A /20MC1241B	NSS / NCC	0	0	0	2	Completed / Not completed		
Total		**19.5**	**13**	**0**	**15**	**180**	**420**	**600**

L – Lecture T – Tutorial P – Practical

COMMUNICATIVE ENGLISH II

Course Code	20HS1201	**Year**	I	**Semester**	II
Course Category	Humanities	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	Understand various Linguistic aspects (L2)
CO2	Apply language to draft letters for various business purposes(L3)
CO3	Interpret the text for information processing and effective communication. (L3)
CO4	Analyze the data for report writing and précis writing. (L4)
CO5	Relate advanced writing skills for better employability. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Reading:** Reading for presenting - strategies to select, compile and synthesize information for presentation-Comprehending a wide range of texts -Reading to recognize academic style **Reading for Writing:** Paraphrasing - using quotations and in-text references; using academic style - avoiding colloquial words and phrases - Writing an essay after researching a topic - Citing the sources used **Grammar and Vocabulary:** Academic verbs in context; formal words and phrases-Awareness about Root words	CO1, CO3, CO5
2	**Reading:** Recognizing formal and informal styles -Recognizing the difference between facts and opinions - Identifying and understanding different perspectives **Writing:** Letter writing and e mail writing - Structure, Conventions and Etiquette – Informal, semi-formal and formal (enquiry, complaints, seeking permission, seeking internship - Re-draft a piece of text from a different perspective - Writing brief critical reviews of short texts. Communication skills-verbal /Non verbal **Grammar and Vocabulary:** Agreement: Subject-verb, Noun-pronoun; Editing short texts - Phrasal verbs - Phrasal prepositions - Avoiding clichés	CO1,CO2, CO4, CO5
3	**Reading:** Identifying claims, evidences, views/opinions, purpose, and stance/position -Understand the correlation between a talk and a reading text based on inferences made. **Writing:** Writing structured analytical and argumentative essays on general topics using suitable claims and evidences with the sources cited-Peer review of	CO1, CO3, CO5

	the essays written **Grammar and Vocabulary:** Language for different functions such as stating a point, expressing opinion, Agreeing/disagreeing, Adding information to what someone has stated, and asking for clarification - Modifiers and misplaced modifiers. Corporate grooming	
4	**Reading:** Reading varied text types - Structure and contents of a formal report - Sections in a report and understanding the purpose of each section- Significance of references **Writing:** Writing reports **Grammar and Vocabulary:** Active and passive voice - Use of passive verbs in academic writing- **Precis writing**	CO1, CO3 CO4, CO5
5	**Reading:** Reading for inferential comprehension **Writing:** Writing one's CV and cover letter - Applying for a job/internship **Grammar and Vocabulary:** Reinforcing learning **-** Edit one's writing to correct common errors in grammar and usage **-** Use appropriate vocabulary for speaking and writing – Various purposes, Jumbled sentences	CO1, CO2, CO5

Learning Resources

Text Books

1. Prabhavathy Y, M.Lalitha Sridevi "English all Round2: Communication skills for Undergraduate students", Orient Black Swan, 2020

Reference Books

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012(Student Book, Teacher Resource Book, CD & DVD)

e- Resources & other digital material

Grammar/Listening/Writing:
1-language.com; http://www.5minuteenglish.com/ https://www.englishpractice.com/
Grammar/Vocabulary:
English Language Learning Online; http://www.bbc.co.uk/learningenglish/
http://www.better-english.com/; http://www.nonstopenglish.com/
https://www.vocabulary.com/; BBC Vocabulary Games
Free Rice Vocabulary Game
Reading:
https://www.usingenglish.com/comprehension/; https://www.englishclub.com/reading/short-stories.htm; https://www.english-online.at/
All Skills:
https://www.englishclub.com/; http://www.world-english.org/ http://learnenglish.britishcouncil.org/
Online Dictionaries:
Cambridge dictionary online; MacMillan dictionary; Oxford learner's dictionaries

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Code	20BS1201	**Year**	I	**Semester**	II
Course Category	Basic Science	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	Understand the basic concepts of differential equations and vector calculus (L2).
CO2	Apply different methods to solve differential equations (L3).
CO3	Apply the differential operator to calculate the divergence and flux of vector point functions (L3).
CO4	Analyse the given differential equation to find the solution (L4).
CO5	Calculate work done and flux by applying vector integral theorems (L4).
CO6	Apply the concepts of differential equations and vector calculus to the given problem and submit a report (L3).

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													2	1
CO2	3								2	2			2	1
CO3	3								2	2			2	1
CO4		3											2	1
CO5		3											2	1
CO6	3								2	2			2	1

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Ordinary Differential Equations Of First order and First degree**: Exact differential equations, Equations reducible to exact equations, orthogonal trajectories in Cartesian and polar coordinates. **Applications**: Newton's Law of cooling, Law of Natural growth and decay.	CO1,CO2, CO4,CO6
2	**Linear Differential Equations of Higher Order: O**perator D, rules for finding complementary function, inverse operator, rules for finding particular integral, method of variation of parameters.	CO1,CO2, CO4,CO6
3	**Partial Differential Equations:** Formation of partial differential equations, Linear equations of first order, Non-Linear equations of first order, Charpit's method.	CO1,CO2, CO4,CO6
4	**Vector Differentiation:** Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions- Divergence and Curl.	CO1,CO3, CO5,CO6
5	**Vector Integration:** Line integral, surface integral, volume integral, Green's theorem in the plane, Stoke's theorem, Divergence theorem (All theorems without proof). **Applications**: work done, flux.	CO1,CO3, CO5,CO6

Learning Resources
Text Books
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44/e, 2019. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.
Reference Books
1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3/e, Alpha science International Ltd,2002
e- Resources & other digital material
1. https://nptel.ac.in/courses/111/105/111105121/ 2. https://nptel.ac.in/courses/111/105/111105122/ 3. https://nptel.ac.in/courses/111/107/111107108/ 4. http://202.53.81.118/ -> PVPSIT FED Moodle

ENGINEERING PHYSICS

Course Code	20BS1203	**Year**	I	**Semester**	II
Course Category	Basic Science	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the electric, magnetic, optical communication and semiconductor principles in technical aspects. **(L2)**
CO2	**Apply** the knowledge of Physics and optical Principles in optoelectronic devices. **(L3)**
CO3	**Apply** basic laws of electromagnetism and materials for engineering applications**. (L3)**
CO4	**Analyze** the theory of solids and deduce different analytical parameters. **(L4)**
CO5	**Examine** the mechanism of electromagnetic, in sensors and semiconductor devices. **(L4)**
CO6	**Ability** to understand the concepts of optical fibers, the theory of solids, laws of electromagnetism, principles of semiconductor devices and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												1	2
CO3	3												1	2
CO4		3											1	2
CO5		3											1	2
CO6									2	2		2	1	2

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Fiber Optics:** Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, fiber optic sensors (Temperature, displacement and force), applications.	CO1,CO2 CO5, CO6
2	**Dielectric and Magnetic materials** **Dielectric-materials:** Introduction, electronic polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (Qualitative),frequency dependence of polarization, Lorentz field (quantitative), Clausius-Mossotti equation. **Magnetic materials:** Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, domain theory, hysteresis, soft and hard magnetic materials.	CO1,CO3 CO4, CO6
3	**Electromagnetics:** **Electrostatic field:** Electric potential, Coulombs law and Gauss law, derivation of Coulombs law from Gauss law, applications of Gauss law (line charge, thin sheet of charge and solid charged sphere), Gauss law of electrostatics in dielectric medium, Poisson's and Laplace equations. **Magnetostatic field:** Bio–Savart law, Faraday's and Ampere's laws in	CO1,CO3 CO5, CO6

	integral and differential form, displacement current, continuity equation and Maxwell's equations (qualitatively).	
4	**Semiconductor Physics** Introduction, origin of energy band, intrinsic and extrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of Fermi level with temperature in intrinsic semiconductor, n-type and p-type semiconductors, carrier concentration in n type and p type semiconductors, variation of Fermi level with temperature in extrinsic semiconductors.	CO1,CO3, CO4, CO6
5	**Semiconductor Devices** Drift and diffusion currents in semiconductors, Hall effect and its applications, p-n junction diode formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell	CO1, CO2, CO5, CO6

Learning Resources

Text Books

1. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001.
2. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016)

Reference Books

1. A Text Book of Engineering Physics, M.N.Avadhanulu & P.G.Kshrisagar, S.Chand Publications, fourth edition, 2014.
2. Semiconductor Devices & Physics, S.M.Sze,Wiley, 2008.
3. Applied Physics, P.K. Palanai Swamy, Sci-Tech Publications. December, 2018
4. Engineering Physics, Dr.M.Arumugam, Anuradha Publications, Second edition, 2005.
5. Introduction To Electrodynamics, David.J.Griffths, Pearson Education India Learning Private Limited, Fourth edition, 2015.

e- Resources & other digital material

1. http://physicsforidiots.com/physics/electromagnetism/
2. https://www.arcelect.com/fibercable.htm
3. http://freevideolectures.com/Course/3048/Physics-of-Materials/36
4. https://www.iitk.ac.in/mse/electronic-materials-and-devices
5. https://link.springer.com/chapter/10.1007/978-3-319-48933-9_35

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Course Code	20ES1201	**Year**	I	**Semester**	II
Course Category	Engineering Science	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	**Understand** the basic concepts of DC circuits, Electrical Machines, Concepts of Electronic Devices and Circuits and realize the Applications of Electrical & Electronics in Interdisciplinary Engineering Domains (L2)
CO2	**Apply** the basic knowledge of mathematics, science and electrical engineering to obtain the desired parameters of Electric circuits and Machines. (L3)
CO3	**Analyse** the behaviour of Electric circuits, transformers and Electrical machines. (L4)
CO4	**Apply** the basic principles of Electronics to solve Analog Circuits. (L3)
CO5	**Analyse** the characteristics/ performance parameters of Electronic Circuits. (L4)
CO6	Ability to **investigate** various problems in DC circuits, Electrical Machines and Electronic Devices and Circuits and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3		3											2	1
CO4	3												2	1
CO5		3											2	1
CO6				3					2	2			2	1

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Basic laws and Theorems-DC Circuits**: Ohms law, Kirchhoff's Laws, series and parallel resistive circuits, source transformations, delta-wye conversion. Mesh analysis, nodal analysis. Superposition theorem, Thevenin's theorem, Norton's theorem and maximum power transfer theoremwith simple examples (**independent sources only**).	CO1,CO2, CO3,CO6
2	**DC Machines**: Construction, working principle, Voltage Build up, EMF equation, Torque expression, types of excitation, types of dc machines, necessity of Starter, losses and efficiency.	CO1,CO2, CO3,CO6
3	**Transformers**: Construction, working principle, EMF equation, open and short-circuit tests, voltage regulation definition, losses and efficiency. **Three Phase Induction Motors:** Construction, working principle of three phase induction motor.	CO1,CO2, CO3,CO6
4	**Semiconductor Devices**: P-N Junction diode - Basic operating principle, current-voltage characteristics, half-waverectifier, full-waverectifier,rectifiers with filter capacitor, Zener diode as Voltage Regulator.	CO1,CO4, CO5,CO6
5	**Operational Amplifiers**: The Ideal Op Amp, The Inverting Configuration-The	CO1,CO4,

	closed loop gain, Effect of Finite open-loop gain, The Non-inverting Configuration - The closed loop gain, Characteristics of Non Inverting Configuration, Effect of finite open loop gain, The voltage follower.	CO5,CO6

Learning Resources

Text Books

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1st Edition, McGraw Hill Education (India) Private Limited, 2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1st Edition, S.Chand Publishing, New Delhi, 2006.
3. Millman Jacob, Halkias C Christos, Electronic Devices and Circuits, 2nd Edition, Tata Mcgrawhill Publications, 2007.

Reference Books

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2nd Edition, Pearson Education, 2008.
3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

e- Resources & other digital material

1. http://202.53.81.118/course/view.php?id=122
2. https://nptel.ac.in/courses/108105112/

COMMUNICATIVE ENGLISH II LAB

Course Code	20HS1251	**Year**	I	**Semester**	II
Course Category	Humanities	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

Upon successful completion of the course, the student will be able to	
CO1	Hone employability skills (L3)
CO2	Develop an ability of making discussions, inferences and presentations (L3)
CO3	Refine communication skills through various strategies (L4)
CO4	Process the information in different contexts (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Expt. No.	Syllabus	Mapped CO's
1	**Listening for presentation strategies and answering questions on the speaker, audience, and key points**	CO1, CO2, CO4
2	Formal presentations using PPT slides (individual)	
3	Relating a reading text to a talk/presentation – understanding different perspectives and drawing inferences	CO1, CO2, CO4
4	Formal team presentations using PPT slides/audio- visual aids	
5	Identifying views and opinions expressed by different speakers while listening to discussions	CO1, CO3, C04
6	Group discussion on general topics	
7	Processing of information using context clues while listening to talks/lectures	CO1, CO3, CO4
8	Role plays – people from various fields of work	
9	Processing of explicit information presented in the text and implicit information inferable from the text or from previous/background knowledge	CO1, CO3, CO4
10	Mock interviews for jobs/internships	

ENGINEERING PHYSICS LAB

Course Code	20BS1252	**Year**	I	**Semester**	II
Course Category	Basic Science	**Branch**	EEE	**Course Type**	Theory
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

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

CO1	Demonstrate the importance of dielectric material and measure magnetic parameters. [L3]
CO2	Identify the type of semiconductor using hall effect and measure the energy band gap. [L3]
CO3	Examine the characteristics of photodiode, p-n junction diode and solar cell. [L4]
CO4	Assess the intensity of the magnetic field of circular coil carrying current with distance and measure resistance using four probe method. [L4]
CO5	Estimate the acceptance angle of an optical fiber and numerical aperture. [L4]
CO6	Summarize and tabulate the experimental observations and output.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3								2	1	2
CO2	3			3								2	1	2
CO3	3			3								2	1	2
CO4	3			3								2	1	2
CO5	3			3								2	1	2
CO6	3			3								2	1	2

Syllabus

Expt. No.	Syllabus	Mapped CO's
1	Determine the Dielectric Constant of various Solid samples.	CO1,CO6
2	Determine the Magnetic Susceptibility by Gouy's Method.	
3	Determine the Hall Coefficient using Hall Effect experiment.	CO2,CO6
4	Determine the Energy Band gap of a Semiconductor.	
5	Study the characteristic curves of a Photo Diode.	CO3,CO6
6	Illustrate the V-I the characteristics of P-N junction Diode.	
7	Draw the V-I characteristics of a Solar Cell.	
8	Determine The Magnetic Field along the axis of a Circular Coil carrying current.	CO4,CO6
9	Determine the Resistivity of Semiconductor by Four Probe Method.	
10	Determine the Numerical Aperture of a given Optical Fibre and Find its Acceptance Angle.	CO5,CO6

Learning Resources
Text Books
1. RamaraoSri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics" Vth ed., Excell Books, 2010
Reference Books
1. Semiconductor Devices & Physics, S.M.Sze,Wiley,2008.
e- Resources & other digital material
1. https://nptel.ac.in/courses/115/105/115105120/ 2. https://nptel.ac.in/courses/115/107/115107095/ 3. https://nptel.ac.in/courses/115/104/115104109/ 4. http://www.physicsclassroom.com/The-Laboratory 5. https://www.vlab.co.in/broad-area-physical-sciences 6. https://www.niser.ac.in/sps/teaching-laboratories

BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB

Course Code	20ES1251	**Year**	I	**Semester**	II
Course Category	Engineering Science	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

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

CO1	**Apply** techniques/procedures of Electrical & Electronics Engineering to solve problems (L3).
CO2	Conduct experiments as a team / individual by using equipment available in the laboratory.
CO3	**Examine** the network theorems and Kirchhoff's laws for DC electrical circuits (L4).
CO4	**Analyse** the open circuit characteristic of DC shunt generator and efficiency of single phase transformer (L4).
CO5	**Analyse** the characteristics/ performance parameters of Electronic and Analog Circuits. (L4)
CO6	make an effective report based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3									1	1
CO2				3	3				3				1	1
CO3		3		3									1	1
CO4		3		3									1	1
CO5		3		3									1	1
CO6				3						3			1	1

Syllabus

Expt. No.	Syllabus	Mapped CO's
	Conduct any ten experiments	
1	Verification of Kirchhoff's Laws KVL and KCL.	CO1,CO2, CO3,CO6
2	Verification of DC Superposition Theorem.	CO1,CO2, CO3,CO6
3	Verification of Thevenin's Theorem and Norton's Theorem.	CO1,CO2, CO3,CO6
4	Open circuit characteristics/magnetization characteristics of DC shunt generator.	CO1,CO2, CO4,CO6
5	OC and SC Tests on single phase transformer.	CO1,CO2, CO4,CO6
6	Voltage Current Characteristics of a p-n Junction Diode.	CO1,CO2, CO5,CO6
7	Half wave rectifier with and without filter.	CO1,CO2, CO5,CO6
8	Full wave rectifier with and without filter.	CO1,CO2, CO5,CO6
9	Voltage Regulation with Zener Diode.	CO1,CO2,

		CO5,CO6
10	Inverting and Non-inverting Amplifier Design with Op-amp.	CO1,CO2, CO5,CO6
11	Verification of KCL and KVL using PSPICE.	CO1,CO2, CO3,CO6
12	Verification of Network Theorems using PSPICE.	CO1,CO2, CO3,CO6
13	Diode and Transistor Circuit Analysis using PSPICE.	CO1,CO2, CO5,CO6
14	Inverting and Non-inverting Amplifier Design with Op-ampusing PSPICE.	CO1,CO2, CO5,CO6

Learning Resources

Text Books

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1st Edition, McGraw Hill Education (India) Private Limited, 2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1st Edition, S.Chand Publishing, New Delhi, 2006.
3. Millman Jacob, Halkias C Christos, Electronic Devices and Circuits, 2nd Edition, Tata Mcgrawhill Publications, 2007.

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1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2nd Edition, Pearson Education, 2008.
3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

e- Resources & other digital material

1. http://202.53.81.118/course/view.php?id=122
2. https://nptel.ac.in/courses/108105112/

BASIC WORKSHOP

Course Code	20ES1252	**Year**	I	**Semester**	II
Course Category	Engineering Science	**Branch**	ECE	**Course Type**	Lab
Credits	3	**L-T-P**	1-0-4	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

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

CO1	**Study and practice on basic hand tools and their operations. (L3)**
CO2	**Practice on manufacturing of components using workshop trades including Tin smithy, fitting and carpentry. (L3)**
CO3	**Apply basic electrical engineering knowledge for house wiring and soldering practice. (L3)**
CO4	Demonstrate basic concepts of software installations, operating systems and networking. **(L3)**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	Familiarity with different types of woods and tools used in wood working and make following joints 1. Half – Lap joint. 2. Mortise and Tenon joint. 3. Corner Dovetail joint or Bridle joint.	CO1, CO2
2	Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets 1. Tapered tray 2. Conical funnel **3.** Elbow pipe	CO1, CO2
3	Familiarity with different types of tools used in fitting and do the following fitting exercises 1. V-fit 2. Dovetail fit 3. Semi-circular fit 4. Bicycle tire puncture and change of two wheeler tire	CO1, CO2
4	**Familiarities with different types of basic electrical circuits and make the following connections** 1. Preparation of a circuit for Parallel and series connection. 2. Preparation of a circuit for Go down lighting using Two-way 3. switch to connect tube light. 4. Soldering of wires	CO1, CO3
5	**1.** Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify	CO4

<table>
<tr><td></td><td>the problem and fix it to get the computer back to working condition.
2. nstallation of MS-Windows and Linux. Connection of LAN and access the Internet, Configuration of TCP/IP setting and access of websites and email.
3. Exploring MS-Word and sample tasks. Document creation and editing text documents in your web browser using Google docs.</td><td></td></tr>
<tr><td colspan="3" align="center">Learning Resources</td></tr>
<tr><td colspan="3">Text Books</td></tr>
<tr><td colspan="3">1. Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech Publishers.
2. Workshop Manual / Venkat Reddy/ BS Publications/Sixth Edition.</td></tr>
</table>

II B.TECH I SEMESTER SYLLABUS

II B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20BS1302	Numerical Methods & Complex Variables	3	3	0	0	30	70	100
20ES1302	Circuit Theory	3	3	0	0	30	70	100
20EE3301	Electronic Devices & Amplifier Circuits	3	3	0	0	30	70	100
20EE3302	Signals and Systems	3	3	0	0	30	70	100
20EE3303	Electrical Machines-I	3	3	0	0	30	70	100
20ES1352	Circuit Theory Lab	1.5	0	0	3	15	35	50
20EE3351	Electronic Devices & Amplifier Circuits Lab	1.5	0	0	3	15	35	50
20EE3352	Electrical Machines-I Lab	1.5	0	0	3	15	35	50
20SO8352	Electrical Workshop	2	1	0	2	0	50	50
20MC1341A /20MC1341B	NSS / NCC	-	0	0	2	-	-	-
20EE3391	Community Service Project	4	0	0	-		100	
Total		**21.5**	**16**	**0**	**13**			

L - Lecture T - Tutorial P – Practical

NUMERICAL METHODS & COMPLEX VARIABLES

Course Code	20BS1302	Year	II	Semester	I
Course Category	Basic Sciences course	Branch	ECE, EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes	
After successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of Numerical Methods and complex variables.(L2)
CO2	**Apply** different Numerical methods to solve the problems of numerical differentiation, integration, ordinary differential equations.(L3)
CO3	**Construct** an analytic function and complex power series. (L3)
CO4	**Estimate** the interpolated values, approximate roots, areas and derivatives. (L4)
CO5	Analyse the region to evaluate integrals. (L4)
CO6	**Apply the** concepts of Numerical methods and Complex variables to solve the problems and submit a report. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations(3-High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3								2	2				
CO3	3								2	2				
CO4		3												
CO5		3												
CO6	3								2	2				

Unit No.	Contents	Mapped COs
I	**Solution to Algebraic and Transcendental Equations** Solution of algebraic and transcendental equations: Bisection method, methodof false position and Newton-Raphson's method. Finite differences, relation between operators, interpolation using Newton'sforward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formula. (All theorems/properties without proofs)	**CO1,CO2, CO4,CO6**
II	**Numerical Differentiation and Integration** Numerical Differentiation- Newton's forward and backward difference formulae. Numerical integration- trapezoidal rule, Simpson's $\frac{1}{3}^{rd}$ - and $\frac{3}{8}^{th}$ - rules. Ordinary differential equations: Euler's, modified Euler's, Runge-Kutta methodof fourth order for solving first order equations. (All theorems/properties withoutproofs)	**CO1,CO2, CO4,CO6**
III	**Functions of a complex variable:** Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesianand polar coordinates. Harmonic and conjugate harmonic functions – Milne- Thompson's method. (All theorems/properties without proofs)	**CO1,CO3, CO5,CO6**
IV	**Complex Integration:** Line integral – Evaluation along a path– Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula. Complex power series: Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series. (All theorems/properties without proofs)	**CO1,CO3, CO5,CO6**
V	**Singular points** – Isolated singular point – pole of order n – essential singularity. **Residue** – Evaluation of residues - Residue theorem - Evaluation of integrals of the form $\int_0^{2\pi} f(\cos\theta,\ \sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$ (All theorems/properties without proofs)	**CO1,CO3, CO5,CO6**

Learning Resource(s)
Text Book(s)
1. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44/e, 2019. 2. Engineering Mathematics (Volume – III) - S. Chand - T. K. V. Iyengar, B. Krishna Gandhi, S.Ranganatham, M.V.S.S.N. Prasad- 9th Revised Edition: 2012.
Reference Book(s)
1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 9/e, John Wiley & Sons, 2006.
e- Resources & other digital material
1. https://www.nptel.ac.in/courses/111/107/111107105/ 2. https://www.nptel.ac.in/courses/111/105/111105134/ 3. https://nptel.ac.in/courses/111/106/111106141/

CIRCUIT THEORY

Course Code	20ES1302	Year	II	Semester(s)	I
Course Category	Engineering Science	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	BEEE (20ES1201)
Continuous Internal Evaluation	**30**	Semester End Evaluation:	**70**	Total Marks:	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of AC circuits, Resonance, Concepts of magnetically coupled circuits, two port networks, transient analysis and three phase circuits(L2)
CO2	**Apply** the basic electrical laws, engineering mathematics and sciences to obtain, the desired circuit variables, steady state, transient responses of electrical circuits and relationship between two port network parameters. (L3)
CO3	**Apply** the principles of electrical engineering to solve resonant circuits, magnetically coupled circuits, three phase networks and verify circuit theorems. (L3)
CO4	**Analyze** the different three phase circuit configurations and transient response of electrical circuits. (L4)
CO5	**Analyze** two port networks, super mesh and super node circuits to obtain desired parameters. (L4)
CO6	**Investigate** various electrical circuit problems and **submit a report**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												3	1
CO3	3												3	1
CO4		2											3	1
CO5		2											3	1
CO6									3	3			2	

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Sinusoids & Phasors:** Sinusoids, Phase, Phase difference, Phasors, phasor relationships for circuit elements. Complex and polar form representations, J-notation, Effective values of current and voltage. Instantaneous power, average power, Apparent power, real power, reactive power, power triangle, complex power, power factor. Steady state analysis of RL, RC and RLC circuits.	**CO 1** **CO 2** **CO 6**
II	**Resonance:** Series resonance, Parallel resonance, bandwidth, quality factor. Super Mesh and Super Node, Reciprocity theorem, Millman's theorem, Compensation theorem and Tellegen's theorem.	**CO 1** **CO 3** **CO 5** **CO 6**
III	Magnetically coupled circuits, Self-Inductance, Mutual Inductance, Coupling coefficient, Dot convention. Two port networks - impedance parameters, admittance parameters, Hybrid parameters and Transmission parameters, relationships between parameters.	**CO 1** **CO 2** **CO 3** **CO 5** **CO 6**
IV	**Transient Analysis:** Time response of RL, RC, RLC series circuits for Zero input, Step input, sinusoidal excitation - Initial conditions-solution approachusing differential equation and Laplace transforms.	**CO 1** **CO 2** **CO 4** **CO 6**
V	Three –phase circuits: Phase sequence, Relation between line and phase voltages and currents in balanced systems – Analysis of balanced three phase circuits – two wattmeter method for measurement of active & reactive power, measurement of three phase reactive power using one wattmeter method.	**CO 1** **CO 3** **CO 4** **CO 6**

Learning Resources

Text Books

1. William H. Hayt Jr., Jack E. Kemmerly, 'Engineering Circuit Analysis', 9/e, McGraw Hill,2020.
2. Charles K.Alexander, Mathew N.O.Sadiku, "Fundamentals of Electric Circuits" (Sixth Edition), Tata McGraw-Hill,2019.

Reference Books

1. Van Valkenburg M.E, 'Network Analysis', 3/e, Prentice Hall India , 2014
2. Sudhakar and ShyamMohan ,Network Theory', ,2/e, TMH,2012.
3. Schaum's outlineseries—Basiccircuit analysis,McGraw-Hill Professional, 2012
4. A.Chakrabarti,Circuit Theory – Analysis and Synthesis', 7/e, DhanpatRai and Company, 2014.

Web Links

1. https://nptel.ac.in/courses/117/106/117106108/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/

ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS

Course Code	20EE3301	Year	II	Semester	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	BEEE
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Describe** the basic concepts of BJT, MOSFET Circuits and IC design Philosophy**. (L2)**
CO2	**Analyze** the BJT and MOSFET Characteristics. **(L4)**
CO3	**Analyze** the Amplifiers using MOSFET **(L4)**
CO4	**Apply** the different biasing techniques of BJT, MOSFET and IC Design **(L3)**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2									2			2	
CO2		3								3			3	
CO3		3								3			3	
CO4	3									3			3	

Syllabus

Unit No.	Contents	Mapped CO
I	**Bipolar Junction Transistors:** Device structure and physical operation, current-voltage characteristics, the BJT as an amplifier and as a switch, biasing in BJT amplifier circuits, small signal operation and models.	CO1,CO2,CO4
II	**MOS Field-Effect Transistors:** Device structure and physical operation, current-voltage characteristics, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation and models.	CO1,CO2,CO4
III	**Single Stage MOSFET Amplifiers:** Estimating 3dB frequency of amplifiers, Basic MOSFET amplifier configurations, MOSFET internal capacitances and high frequency model. Low Frequency and High Frequency Response Of MOSFET Amplifiers	CO1, CO3
IV	**Differential Amplifiers:** The MOS differential pair, small-signal operation of the MOS differential pair, other non-ideal characteristics of MOS differential amplifier, the MOS differential amplifier with active load, multistage MOS amplifiers.	CO1, CO3
V	**IC Design Philosophy**: Comparison of the MOSFET and the BJT, IC biasing-current sources, current mirrors and current-steering circuits,	CO1,CO4

Learning Resources
Text Books
1.Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.
Reference Books
1. BehzadRazavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013. 2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009. 3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
e- Resources & other digital material
http://www.faadooengineers.com/threads/4615-Electronic-Devices-and-Circuit-Theory-Boylestad-and-Nashelsky https://docplayer.net/53934331-J-b-gupta-electronic-devices-and-circuits.html

SIGNALS AND SYSTEMS

Course Code	20EE3302	Year	II	Semester	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Identify** different characteristics of signals and systems (L2).
CO2	**Apply** different signal operations to characterize systems (L3).
CO3	**Apply** the various transform techniques to evaluate periodic and aperiodic signals (L3).
CO4	**Analyse** the various continuous and discrete-time signals using various transform techniques (L4).

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Contents	Mapped CO
I	**Signals and Systems:** Continuous-time and Discrete-time signals, Transformations of the independent variable, Exponential and Sinusoidal signals, The unit impulse and unit step functions, Continuous-time and Discrete-time systems, Basic System properties.	CO1, CO2
II	**Linear Time Invariant Systems(LTI systems):** Discrete-time LTI systems, The convolution sum, Continuous time LTI systems, The convolution Integral, Properties of Linear Time-Invariant Systems.	CO1,CO2
III	**Fourier analysis of Continuous Time Signals and Systems:** Fourier series representation of continuous time periodic signals, convergence of the Fourier series, Properties of continuous-time Fourier series. The Continuous-Time Fourier Transform: The Fourier transform for periodic signals. Properties of the Continuous-time Fourier transform, Systems characterized by linear constant-coefficient differential equations.	CO1, CO3, CO4
IV	**Fourier analysis of Discrete Time Signals and Systems:** The Discrete-Time Fourier Transform, Properties of the Discrete-time Fourier transform, The Fourier transform for periodic signals. Systems characterized by linear constant-coefficient difference	CO1, CO3, CO4

	equations.	
V	**Analysis of Continuous time and Discrete time signals using Laplace Transform and Z Transform:** The Laplace Transform: The Region of convergence for Laplace transforms, the Inverse Laplace transform, Properties of the Laplace transform. The Z-Transform: The Region of Convergence for the Z-transform, The Inverse Z-transform, Properties of the Z-transform.	CO1, CO3, CO4

Learning Resources
Text Books
1. Alan V. Oppenheim, Alan S. Wilsky with S.Hamid Nawab, 'Signals and Systems', 2/e, Pearson Education, 1997.
Reference Books
1. Simon Haykin, Barry Van Veen, 'Signals and Systems', 2/e, Wiley Student Edition. 2. Bhagawandas P. Lathi, 'Linear Signals and Systems', Oxford University Press, 2009. 3. Signals and Systems using MATLAB, Kindle Edition, Luis Chaparro
e- Resources & other digital material
1. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and %20System/TOC-M1.htm 2. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and %20System/Course%20Objective.htm. 3. http://www.stanford.edu/~boyd.ee102 4. http://www.ece.gatech.edu/users/bonnie/book 5. http://ocw.mit.edu

ELECTRICAL MACHINES-I

Course Code	20EE3303	**Year**	II	**Semester(s)**	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basic Electrical and Electronics Engineering
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of magnetic circuits, construction and operation of DC machines, single phase transformer, auto transformer and three phase transformer. (L2)
CO2	**Apply** the basic knowledge to obtain the desired parameters/performance characteristics of magnetic systems and DC machines. (L3)
CO3	**Apply** the basic knowledge to obtain the desired parameters/performance characteristics of single phase transformer, auto transformer and three phase transformer. (L3)
CO4	**Analyze** the performance characteristics, speed control methods and testing techniques of DC machines. (L4)
CO5	**Analyze** the different configurations and testing techniques of single phase transformer, auto transformer and three phase transformer. (L4)
CO6	**Submit a report** in DC machines, single phase transformer, auto transformer and three phase transformer.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3	3												2	1
CO4		3											2	1
CO5		3											2	1
CO6									3	3			2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	Magnetic circuits: Definition of magnetic quantities, analysis of magnetic circuits- series, parallel, leakage flux, comparison of magnetic and electric circuits. B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; Energy in Magnetic Systems-Field energy and mechanical force-singly and doubly excited magnetic field systems- forces and torques in systems with electromagnets.	CO1 CO2 CO6
II	DC Generators: Principle of operation, armature winding - lap and wave windings, separately and self-excited generators, armature reaction-cross magnetization and demagnetization AT/pole, compensating winding, commutation process, methods of improving commutation, voltage build-up in a shunt generator, critical field resistance and critical speed, internal and external characteristics of shunt, series and compound generators, parallel operation.	CO1 CO2 CO4 CO6
III	DC Motors: Principle of operation, characteristics of shunt, series and compound motor, speed control methods, 4-point starter- design of starter elements , losses in DC machine, testing of DC machine – No load test, load test, Hopkinson‘s test , retardation test and field test.	CO1 CO2 CO4 CO6
IV	Single-Phase Transformers: Principle of operation, ideal transformer, transformer under no load and on load with Phasor diagrams, equivalent circuit, condition for maximum efficiency and voltage regulation, all day efficiency. Determination of equivalent circuit parameters, efficiency at different loadings and regulation using O.C and S.C test, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Parallel operation of single-phase transformers.	CO1 CO3 CO5 CO6
V	Autotransformers - construction, principle of operation, applications and comparison with two winding transformer. Three-Phase Transformers: Types of connection and their comparative features, Scott connection, Tap-changing transformers - No- load and on-load tap-changing of transformers.	CO1 CO3 CO5 CO6

Learning Resources

Text Books

1. Electrical Machinery by Dr.P. S Bimbhra, 7/e, Khanna Publishers,2018.
2. Electric Machines by I.J. Nagarath and D.P. Kothari,4/e, McGraw Hill, 2010.

Reference Books

1. Theory and performance of Electrical Machines by J.B. Gupta, Katson Publishers.
2. Performance and Design of DC Machines by A.E. Clayton and N N Hancock,Oxford,1987
3. Electrical Machines by Abhijit Chakrabarti, Sudipta Debnath, 1/e, Mc Graw Hill,2015.
4. Electric Machine Fundamentals by S.J. Chapman, 5/e, McGraw Hill, 2011.

e- Resources

https://nptel.ac.in/courses/108/105/108105155/

CIRCUIT THEORY LAB

Course Code	20ES1352	Year	II	Semester(s)	I
Course Category	Engineering Science	Branch	EEE	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	BEEE Lab
Continuous Internal Evaluation:	15	Semester End Evaluation:	35	Total Marks:	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Analyze response in a given network by using theorems. (L4)
CO2	Determine two port network parameters of electrical network and self & mutual inductance of coupled circuits. (L3)
CO3	Calculate resonance frequency of RLC circuits, three phase power drawn by balanced circuits. (L3)
CO4	**Simulate** electrical circuits to verify network theorems and obtain their transient behaviour using PSPICE tools. (L4)
CO5	Conduct experiments as a **team / individual** by using equipment available in the laboratory
CO6	Make an effective **report** based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3		3									3	1
CO2	3			3									3	1
CO3	3			3									3	1
CO4		3		3	3								3	1
CO5					3				3				3	1
CO6										3			3	1

Syllabus		
Expt. No.	Contents	Mapped CO
PART-A(Any Eight Experiments)		
1	Verification of Maximum Power Transfer Theorem	CO1 CO5 CO6
2	Verification of Reciprocity Theorem	
3	Verification of Millman's Theorem	
4	Verification of Compensation Theorem	
5	Series and Parallel Resonance with frequency variations	CO3 CO5 CO6
6	Determination of Self, Mutual Inductances and Coefficient of coupling	CO2 CO5 CO6
7	Determination of impedance and admittance Parameters	
8	Determination of Transmission and hybrid parameters	
9	Measurement of Active& Reactive Power using two wattmeter method	CO3 CO5 CO6
10	Measurement of Reactive Power using one wattmeter method	

PART-B: PSPICE SIMULATION OF ELECTRIC CIRCUITS (Any Two Experiments)		
11	Mesh and Nodal Analysis using PSpice	CO 4 CO 5 CO 6
12	Verification of Thevenin's and Norton's Theorem using PSpice	
13	Verification of Superposition theorem using PSpice	
14	DC Transient response using PSpice	
15	AC Transient response using PSpice	
LearningResources		
TextBooks		
1. Charles K.Alexander, Mathew N.O.Sadiku,"Fundamentals of Electric Circuits"(SixthEdition), Tata McGraw-Hill. 2. Sudhakar and Shyammohan S Palli, Circuits and Networks: Analysis and Synthesis, FifthEdition,McGraw-HillEducation.		

ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS LAB

Course Code	20EE3351	**Year**	II	**Semester**	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation:	15	**Semester End Evaluation:**	35	**Total Marks:**	50

CO1	**Analyze** the devices BJT and MOSFET to model their small signal behavior. (L4)
CO2	**Apply** the network analysis techniques to find the parameters of BJT and MOSFET based amplifiers. (L3)
CO3	**Analyze** NMOS differential amplifiers for gain, input common mode range, power dissipation and CMRR. (L4)
CO4	**Evaluate** the performance of NMOS Current Mirror and to develop PCB Layout for Astable Multivibrator.(L5)
CO5	Make an effective report based on experiments.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3							3				3	
CO2	3								3				3	
CO3		2							2				2	
CO4			2						2				2	
CO5										3				

SYLLABUS

Any Ten Experiments (H/W or Simulation)		
Expt. No.	**Contents**	**Mapped CO**
1	Voltage-Current Characteristics of BJT / Measurement of scale current & common emitter current gain	**CO1, CO5**
2	Measurement of small signal parameters (g_m, r_o, r_π, r_e) of BJT at a given operating (Q) point.	**CO1 CO5**
3	Implement BJT amplifier and Inverter logic gate	**CO2, CO5**
4	Voltage-Current Characteristics of MOSFET / Measurement of threshold voltage	**CO1, CO5**
5	Measurement of small signal parameters (g_m, ro, g_{mb}) of MOSFET at a given operating point.	**CO1, CO5**
6	Analyze Common Source Amplifier for Gain, Power dissipation requirements	**CO2, CO5**
7	Design and Simulation of Common Drain Amplifier (Voltage Buffer) for Gain, Output Impedance, Level Shift requirements	**CO2, CO5**
8	Analyze the necessary parameters for Basic NMOS Differential Pair.	**CO3, CO5**

9	Design and Simulation of Differential Amplifier with active current mirror load for gain, power dissipation CMRR requirements.	**CO3, CO5**
10	Analyze the basic NMOS current mirror and current steering circuit	**CO4, CO5**
11	Simulate the PCB fabrication of a BJT Multivibrator Circuit	**CO4, CO5**

Learning Resources

Text Books

1.Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.

Reference Books

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009.
3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.

e- Resources & other digital material

https://www.researchgate.net/publication/314154179_Electronics_Lab_Manual
http://abexp.aiaiai.dk/electronic_devices_and_circuits_lab_manual_bgpltd.pdf

ELECTRICAL MACHINES-I LAB

Course Code	20EE3352	**Year**	II	**Semester(s)**	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisite**	Basic Electrical and Electronics Engineering Lab
Continuous Internal Evaluation:	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Analyze the load characteristics of D.C generators. (L4)
CO2	Obtain the performance characteristics and speed control characteristics of DC motor (L3)
CO3	Determine efficiency of D.C machine. (L3)
CO4	Obtain the characteristics and testing methods of single-phase transformers. (L3)
CO5	conduct experiments as a team / individual by using equipment available in the laboratory
CO6	make an effective report based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3		3				3				3	3	1
CO2	3			3				3				3	3	1
CO3	3			3				3				3	3	1
CO4	3			3									3	1
CO5					3				3				3	1
CO6										3			3	1

	Syllabus	
Sl No.	**Contents**	
1	Load characteristics of DC shunt generator.	CO1 CO5 CO6
2	Load test on DC series generator.	
3	Load test on DC compound generator.	
4	Brake test on DC Compound motor.	CO2 CO5 CO6
5	Speed control of DC shunt motor by field and armature control.	
6	Hopkinson‘s test on D.C shunt machines.	CO3 CO5 CO6
7	Field’s test on D.C series machines.	
8	Separation of losses in DC shunt machine.	
9	Determination of equivalent circuit parameters and voltage regulation using OC and SC tests on single phase transformer.	CO4 CO5 CO6
10	Load test on single phase transformer.	
11	Parallel operation of two single phase transformers.	
12	Sumpner’s test on single phase transformers.	
13	Scott connection of transformers.	
14	Separation of losses in single phase transformer	

Learning Resources
Text Books
1. Electrical Machinery by Dr.P. S Bimbhra, 7/e, Khanna Publishers,2018. **2.** Electric Machines by I.J. Nagarath and D.P. Kothari,4/e, McGraw Hill, 2010.

ELECTRICAL WORKSHOP

Course Code	20SO8352	**Year**	II	**Semester(s)**	I
Course Category	Skill oriented	**Branch**	EEE	**Course Type**	Skill Oriented Course
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Basic Electrical & Electronics Engineering
Continuous Internal Evaluation:	0	**Semester End Evaluation:**	**50**	**Total Marks:**	**50**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** various tools, identify and measure electrical components and quantities.(L2)
CO2	**Demonstrate** the wiring of various electrical circuits(L2)
CO3	**Apply software tools for** Electrical Circuits analysis (L3)
CO4	**Measurement** of illumination from light source (L2)
CO5	**Learn various** electrical safety measures and First Aid activities (L3)
CO6	**Submit a report** based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3	3	3	3		3	3		3	3			3	3
CO3	3	3	3	3	3	3	3		3	3			3	3
CO4	2	2	2	2		2	2		2	2			2	2
CO5	3	3	3	3	3	3	3		3	3			3	3
CO6	3				3				3	3				

Syllabus

Unit No.	Contents	Mapped CO
I	**Electrical Wiring & Testing** Study of various electrical tools and symbols- Identify different types of cables/wires and switches, fuses & fuse carriers -Fundamental of MCB and ELCB, MCCB -Measurement of earth resistance - common faults and trouble shooting of household appliances - Wiring of backup power supply-Calculation of Loads and design of its related components.	CO 1, CO 2, CO 6
II	**Electrical Circuit Design and verification in MATLAB** Basic Electrical circuit design with R, RL, RC, Design, Simulate and Verification of KVL , KCL Thevenin’s & Norton‘s theorems in MATLAB/Simulink.	CO 3, CO 6

III	**Illumination** Study of Sources of lights- Incandescent lamps, Florescent tubes, Compact Fluorescent lamp, LED lamp, Comparison of Electrical Power consumption.	CO 4, CO 6
IV	**Electrical Safety and Precautions** Importance of Neutral and Grounding- Precautions from electric shock and methods of First Aid for Electric Shock Treatment - Source of Fire in electrical systems - quenching the fire - Practicing with Fire extinguisher - Working and operation of Extinguisher.	CO 5, CO 6

Ex.No	List of Experiments	Mapped CO
1	Demonstration of various electrical tools and symbols	CO1,CO 6
2	Identify different types of cables/wires and switches, fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage	CO 1,CO 6
3	Measurement of Earth resistance and testing of cables	CO 1,CO 6
4	Wiring of light/fan circuit using two way control (Staircase wiring	CO 2,CO 6
5	Wiring of backup power supply including Diesel Generator, inverter with changeover.	CO 2,CO 6
6	Load calculation for household/Industrial appliances and selection of related components	CO 2,CO 6
7	Simulation and verification of KVL and KCL law (DC circuits) using MATLAB.	CO 3,CO 6
8	Response of an RLC circuit by parametric analysis using MATLAB	CO 3,CO 6
9	Measurement of illumination using Lux meter	CO 4,CO 6
10	Study of various Electrical safety measures and First Aid for shock treatment	CO 5,CO 6
11	Understanding the operation of Fire extinguishers and utilization of the Fire extinguisher	CO 5,CO 6

References

Learning Resources

Text Books

1. J.B.Gubta, "Utilization of Electric Power & Electric Traction", S.K. Kataria & Sons publications, 2013
2. Dr. Shailender Gupta & Bharat Bhushan, "An Insight to Matlab & Simulink", S.k. Kataria publications, 2017
3. A. El-Sharkawi, "Electric Safety:Practice And Standards", T&F India publications, 2020

Reference Books

1. K. B. Raina, "Electrical Design Estimating and Costing", New Age International Private Limited publications, 2017
2. Sulaymon Eshkabilov, "Beginning MATLAB and Simulink: From Novice to Professional", Apress publications, 2019

e- Resources & other digital material

1. https://in.mathworks.com/
2. https://www.firstaidforfree.com/fire-safety-advice-first-aiders/

II B.TECH II SEMESTER SYLLABUS

II B.Tech., II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20ES1401	Programming with C	3	3	0	0	30	70	100
20BS1401	Electromagnetic Field Theory	3	3	0	0	30	70	100
20EE3401	Measurements and Instrumentation	3	3	0	0	30	70	100
20EE3402	Electrical Machines –II	3	3	0	0	30	70	100
20EE3403	Digital and Analog Circuits	3	3	0	0	30	70	100
20ES1451	Programming with C Lab	1.5	0	0	3	15	35	50
20EE3452	Digital and Analog Circuits Lab	1.5	0	0	3	15	35	50
20EE3451	Electrical Machines –II Lab	1.5	0	0	3	15	35	50
20SO8452	Data Structures	2	1	0	2	0	50	50
20MC1402	Environmental Science	-	2	0	0	-	-	-
Total		**21.5**	**18**	**0**	**11**			

L - Lecture T - Tutorial P – Practical

HONORS -I								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE6401A	Battery Management System	4	3	1	0	30	70	100
20EE6401B	Digital System Design with FPGAs	4	3	1	0	30	70	100
20EE6401C	Modern Control Systems	4	3	1	0	30	70	100
20EE6401D	Distributed Generation and Microgrids	4	3	1	0	30	70	100

L - Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks	Minor in
20CS5401	Computational Thinking	4	4	0	0	30	70	100	CSE
20IT5401	Operating Systems	4	4	0	0	30	70	100	IT
20EC5401	Analog Systems	4	3	1	0	30	70	100	ECE
20EC5402	Microcontrollers and Interfacing	4	3	1	0	30	70	100	IoT
20ME5401	Automobile Engineering	4	3	1	0	30	70	100	Automobile Engineering
20ME5402	Additive Manufacturing	4	3	1	0	30	70	100	Digital Manufacturing
20CE5401A	Solid Mechanics	4	3	1	0	30	70	100	Civil
20CE5401B	Soil Mechanics	4	3	1	0	30	70	100	Civil

L – Lecture T - Tutorial P – Practical

PROGRAMMING with C

Course Code	20ES1401	**Year**	II	**Semester(s)**	II
Course Category	Engineering Sciences	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the principles of structured programming and C constructs for solving problems. (L2)
CO2	**Apply** suitable control constructs and array concepts to solve problems. (L3)
CO3	**Apply** the concept of functions, pointers, user defined data types and files to solve problems. (L3)
CO4	**Analyze** the given problem and use modular programming approach to develop solutions. (L4)
CO5	Develop an effective / optimum solution for a given problem and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3													
CO3	3													
CO4		3												1
CO5									3	3				

Unit No.	**Contents**	**Mapped CO**
I	**Introduction to C:** Introduction, Structure of C Program, A Simple C Program, C-Tokens, Basic Data types, Variables, Constants, Input / Output statements, Operators, Type conversion and Type casting. **Conditional Branching Statements:** if, if-else, if-else-if Statements and Switch case.	CO1, CO2, CO5
II	**Iterative Statements:** while, do-while and for loops, Nested loops, break and continue statements. **Arrays:** Declaration, Accessing array elements, Storing values, Operations on arrays, Multi-dimensional arrays. **Strings:** Introduction, String manipulation functions.	CO1, CO2, CO5
III	**Functions:** Introduction, Function declaration, Function definition and Function call, Types of Functions, Parameter passing, Passing arrays to functions, Recursion, Storage classes, Command line arguments.	CO1, CO3, CO4,

		CO5
IV	**Pointers:** Declaration and Initialization of pointer variables, Pointer arithmetic, Pointers and arrays, Pointer to pointer, Array of pointers, Pointers and functions, Dynamic memory allocation. **Pre-processor directives:** The #define Directive, Undefining a Macro, Token Pasting and Stringizing Operators, The #include Directive, Conditional Compilation.	CO1, CO3, CO5
V	**User defined data-types:** Introduction, bit-fields, Nested structures, Array of structures, Structures and functions, Unions, enum, typedef. **File management in C:** Using Files in C, Read data from files, Writing data to files, Random access to files of records.	CO1, CO3, CO5

Text Books

1. Programming in C, Reema Thareja, AICTE Edition, 2018, Oxford University Press.
2. Programming in C, by Ashok N.Kamthane, 2nd Edition, Pearson publications, 2011.

References

1. Computer Science: A Structured Programming Approach Using C, B. A. Forouzan and R.F. Gilberg, Third Edition, 2007, Cengage Learning.
2. Programming in C, PradipDey, Manas Ghosh, AICTE Edition, Oxford University Press.
3. Programming in ANSI C, 5th Edition by E. Balaguruswamy, McGraw-Hill publications.
4. Programming with C, B. Gottfried, Third Edition, 2017, Schaum's outlines, McGraw Hill (India).
5. Problem Solving and Program Design in C, Jeri R. Hanly, Ellot B. Koffman, Fifth Edition, Pearson.

e-Resources & other digital material

1. http://cprogramminglanguage.net/
2. https://www.geeksforgeeks.org/c-programming-language/
3. https://www.greatlearning.in/academy/learn-for-free/courses/c-programming
4. https://www.udemy.com/course/the-complete-c-programming/
5. https://nptel.ac.in/courses/106/105/106105171/

ELECTROMAGNETIC FIELD THEORY

Course Code	20BS1401	**Year**	II	**Semester(s)**	II
Course Category	Basic Sciences	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Differential Equation and Vector Calculus (20BS1201)
Continuous Internal Evaluation	30	**Semester End Evaluation**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts on Electrostatics, Magnetostatics and Time varying fields.(L2)
CO2	**Apply** basic laws and theorems to determine the electrostatic fields. (L3)
CO3	**Analyze** different parameters of static electric fields. (L4)
CO4	**Apply** basic Laws to determine the various parameters of Magnetostatic and Time varying fields. (L3)
CO5	**Analyze** various parameters of Magnetostatic fields and Time varying fields. (L4)
CO6	**Submit a report** in Electrostatic, Magnetostatic fields and Time varying fields**.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	
CO3		2											2	
CO4	3												2	
CO5		3											2	
CO6									3	3			2	

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	Static Electric Field – I Coulomb‘s law, Electric field intensity, Electrical field due to point charges, Line Charges (Derivations Only) – Infinite, Finite and Circular Ring, Surface charges (Derivations Only) – Infinite sheet and Circular Disk. Electric Flux Density, Gauss law and applications of Gauss’s Law to Point Charges, Infinite Line Charge, Infinite Sheet of Charge, Co-axial cable, Spherical shell and Uniformly charged sphere. Divergence and Divergence	**CO1, CO2, CO3,CO6**

	theorem. Maxwell's first law, div(D)=ρv Energy expended in moving a charge in an electric field, Absolute Electric potential, Potential difference, Calculation of potential difference for point charges, Potential Gradient.	
II	Static Electric Field – II Poisson's and Laplace's equations, Solution of Laplace equations in one variable Electric dipole, Dipole moment, potential and electric field due to an electric dipole, Torque on an Electric dipole in an electric field. Electrostatic Energy and Energy density. Current and current density, Ohms Law in Point form, Continuity of current equation. Electric field inside dielectric material - concept of Polarization, Boundary conditions between conductor dielectric and two dielectric materials. Capacitance, Capacitance of parallel plate, Spherical, Co-axial capacitors and parallel plates with Composite Dielectric.	**CO1, CO2, CO3,CO6**
III	Static Magnetic Fields Biot – Savart's Law, Magnetic Field Intensity (MFI), MFI due to straight current carrying filament, circular, square and solenoid current carrying loops. Magnetic flux and flux density, Maxwell's second Equation, div(B)=0. Ampere circuital Law, Applications of Ampere's circuital law to infinite sheet of current and a long current carrying filament. Point form of Ampere's circuital law, Maxwell's third equation, Curl (H)=J.	**CO1, CO4, CO5, CO6**
IV	Magnetic Forces and Inductance Force on a moving charge, Lorentz force equation, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic dipole and dipole moment, a differential current loop as a magnetic dipole, Torque on a current loop placed in a magnetic field Inductances and mutual inductances, determination of self-inductance of a solenoid and toroid 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.	**CO1, CO4, CO5, CO6**
V	Time Varying Fields Faraday's laws of electromagnetic induction – its integral and point forms, Maxwell's fourth equation, Curl (E)=-∂B/∂t, statically and dynamically induced EMF – simple problems, modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.	**CO1, CO4, CO5, CO6**

Learning Resources
Text Books
1. Mathew N. O. Sadiku "Principles of Electromagnetics," Oxford University Press, 6th Edition 2015 2. William H. Hayt, Jr. John A. Buck, M Jaleel Akhtar "Engineering Electromagnetics", McGraw-Hill, 9th Edition, 2020
Reference Books
1. Ashutosh Pramanik, "Electromagnetism - Theory and Applications", Prentice Hall India, 2nd edition, New Delhi, 2008. 2. Ashutosh Pramanik, "Electromagnetism - Problems with solution", Prentice Hall India, 2nd

Edition, 2012.

3. John D Kraus, Daniel Fleisch "Electromagnetics with Applications", McGraw Hill, 5th Edition, 2017.
4. Nathan Ida, "Engineering Electromagnetics, Springer 2nd Edition, 2005.

e- Resources & other digital material

1. https://nptel.ac.in/courses/108/106/108106073/#
2. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/

MEASUREMENTS AND INSTRUMENTATION

Course Code	20EE3401	**Year**	II	**Semester**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basics of Electrical Engineering
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of measuring instruments. (L2)
CO2	**Apply** the basic knowledge to determine electrical quantities using various measuring instruments and bridges.(L3)
CO3	**Apply** the basic knowledge to measure physical and electrical quantities using various transducers and digital meters (L3)
CO4	**Analyze** the operation of measuring instruments, DC and AC bridges for measurement of electrical Quantities (L4)
CO5	**Analyze** the operation of transducers and digital meters for measuring physical and electrical quantities (L4)
CO6	**Submit a report** on operation of measuring instruments, instrument transformers, transducers, DC and AC bridges.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3	3												2	1
CO4		3											2	1
CO5		3											2	1
CO6									3	3			2	1

Syllabus

Unit No.	**Contents**	**Mapped CO**
I	Classification, deflecting, control and damping torques, Ammeters and Voltmeters, PMMC, moving iron type instruments, expression for deflecting torque and control torque, errors and compensations. Instrument Transformers: Current Transformers and Potential Transformers-theory, ratio error and phase angle error.(only theory no problems)	CO1 CO2 CO4 CO6
II	Single phase dynamometer wattmeter, LPF and UPF, three phase power measurement by two wattmeter method, Single phase induction type energy meter, driving and braking torques. Electrodynamometer and Moving Iron	CO1 CO2 CO4

	Power Factor meters.	CO6
III	Measurement of resistances using Wheat stone's bridge, Kelvin's double bridge, and megger. Measurement of inductance using Maxwell's bridge, Hay's bridge, Anderson's bridge, Measurement of capacitance using Schering Bridge.	CO1 CO2 CO4 CO6
IV	Classification of transducers, Resistive, Inductive and Capacitive Transducer, Strain Gauge, Thermistors, Thermo couples, Linear Variable Differential Transformers, Piezo electric Transducer.	CO1 CO3 CO5 CO6
V	Digital Voltmeters-Successive approximation, ramp and integrating type DVM, Digital frequency meter, Digital multimeter, Digital energy meter, wave analyzer, spectrum analyzer, power analyzer.	CO1 CO3 CO5 CO6

Learning Resources

Text Books

1. A course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, 9th Edition, Dhanpat Rai & Co. Publications.
2. Electrical Measurements and Measuring Instruments, E.W. Golding and F.C. Widdis, 5th Edition, Wheeler Publishing company.

Reference Books

1. Electrical Measurements: Fundamentals, Concepts, Applications by Martin. U. Reissland, New Age International Publishers Limited.
2. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd.

e- Resources

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

ELECTRICAL MACHINES-II

Course Code	20EE3402	**Year**	II	**Semester(s)**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	1.Basic Electrical and Electronics Engineering 2.Electrical Machines-I
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of three phase induction motors, synchronous machines single phase motors and special electrical machines. (L2)
CO2	**Apply** the basic knowledge to obtain the desired parameters and performance characteristics of three phase induction motors. (L3)
CO3	**Apply** the basic knowledge to obtain the desired parameters and performance characteristics of synchronous machines, single phase motors and special electrical machines. (L3)
CO4	**Analyze** the concepts of torque equation, testing techniques and speed control methods of three phase induction motor (L4)
CO5	**Analyze** the concepts of synchronous machines, single phase motors and special electrical machines. (L4)
CO6	**Submit a report** in three phase induction motors, synchronous machines, single phase motors and special electrical machines.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3	3												2	1
CO4		3											2	1
CO5		3											2	1
CO6									3	3			2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Three phase Induction motors:** Concept of rotating magnetic field, principle of operation, constructional details of squirrel-cage & slip-ring rotor machines, slip, torque-slip characteristics, maximum torque, equivalent circuit and phasor diagram of induction motor.	CO1 CO2 CO4 CO6

II	**Testing of three-phase Induction Motor:** Losses in three phase induction motor, efficiency, no-load and blocked rotor tests, circle diagram and performance evaluation of induction motor, cogging and crawling. **Starting methods of Induction Motors:** Necessity of starter, Direct on Line (DOL), star-delta starter, autotransformer starter and Rotor resistance starter. **Speed Control of Three-phase Induction Motors:** frequency, voltage and rotor resistance control methods, pole changing and cascading of motors. Principle of operation of induction generator.	CO1 CO2 CO4 CO6
III	**Synchronous Generator** Constructional Features of wound rotor and salient pole machines, distributed and concentrated windings, distribution, pitch and winding factors, E.M.F Equation. harmonics in generated e.m.f. – suppression of harmonics, Voltage regulation by synchronous impedance method, M.M.F. method and Z.P.F. method, salient pole alternators, determination of Xd and Xq (Slip test), phasor diagrams. Parallel operation of alternators Synchronizing of alternators with infinite bus bars, synchronizing power and torque, parallel operation and load sharing.	CO1 CO3 CO5 CO6
IV	**Synchronous Motors – Principle of Operation** Theory of operation, phasor diagram, variation of current and power factor with excitation , synchronous condenser, mathematical analysis for power developed, V and inverted V curves, hunting and its suppression, methods of starting.	CO1 CO3 CO5 CO6
V	**Single Phase Induction Motor** Classification of single phase induction motors, double revolving field theory – working principle of single phase single winding induction motor – equivalent circuit, no load and blocked rotor tests, spilt phase induction motor, capacitor start motor, capacitor start capacitor run motor, shaded pole motor, ratings and their applications. **Special Electrical Machines** **Principle of Operation:** Stepper Motor, Reluctance Motor, Universal Motor, BLDC Motor. **(Theoretical Analysis Only)**	CO1 CO3 CO5 CO6

Learning Resources
Text Books
1. Electrical Machinery by Dr. P. S Bimbhra- -7/e -Khanna Publishers,2018 2. Electric Machines by I.J. Nagarath and D.P. Kothari,4/e, McGraw Hill, 2010.
Reference Books
1. Electrical Machines by J.B.Gupta, Kataria publications. 2. The Performance and Design of A.C.Machines by M.G.Say, ELBS and Pitman & Sons. 3. Electromachanics-III (Synchronous and single phase machines) by S.Kamakashiah, Right Publishers.
e- Resources
https://nptel.ac.in/courses/108/105/108105131/

DIGITAL & ANALOG CIRCUITS

Course Code	20EE3403	**Year**	II	**Semester**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	BEEE
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	***Understand*** the basic concepts of digital and analog fundamental circuits (L2)
CO2	***Apply*** the basic knowledge of digital fundamentals for implementation in digital applications.(L3)
CO3	***Analyze*** different digital circuits for digital applications. (L4)
CO4	***Develop*** various digital and analog circuits using OP-AMP. (L3)
CO5	***Compare*** the performance of various ADC and DAC Circuits using OP-AMP.(L4)
CO6	***Ability to*** do various problems in digital and analog circuits and submit a report.

Mapping of course outcomes with Program outcomes(CO/PO/PSO Matrix)
Note:1-Weakcorrelation2-Mediumcorrelation3-Strongcorrelation
*-Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3				3								2	1
CO3		3			3							3	2	1
CO4	3				3							3	2	1
CO5		2			3								2	1
CO6									3	3			2	1

Syllabus

Unit No.	Contents	Mapped CO
I	**Digital fundamentals:** Binary Systems, Boolean Algebra, Minimization of Functions Using Boolean Identities and Karnaugh Map(4,5 Variables),CMOS Logic families	CO1,CO2 CO3 & CO6
II	**Combinational Logic Circuits:** Arithmetic Circuits, Code Converters, Decoders. Encoders, Multiplexers, De-Multiplexer, Parity Generators and Checkers	CO1,CO2 CO3 & CO6
III	**Sequential Logic Circuits:** Latches and Flip-Flops, Shift-Registers, Counters, Propagation Delay, Setup and Hold Time.	CO1,CO2 CO3 &CO6

IV	**Operational Amplifiers:** Review Of Op-Amp, Summing ,Averaging & Differential Amplifiers Differentiators, Integrators, Active filters (LPF,HPF,BPF,BSF), Sinusoidal Oscillators, Schmitt Triggers	CO1,CO4,CO5&CO6
V	**Data Converters:** Sample and Hold Circuits, DAC & ADC Characteristics, R–2R Ladder DAC,ADC's-Integrating, Successive Approximation, Flash Type, Dual Slope.	CO1,CO4, CO5&CO6

Learning Resources
Text Books
1. MichaelD.Ciletti,M. Morris Mano, Digital Design,4/e. Pearson Education, 2007. 2. Ramakanth Gayakward, Op-Amps and Linear Integrated Circuits, 4/e, Pearson Education, 2007.
Reference Books
1. D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003. 2. Thomas L Floyd ,Digital Fundamentals, 11th Edition **,**Pearson education 2015.
e-Resources & other digital material
1. http://www.ece.ubc.ca/~saifz/eece256.html 2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/digital_circuit /frame/index.html

PROGRAMMING with C LAB

Course Code	20ES1451	Year	II	Semester	II
Course Category	Engineering Science	Branch	EEE	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	
Continuous Internal Evaluation:	15	Semester End Evaluation:	35	Total Marks:	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Apply Structured Programming/C constructs for solving problems. (L3)
CO2	Implement programs as an individual on different IDEs/ online platforms. (L3)
CO3	Develop an effective report based on various programs implemented.
CO4	Analyze outputs using given constraints/test cases. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus:

Expt. No.	Contents	Mapped CO
1	Programs on Basics	CO1,CO2 CO3,CO4
2	Programs on Operators	
3	Programs on Decision Statements	
4	Programs on Switch operations	
5	Programs on Basic Loop operations	
6	Programs on Advanced loops	
7	Programs on 1-D arrays	
8	Programs on 2-D arrays	
9	Programs on Strings	
10	Sample Programs on Function	
11	Programs on Pointers and Dynamic Memory allocation	
12	Programs on Structures	

Learning Resources
Text Books
1. Reema Thareja , Programming in C, Oxford University Press, AICTE Edition, 2018.
Reference Books
1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning, 2007. 2. Pradip Dey, Manas Ghosh, Programming in C, Oxford University Press, AICTE Edition, 3. B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017. 4. Jeri R. Hanly, Ellot B. Koffman, Problem Solving and Program Design in C, 5/e, Pearson.
e- Resources & other digital material
1. http://cprogramminglanguage.net/ 2. https://nptel.ac.in/courses/106105085/4

ELECTRICAL MACHINES-II LAB

Course Code	20EE3451	**Year**	II	**Semester(s)**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisite**	Electrical Machines-I Lab
Continuous Internal Evaluation:	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Determine the performance of three phase induction machine (L3)
CO2	Determine the performance of single phase induction machine and special machines such as three phase schrage motor. (L3)
CO3	Analyze the performance of the alternator and predetermine the regulation. (L4)
CO4	Obtain the characteristics and parameters of synchronous machine (L3)
CO5	Conduct experiments as a team / individual by using equipment available in the laboratory
CO6	Make an effective report based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3				3				3	3	1
CO2	3			3				3				3	3	1
CO3		3		3				3				3	3	1
CO4	3			3									3	1
CO5					3				3				3	1
CO6										3			3	1

	Syllabus	
Sl No.	**Contents**	
1.	Brake test on three phase Induction Motor	CO1 CO5 CO6
2.	No–load & Blocked rotor tests on three phase squirrel cage induction motor	
3.	Equivalent circuit of a three phase induction motor.	
4.	Equivalent circuit of a single phase induction motor.	CO2 CO5 CO6
5.	Brake test on single phase induction motor	
6.	Regulation of a three-phase alternator by synchronous impedance method	CO3 CO5 CO6
7.	Regulation of a three-phase alternator by mmf method.	
8.	Regulation of a three-phase alternator by Z.P.F. method	

9.	Measurement of sequence impedance of a three-phase alternator	
10.	‘V ’ & ‘Λ ’ curves of a three-phase synchronous motor.	CO4 CO5 CO6
11.	Determination of Xd and Xq of a salient pole synchronous machine	
12.	Brake test on three phase Schrage motor.	CO2 CO5 CO6
13.	Determination of performance of induction generator.	CO1 CO5 CO6

Learning Resources
Text Books
1. Electrical Machinery by Dr.P. S Bimbhra, 7/e, Khanna Publishers,2018. 2. Electric Machines by I.J. Nagarath and D.P. Kothari,4/e, McGraw Hill, 2010.

DIGITAL AND ANALOG CIRCUITS LAB

Course Code	20EE3452	Year	II	Semester	II
Course Category	Professional Core	Branch	EEE	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	BEEE Lab
Continuous Internal Evaluation:	15	Semester End Evaluation:	35	Total Marks:	50

Course Outcomes	
Upon successful completion of the course, the student will be able to do either hard ware /software	
CO1	Construct the truth tables of Boolean functions using logic gates (L2)
CO2	Apply the essential information on combinational circuits to check the results of the adders,decoders and parity generator.(L3)
CO3	Analyze operation of shift registers, counters and op-amp based differentiator and integrator circuits. (L4)
CO4	Analyze operation of arithmetic circuits,filter circuits and Data convertors using Op-amp. (L4)
CO5	Conduct experiments as a team / individual by using equipment /software available in the laboratory
CO6	Make use an effective report based on experiments.

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3		3									3	1
CO2	3			3	3								3	1
CO3		3		3	3								3	1
CO4		3		3									3	1
CO5									3				3	1
CO6										3			3	1

Syllabus		
Any Ten Experiments(H/W or Simulation)		
Expt. No.	**Contents**	**Mapped CO**
I	Implementation of Basic gates using Universal Gates.	**CO1, CO5,CO6**
II	Simplification of the given Boolean functions using K-map and implementation using logic gates	**CO1, CO5,CO6**
III	Develop and verification of Full adder and Full Subtractor using logic gates	**CO2, CO5,CO6**
IV	Implementation of the BCD to 7-segmet decoder	**CO2, CO5,CO6**

V	Implementation of an even parity generator for a 3- bit input	**CO2, CO5,CO6**
VI	Implement and Verify the operation of a 4-bit Shift Register.	**CO3, CO5,CO6**
VII	Implement and Verify the operation of 3-bit Ripple Counters using JK-FF.	**CO3, CO5,CO6**
VIII	Simulate the RC differentiator using Op-Amp	**CO3, CO5,CO6**
IX	Simulate the RC integrator using Op-Amp	**CO3, CO5,CO6**
X	Analyze Adder and Subtractor circuits using Op-Amp	**CO4, CO5,CO6**
XI	Analyze LPF,HPF filter using Op-Amp .	**CO4, CO5,CO6**
XII	Construct 4 bit DAC using OP-Amp	**CO4, CO5,CO6**

Learning Resources

Text Books

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 4/e. Pearson Education, 2007
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Fourth Edition, Pearson 2015

Reference Books

1. Thomas L Floyd ,Digital Fundamentals , 11th Edition ,Pearson education 2015
2. John F. Wakerly, Digital Design Principles and Practices, 4/e, Pearson Education, 2008.

e- Resources & other digital material

1. http://www.ece.ubc.ca/~saifz/eece256.html
2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/digital_circuit/frame/index.html

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DATA STRUCTURES

Course Code	20SO8452	Year	II	Semester	II
Course Category	Skill Course	Branch	EEE	Course Type	Skill Oriented Course
Credits	2	L-T-P	1-0-2	Prerequisites	C
Continuous Internal Evaluation:	0	Semester End Evaluation:	50	Total Marks:	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Apply Structured Programming constructs for solving problems. (L3)
CO2	Implement programs as an individual on different IDEs/ online platforms.
CO3	Develop an effective report based on various programs implemented.
CO4	Analyze outputs using given constraints/test cases. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

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

Syllabus

Unit No	Contents	Mapped CO
I	**Sorting and Searching:** Searching; Linear and Binary, Sorting; Bubble, Insertion, Selection, Merge, Quick, Radix **Exercise 1** Write the programs for the following searching techniques: Linear and Binary. **Exercise 2** Write the programs for the following sorting techniques: Bubble, Insertion, Quick, and Merge	**CO1,CO2, CO3,CO4**
II	**STACKS AND QUEUES:** Stacks, queues, infix to postfix , evaluating postfix expression. , **Exercise 3** a) Implementation of stack operations using arrays. b) Implementation of queue operations using arrays. **Exercise 4** a) Railroad cars numbered are as 0,1,2,---,n-1. Each car is brought into the stack and removed at any time. For instance, if n=3, we could move 0, move 1, move 2 and then take the cars out, producing 2,1,0.	**CO1,CO2, CO3,CO4**

	Implement application for the given problem. b) Consider a payment counter at which the customer pays for the items purchased. Every time a customer finished paying for their items, he/she leaves the queue from the front. Every time another customer enters the line to wait, they join the end of the line. Implement the application for this problem. **Exercise 4-** a) Implementation of infix to postfix conversion b) Implementation of evaluating postfix expression	
III	**Linked list**: Single linked lists, circularly linked lists, doubly linked lists, Polynomials Representation, adding polynomials, linked stacks and queues. **Exercise 5** Implementation of singly linked list **Exercise 6** Implementation of doubly linked list **Exercise 7** a) Implement Exercise 4(a) using linked lists. b) Implement Exercise 4(b) using linked lists. **Exercise 8** A polynomial has the main fields as coefficient, exponent in linked list it will have one more field called link to point to next term in the polynomial. If there are n terms in the polynomial then n such nodes has to be created.	**CO1,CO2, CO3,CO4**
IV	**Trees**: Introduction Terminology, representation of trees, Properties of binary trees, binary tree representation, binary tree traversals In order, preorder, post order, Binary search trees Definition **Exercise 9** Implementation of Binary Search Tree operations	**CO1,CO2, CO3,CO4**
V	**Graphs:** Definition, graph representation, elementary graph operations BFS, DFS **Exercise 10** Implementation of Graph traversals I) BFSII) DFS	**CO1,CO2, CO3,CO4**

Learning Resources
Text Books
1. Data Structures and Algorithm Analysis in C – 2nd Edition, Mark Allen Weiss, Pearson 2. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, CareerMonk Publications.
References
1. Introduction to ALGORITHMS – 3rd edition, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI 2. Fundamental of Data Structures in C – 2nd Edition, Horowitz, Sahani, Anderson-Freed, University Press. 3. Classic Data Structures – 2nd Edition, Debasis Samantha, PHI.
E-Resources and other Digital Material
1. http://cse.iitkgp.ac.in/pds/ 2. http://cmpe.emu.edu.tr/bayram/courses/231/LectureNotesSlides/IQBAL/Lecture%20Notes

3. https://www.geeksforgeeks.org/data-structures/
4. https://www.programiz.com/dsa
5.https://www.tutorialspoint.com/data_structures_algorithms/index.htm
6.https://www.youtube.com/watch?v=zWg7U0OEAoE&list=PLBF3763AF2E1C572F
7.https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_V-ZKxRKrxgFyOutPJpoLFBaQMOpK-

ENVIRONMENTAL SCIENCES

Course Code	20MC1402	**Year**	II	**Semester**	II
Course Category	Mandatory course	**Branch**	EEE	**Course Type**	Theory
Credits	0	**L-T-P**	2-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
After successful completion of the course, the student will be able to	
CO1	Apply advanced solutions to measure the threats and hazards in environment to link with human natural systems.(L3)
CO2	Analyze the ethical ,cultural and historical interactions between man and environment.(L4)
CO3	Analyze various environmental assets and record for better management(L4)
CO4	Analyze global issues to design and evaluate policies(L4)
CO5	Apply system concepts to methodological social and environmental issues(L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

UNIT NO	Contents	Mapped COs
I	**INTRODUCTION TO ENVIRONMENT AND NATURAL RESOURCES** Introduction to environment: Definition scope importance need for public awareness. Natural resources: Renewable and non-renewable resources, natural resources and associated problems. Forest resources: Uses, Reasons for over-exploitation, deforestation effects case studies. Water resources: Use and over – utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Mineral resources: Uses, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, Impacts of overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy	CO1 CO2

	needs, use of renewable and non renewable energy sources, case studies.	
II	**ECOSYSTEMS AND BIODIVERSITY** Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem, Ecological succession. Biogeochemical cycle: Nitrogen, carbon, Phosphorus cycle. Biodiversity: Definition, Levels of biodiversity: genetic, species and ecosystem diversity. Bio-geographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega – diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: In– situ and Ex-situ conservation of biodiversity.	CO1 CO2
III	**ENVIRONMENTAL POLLUTION AND CONTROL** Environmental Pollution: Definition, causes, effects and control measures: Air Pollution, Water pollution, Soil pollution, Marine pollution, Thermal pollution, Nuclear hazards, Solid waste Management, e-waste, Pollution case studies.	CO3
IV	**SOCIAL ISSUES AND GLOBAL ENVIRONMENT PROBLEMS AND EFFORTS** From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management, Remote sensing and GIS methods. Environmental ethics: Issues and possible solutions. Green building concept, Environmental Impact Assessment Environmental Management Plan, Climate change: global warming, acid rain, ozone layer depletion.	CO4 CO5
V	**HUMAN POPULATION AND ENVIRONMENT LEGISLATION** Population growth,. Environment and human health. HIV/AIDS,. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Environmental Protection Act.	CO4 CO5

Learning Resources
Text Books
1. Anubha Kaushik and C.P. Kaushik, Text book of environmental studies New Age International Publisher (2014). 2. Erach Barucha, Text book of environmental studies for undergraduates courses, published by – University Grants Commission, University Press (2005) 3. Anindita Basak, Environmental Studies. Pearson (2009)
Reference Books
1. D.K. Asthana and Meera Asthana, A Text book of Environmental Studies, S. Chand (2010). 2. P.M Cherry Solid and Hazardous waste Management, CBS Publisher (2016). 3. Charles H. Ecclestion, Environmental Impact Assessment, CRC Press (2011).

BATTERY MANAGEMENT SYSTEM

Course Code	20EE6401A	**Year**	II	**Semester(s)**	II
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Analyse** various technical parameters of batteries. (L4)
CO2	**Distinguish** between various types of batteries used for EV applications. (L4)
CO3	**Develop** battery charger for an EV. (L3)
CO4	**Submit a report** on batteries and charging systems.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Battery parameters:** Cell and battery voltages, Charge (or Amphour) capacity, Energy stored, Energy density, Specific power, Amphour (or charge) efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature, heating and cooling needs, Battery life and number of deep cycles	**CO1, CO4**
II	**EV Batteries:** **Lead Acid Batteries** Lead acid battery basics, Special characteristics of lead acid batteries, Battery life and maintenance, Battery charging, Summary **Nickel-based Batteries** Introduction, Nickel cadmium, Nickel metal hydride batteries.	**CO1, CO2, CO4**

III	**Sodium, Lithium and Metal air batteries:** **Sodium-based Batteries** Introduction, Sodium sulphur batteries, Sodium metal chloride (Zebra) batteries **Lithium Batteries** Introduction, The lithium polymer battery, The lithium ion battery **Metal Air Batteries** Introduction, The aluminium air battery, The zinc air battery	**CO1, CO2, CO4**
IV	**Charging Infrastructure:** Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.	**CO2, CO4**
V	**EV Charging:** Battery Chargers: Charge equalisation, Conductive Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods	**CO3, CO4**

Learning Resources
Text Books
1. James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK, Electric Vehicle Technology Explained. 2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001. 3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
Reference Books
1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004. 2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

DIGITAL SYSTEM DESIGN WITH FPGAs

Course Code	20EE6401B	Year	II	Semester(s)	II
Course Category	Honor	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	3-1-0	Prerequisites	Digital and Analog Circuits
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** Basic terminologies used in VHDL programming**(L2)**
CO2	**Apply** the various types of modeling using VHDL for digital circuit design**(L3)**
CO3	**Apply** the concept of subprogram and packages in the VHDL programming**(L3)**
CO4	**Inspect** the VHDL design by using testbenches and State machine models **(L4)**
CO5	**Analyze** the FPGA device architecture and the performance of VHDL design. **(L4)**
CO6	**Submit a report** on fundamental of VHDL Programming, modeling, packages and FPGA device architecture

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3	3												2	1
CO4		3											2	1
CO5		2	2		2		3				3		2	1
CO6									3	3			2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	VHDL INTRODUCTION: Introduction, Basic terminology, Entity declaration, Architecture body, Configuration declaration, package declaration, package body, identifiers, data objects, Data types and operators. example programs.	CO2, CO3, CO6

II	MODELLING: Behavioral modelling-Architecture body, process statement, Assignment statements, Conditional statements-wait, If, case, loop, null, exit, assertion. Data Flow modelling-Concurrent and sequential signal assignment, delta delay, multiple drivers, block statement, Structural modelling- component declaration, component instantiation, example programs.	CO2, CO3, CO6
III	SUB PROGRAMS & PACKAGES: subprograms- functions, procedures, declarations, subprogram overloading, operator overloading, Packages- Package Declarations, Package body. Example programs.	CO3, CO4, CO6
IV	SIMULATION AND MODELING: Simulation, Writing a testbench, Modeling-entity interface, delays, conditional operations, synchronous logic, state machine modeling, modelling Moore FSM, modelling mealy FSM.	CO4, CO6
V	FIELD PROGRAMMABLE GATE ARRAYS Device selection, XILINX Spartan 6 Family device architecture, FPGA design Flow, Synthesis and its report, Timing analysis, Place and Route, Static power dissipation and dynamic power dissipation.	CO5, CO6

Learning Resources
Text Books
1. J.Bhasker , A VHDL Primer, third edition, Pearson, 2015 2. Douglas L. Perry, VHDL:Programming by Example,Fourth Edition,McGraw-Hill, 2017 3. Steve kilts,Advanced FPGA Design Architecture, Implementation, and optimization,Wiley-IEEE Press, 2007
Reference Books
1. Debaprasad Das , VHDL: Design, Synthesis and Simulation, World Rights, First Edition, 2018.
Web Links 1. https://nptel.ac.in/courses/117108040

MODERN CONTROL SYSTEMS

CourseCode	20EE6401C	**Year**	II	**Semester(s)**	II
Course Category	Honor	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	**Understand** various models of linear and nonlinear systems **(L2)**
CO2	**Apply** the knowledge of engineering basics to solve problems of various systems **(L3)**
CO3	**Apply** the basic principles and techniques in designing of control systems **(L3)**
CO4	**Analyze** the linear and nonlinear systems processes that meet the specified needs **(L4)**
CO5	**Ability** to understand the concepts of linear and nonlinear control systems and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**State Space Analysis of Systems:** Eigen-values, Eigen Vectors and a Canonical form of state model-Jordan Canonical form, Diagonal Canonical form. Controllable Canonical and Observable canonical form of State Model. State space model representation for nonlinear systems.	CO1, CO2, CO4, CO5
2	**Design of Control System in State Space:** Effect of state feedback on controllability and observability, Principle of duality. Controller design via pole placement by state feedback (Ackerman's formula). Full order observers (Ackerman's formula).	CO1, CO2, CO3, CO4, CO5
3	**Non Linear Systems:** Introduction – Characteristics of non linear systems - – Limit cycles –frequency entrainment– Jump Phenomenon. Classification of non-linearities – common physical non-linearities. **Analysis of nonlinear systems:** phase-plane analysis - Method of Isoclines for Constructing Trajectories, singular points. Describing function analysis for typical non-linearities.	CO1, CO2, CO4, CO5
4	**Stability Analysis**: Stability in the sense of Lyapunov, Lyapunov's stability and instability theorems - Stability Analysis of the Linear time invariant systems by Lyapunov second method , Generation of Lyapunov functions – Variable gradient	CO1, CO2, CO4,

	and Krasovoskii’s method (descriptive treatment only).	CO5
5	**Linear System Design:** Lag, lead, lag-lead compensators – physical realization, design of compensators using bode plots (construction steps only), and design of PID Controllers in frequency domain.	CO1, CO2, CO3, CO4, CO5

Learning Resources
Text Books
1. Katsuhiko Ogata, “Modern Control Engineering”, Prentice Hall of India Pvt. Ltd., 5th edition, 2013. 2. M.Gopal, “Modern Control System Theory”, New Age International Pvt. Ltd., 2nd edition, 2005.
Reference Books
1. Farid Golnaraghi and Benjamin C. Kuo, “Automatic Control Systems”, John wiley and son’s., 9th edition, 2010. 2. A. Nagoor Kani, “Advanced Control Theory”, CBS Publishers, 3rd edition, 2020. 3. D. Roy Choudhury, “Modern Control Engineering”, Prentice Hall of India Pvt. Ltd., 9th edition, 2015.
e- Resources & other digital material
1. https://nptel.ac.in/courses/107106081 2. https://nptel.ac.in/courses/108107115 3. https://www.youtube.com/watch?v=Xgnwn0G9qoo&list=PLhdVEDm7SZMqSUpBw78Cb2BmI142R2VA

DISTRIBUTED GENERATION AND MICROGRIDS

Course Code	20EE6401D	**Year**	II	**Semester(s)**	II
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** Distributed generation and Microgrid concepts. (L2)
CO2	**Interpret** DG Vs Central power generation, various DG technologies and energy storage systems. (L3)
CO3	**Analyze** Impact of DG integration on power quality and reliability. (L4)
CO4	**Analyze** various control aspects of Microgrids. (L4)
CO5	**Interpret** micro grid configuration**,** various operational & Protection issues for Microgrids and Microgrid economics (L3)
CO6	Ability to engage in independent study to make an effective presentation and **submit a report** on various concepts in Distributed Generation and Micro Grids.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3						1						2	2
CO3		2					2						2	2
CO4		2				1							2	2
CO5	2					1							2	2
CO6	3	3							3	3			2	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Distributed Generation & Microgrids** Distributed generation, Distributed Generation versus Central Station Generation, Active distribution network, Concept of Microgrid, A typical Microgrid configuration, Interconnection of Microgrids, Technical and economical advantages of Microgrid, Management and operational issues of a Microgrid.	**CO 1** **CO 2** **CO 5** **CO 6**

II	**Distributed energy resources** Introduction, Combined Heat & Power (CHP) systems – IC engines, stirling engines, micro turbines, fuel cells, Wind energy conversion systems (WECS), Solar photovoltaic (PV) systems, Small-scale hydroelectric power generation, Energy storage – Battery storage, capacitor storage, flywheels	**CO 1 CO 2 CO 6**
III	**Impact of DG integration on power quality and reliability** Introduction, Power quality disturbances, Power quality sensitive customers,Existing power quality improvement technologies, Impact of DG integration, Issues of premium power in DG integration	**CO 1 CO 3 CO 6**
IV	**Microgrid and active distribution network management system** Network management needs of Microgrid - Microsource generation control, Domestic process control, Energy storage, Regulation and load shifting, Ancillary services. Microsource controller, Central controller - Energy manager module (EMM), Protection co-ordination module (PCM), Information needed for central controller Operation, Control strategies for central controller design.	**CO 1 CO 4 CO 6**
V	**Protection issues for Microgrids and its economics** Islanding: separation from utility, Major protection issues of stand-alone Microgrid, Main issues of Microgrid economics, Microgrids and traditional power system economics, Emerging economic issues in Microgrids, Economic issues between Microgrids and bulk power systems	**CO 1 CO 5 CO 6**

Learning Resources

Text Books

1. S. Chowdhury, S.P. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", The Institution of Engineering and Technology, 2009.
2. H. Lee Willis, Walter G. Scott , "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press, 2000.

Reference Books

1. Nikos Hatziargyriou , 'Microgrids: Architectures and Control' (Wiley - IEEE), 2014.
2. Papia Ray, Monalisa Biswal,'Microgrid: Operation, Control, Monitoring and Protection', Springer, 1st edition,2020

e-resources:

1. https://nptel.ac.in/courses/108108034
2. https://nptel.ac.in/courses/108107143

COMPUTATIONAL THINKING

Course Code	20CS5401	**Year**	II	**Semester(s)**	II
Course Category	Minor in CSE	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the fundamental concepts of searching, sorting and data processing over numerical and textual data. (L2)
CO2	**Apply** the knowledge of fundamental algorithms and factoring methods tomodel a flowchart for a given problem. (L3)
CO3	**Apply** the concepts of data processing techniques to develop algorithms for a given problem. (L3)
CO4	**Analyze** the given problem to develop an efficient solution using sortingor pattern searching techniques. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to computational thinking :** What is computational thinking, Pillars of computational thinking - Decomposition, Pattern Recognition, Data Representation and Abstraction, Algorithm Design. Introduction to Algorithms and Flowcharts, Fundamental Algorithms: Exchanging the values of two variables, Counting, Summation of a set of numbers, Factorial Computation, Generation of Fibonacci sequence, Reversing the digits of an integer.	**CO1, CO2**

II	**Factoring Methods**: Finding the square root of a number, smallest divisor of an integer, Greatest common divisor of two integers, Generating prime numbers, Computing Prime Factors of an integer, generation of pseudo random numbers, raising a number to a large power, computing nth Fibonacci number.	**CO1, CO2**
III	**Array Techniques**: Array order reversal, Array counting or Histogramming, finding the maximum number in a set, removal of duplicates from an ordered array, partitioning an array, finding the kth smallest element.	**CO1, CO3**
IV	**Merging, Sorting and Searching**: The two-way merge, sorting by selection, sorting by exchange, sorting by Insertion, Linear search, binary search.	**CO1, CO3, CO4**
V	**Text Processing and Pattern Searching**: Keyword searching in text,Text line editing, Linear pattern search, Sub linear pattern search.	**CO1, CO3, CO4**

Learning Resources
Text Books
1. How to Solve it by Computer, R.G. Dromey, First Edition, Pearson, 2006.
Reference Books
1. Fundamentals of Computers, Reema Thareja, Oxford University Press. 2. Flowchart and Algorithm Basics: The Art of Programming, A B Chaudhuri,2020, Mercury Learning and Information. 3. Algorithms Unlocked, Thomas H. Cormen, 2013, The MIT Press. 4. An Introduction to Programming and Problem Solving with Pascal, Michael Schneider, Steven W. Weingart, David M. Perlman, Second Edition, 2011, WileyIndia
e-resources: 1. https://onlinecourses.swayam2.ac.in/nou20_cs03/preview 2. https://www.coursera.org/learn/problem-solving?#about 3. https://www.udemy.com/course/flowchartingcourse/ 4. https://raptor.martincarlisle.com/

OPERATING SYSTEMS

Course Code	20IT5401	Year	II	Semester(s)	II
Course Category	Minor in IT	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	4-0-0	Prerequisites	NIL
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the structure and functionalities of operating systems. (L2)
CO2	Apply various concepts to solve problems related to process synchronization, deadlocks and make an effective report. (L3)
CO3	Apply different algorithms of CPU scheduling, Page replacement anddisk scheduling. (L3)
CO4	Analyze process, memory and storage management strategies. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Overview: Introduction**: What Operating Systems Do, Computer- System Organization, Computer-System Architecture, Operating- System Structure, Operating-System Operations **Operating System Structures:** Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls.	CO1
II	**Process Management:** Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication. **Threads:** Overview, Multicore Programming, Multithreading Models. **Process Scheduling:** Basic Concepts, Scheduling Criteria, SchedulingAlgorithms (First-Come, First-Served Scheduling, Shortest-Job-First Scheduling, Priority Scheduling, Round-Robin Scheduling.)	CO1, CO3, CO4

III	**Process Synchronization:** Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization. **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	CO1, CO2
IV	**Memory Management:** **Main Memory:** Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table **Virtual Memory:** Background, Demand Paging, Copy-on-Write, Page Replacement, Basic Page Replacement, FIFO Page Replacement, Optimal Page Replacement, LRU Page Replacement, LRU-Approximation Page Replacement.	CO1, CO3, CO4
V	**Storage Management:** **File–System Interface:** File Concept, Access Methods, Directory and Disk Structure. **File–System Implementation:** File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods. **Mass-Storage Structure**: Overview of Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, FCFS Scheduling, SSTF Scheduling, SCAN Scheduling, C-SCAN Scheduling, LOOK Scheduling, Selection of a Disk-Scheduling Algorithm.	CO1, CO3, CO4

Learning Resources
Text Books
1. Operating System Concepts, Abraham Silberchatz, Peter Baer Galvin, Greg Gagne, Ninth Edition, 2016, Wiley India.
Reference Books
1. Operating Systems - Internal and Design Principles, William Stallings, Ninth Edition, 2018, Pearson. 2. Operating Systems - Harvey M.Deitel, Paul J Deitel and David R.Choffnes , Third Edition, 2019, Pearson.. 3. Operating Systems - A Concept based Approach- D.M. Dhamdhere, Second Edition, 2010, McGraw Hill.
e-resources: 1. https://www.youtube.com/watch?v=z3Nw5o9dS7Q&list=PLsylUObW5M3CAGT6OdubyH6FztKfJCcFB 2. http://www.youtube.com/watch?v=MaA0vFKtew&list=PL88oxI15Wi4Kw1aEY2bC5l_4pouojjtd4

ANALOG SYSTEMS

Course Code	20EC5401	**Year**	II	**Semester(s)**	II
Course Category	Minor in ECE	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic concepts of electronic devices & analog systems (L2)
CO2	Apply the knowledge of transistors to realize switch, amplifier, linear and non-linear applications of op-amp (L3)
CO3	Apply the knowledge of op-amps & IC 555 timer to implement active filters, data converters & Multivibrators (L3)
CO4	Analyse the op-amp and 555 IC Timer based circuits to solve the given problem or to justify the given situation (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Electronic devices** : PN diode-Construction, forward bias, reverse bias, V-I characteristics.BJT-Construction (NPN), CE characteristics, BJT as switch and amplifier. Advantages of FET over BJT, FET classification, MOSFET- Construction (N-channel Enhancement type)	CO1, CO2
II	**Operational Amplifiers** : Block diagram, Ideal characteristics, practical characteristics for IC 741 op-amp, Linear applications- Inverting amplifier, Non Inverting amplifier, Adder, subtractor. non-linear applications- Comparator, Astable Multivibrator, Monostable Multivibrator	CO1, CO2, CO4

III	**Active Filters**: Introduction, classification, Butter worth filters – 1st order, 2nd orderLPF, HPF, Band pass, Band reject filters, All pass filters.	CO1, CO3, CO4
IV	**D/ A & A/ D Converters**: Specifications, weighted resistor DAC, R2R ladder DAC, inverted R- 2R DAC, parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.	CO1, CO3, CO4
V	**IC 555 TIMER**: Introduction to 555 timer, functional diagram, Monostable, Astable operations and applications, Schmitt Trigger.	CO1, CO3, CO4

Learning Resources

Text Books

1. Ramakanth A. Gayakwad- Op-Amps and Linear Integrated Circuits,- PHI, 4th Ed., 2009
2. J.Milliman, C.C Halkias - Electronic Devices and Circuits, Tata Mc-Graw Hill, 2nd Ed., 2007

Reference Books

1. D Roy Choudhury, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003
2. J.Milliman, C.C Halkias- Integrated Electronics, Tata Mc-Graw Hill, 2nd Edition, 2007

e-resources:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/lecture-20/
3. https://nptel.ac.in/courses/108105158
4. https://nptel.ac.in/courses/108108111

MICROCONTROLLERS AND INTERFACING

Course Code	20EC5402	**Year**	II	**Semester(s)**	II
Course Category	Minor in IoT	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Summarize programmer's model of 8051 microcontroller. (L2)
CO2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and instructions of the microcontroller. (L3)
CO3	Effectively utilize peripherals such as interrupts, timers, and serial communications to develop microcontroller based systems. (L3)
CO4	Develop programs to interface various peripherals with microcontroller. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**8051 Microcontroller** Microcontrollers, Types of Microcontrollers, 8051 Microcontroller Architecture, Microcontroller 8051 Pins, 8051 Ports, Internal and External Memory.	CO1
II	**8051 Instruction Set** Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language programs.	CO2
III	**Real Time control: Interrupts** Routine, Interrupt and Interrupt service routine, Interrupt Handling structure of an MCU, Sources of interrupts, Enabling or disabling of the sources, interrupt structure in 8051.	CO3
IV	**Real Time control: Timers and Serial Port** Programmable timers in the MCUs, Timer modes, Free running counter and real time control, Software timers, Serial Communication modes.	CO3

V	**8051 Interfacing Applications** LCD interfacing, Keyboard interfacing, ADC interfacing, DAC interfacing, Stepper motor interfacing and their 8051 Assembly language programming.	CO3, CO4

Learning Resources
Text Books
1. Raj Kamal-Microcontrollers: Architecture, Programming, Interfacing and System Design, 2^{nd} Ed., Pearson. 2. Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay- The 8051 Microcontroller and Embedded Systems – using assembly and C", Pearson, 2^{nd} Ed.
Reference Books
1. Kenneth J. Ayala- The 8051 Microcontroller, 3^{rd} Ed., Thomson/Cengage Learning.

AUTOMOBILE ENGINEERING

Course Code	20ME5401	**Year**	II	**Semester(s)**	II
Course Category	Minor in Automobile Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand basic components of an Automobile. (L2)
CO2	Analyse the working of various systems of engines. (L3)
CO3	Analyse the working of various automobile systems. (L3)
CO4	Analyse various alternative energy resources, emissionsstandards and application of plastic in automobiles. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**INTRODUCTION** Components of four-wheeler automobile – chassis and body – power unit –power transmission – rear wheel drive, front wheel drive, 4-wheel drive. Types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation –engine service, reboring, decarburization, Nitriding of crank shaft. **INTRODUCTION TO NHV:** Definition of Noise, Vibrations & Harshness in reference to Vehicular application.	**CO1, CO2**
II	**FUEL SYSTEM** S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters–carburetor – types – air filters – petrol injection. C.I. Engines: Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. **COOLING SYSTEM:** Cooling Requirements, Air Cooling, Liquid Cooling, Thermosyphon, Forced Circulation System, evaporating cooling and pressure sealed cooling – antifreeze solutions.	**CO1, CO2**

	IGNITION SYSTEM: Ignition System-, battery, magneto, Electronic ignition	
III	**TRANSMISSION SYSTEM:** Clutches: Principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel. Gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres. **SUSPENSION SYSTEM:** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.	**CO1, CO3**
IV	**STEERING SYSTEM:** Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages. **BRAKING SYSTEM:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder, tandem master cylinder, Requirement of brake fluid, Pneumatic and vacuum brakes.	**CO1, CO3**
V	**ELECTRICAL SYSTEM:** Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc. **EMISSION FROM AUTOMOBILES:** Pollution standards National and international – Pollution Control– Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection. Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG,CNG, liquid Fuels and gaseous fuels, electrical-their merits and demerits. **KEY AUTOMOTIVE PLASTICS APPLICATIONS:** Safety and Energy Management, Interiors and Occupant Safety. Glazing, Plastic-Metal Hybrid Structures, Headlamps, Body Panels, Under-the-Hood Components.	**CO1, CO3, CO4**

Learning Resources
Text Books
1. Automotive Mechanics-Vol.1 & Vol.2, by Kirpal sing, Standard Publishers, New Delhi, 2008. 2. Automobile Engineering, (3rd edition), by William crouse, TMH Distributors, New Delhi. 3. Plastics Application Technology for Safe and Lightweight Automobiles, Sudhakar R Marur, SAEInternational (30 October 2013), USA
Reference Books
1. Automobile Engineering Theory and Servicing, by James D. Halderman and Chase D. Mitchell,Pearson education inc, 2001. 2. Automobile Engineering, by Newton's steeds & Garrett Automotive Mechanics Heitner,Butterworth International, London.
E- Resources & other digital material
1.https://nptel.ac.in/courses/107/106/107106088/

ADDITIVE MANUFACTURING

Course Code	20ME5402	Year	II	Semester(s)	II
Course Category	Minor in Digital Manufacturing	Branch	EEE	Course Type	Basic Manufacturing Processes
Credits	4	L-T-P	3-1-0	Prerequisites	NIL
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the working principle and process parametersof different AM processes and Design and develop aproduct for AM process. (L2)
CO2	Explore the Vat Photo polymerization AM Process andtheir applications. (L2)
CO3	Select the Extrusion-Based AM Processes, Sheet Lamination AM Processes suitable material and process for fabricating a given product. (L2)
CO4	Identify various Metal Additive Manufacturing processfor different products. (L2)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Introduction to Additive Manufacturing**: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM	**CO1**
II	**Vat Photopolymerization AM Processes**: Stereolithography (SL), Materials, Process Modeling, SL resin curing process, SL scan patterns, Micro-stereolithography, Mask Projection Processes, Two-Photon vat photo polymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, case studies.	**CO1, CO2**
III	**Material Jetting AM Processes:** Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes. Binder Jetting AM Processes: Materials, Process Benefits and Drawbacks, Research achievements in printing deposition, Technical challenges in printing, Applications of Binder Jetting Processes.	**CO1, CO3**

IV	**Extrusion-Based AM Processes:** Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes, case studies **Sheet Lamination AM Processes:** Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications, case studies.	**CO1, CO4**
V	**Powder Bed Fusion AM Processes:** Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.	**CO1, CO4**

Learning Resources
Text Books
1. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: 3DPrinting, Rapid Prototyping, and Direct Digital Manufacturing”, 2nd Edition, Springer, 2015. 2. Patri K. Venuvinod and Weiyin Ma, “Rapid Prototyping: Laser-based and Other Technologies”,Springer, 2004. 3. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles &Applications”, 4th Edition, World Scientific, 2015.
Reference Books
1. Neil Hopkinson, Richard Hague, Philip Dickens - Rapid manufacturing_ an industrialrevolution for the digital age (2006, Wiley) - libgen.lc.
E- Resources & other digital material
1. https://onlinecourses.nptel.ac.in/noc20_me50/preview 2. https://onlinecourses.nptel.ac.in/noc21_me115/preview

SOLID MECHANICS

Course Code	20CE5401A	Year	II	Semester(s)	II
Course Category	Minor in Civil Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Determine** the resultant of coplanar force system and **analyse** the force system which were involved Friction. (L4)
CO2	**Find** out the center of gravity and moment of inertia and their applications. (L3)
CO3	**Evaluate** the behavior when a solid material is subjected to various types of forces and **estimate** stresses, corresponding strain developed. (L3)
CO4	**Estimate** the forces developed and draw schematic diagram for shear forces, bending moments for simple beams with different types of support and are subjected to various types of loads. (L3)
CO5	**Evaluate** the flexural stresses, section modulus for various sections and draw shear stress distribution for rectangular, circular, triangular, I, T and angle sections (L5)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**ANALYSIS OF FORCE SYSTEMS** Concept of idealization, force, a system of forces, superposition, transmissibility, Resolution, and composition of forces, Law of Parallelogram of forces, polygonal law, Resultant of concurrent coplanar force system, coplanar non-concurrent force system, a moment of forces, couple, Varignons theorem, resultant of coplanar non-concurrent force system, free body diagram, Lamis theorem, equations of equilibrium, equilibrium of concurrent and non-concurrent coplanar force system **FRICTION** Types of friction, laws of friction, limiting friction, coefficient of friction concept of static and dynamic friction, numerical problems on impending motion on horizontal and inclined planes along with connected bodies,	**CO1**

II	**CENTROID** Introduction, methods of determining the centroid, locating the centroid of simple figures from first principle, the centroid of composite and built-up sections. **MOMENT OF INERTIA** Introduction, method of determining the second moment of area of plane sections from first principles, parallel axis theorem and perpendicular axis theorem section modulus, the radius of gyration, moment of inertia of composite area and built-up sections, concept ofproduct of inertia (No problem).	**CO2**
III	**SIMPLE STRESSES AND ELASTIC CONSTANTS** Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity, types of stresses and strains, Hooke's law stress –strain diagram for mild steel working stress, factor of safety, Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them; Bars of varying section, composite bars, temperature stresses. Relationship between elastic constants. Strain Energy –Resilience, Gradual, sudden, impact and shock loadings, simple applications.	**CO3**
IV	**BENDING MOMENT AND SHEAR FORCE DIAGRAMS** Relationship between moment, shear and load. Bending Moment (BM) and Shear Force (SF) diagrams. BM and SF diagrams for cantilevers, simply supported with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments	**CO4**
V	**STRESSES IN BEAMS** Derivation of bending equation, Neutral axis, determination of bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, Design of simple beam sections. Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.	**CO4**

Learning Resources
Text Books
1. A. K. Tayal, Engineering Mechanics (Statics and Dynamics), UmeshPublications, 14th Edition, 2011. 2. V.N Vazirani and M.M Ratwani, Analysis Of Structures Vol-I, KhannaPublishers, 2003. 3. S.Timoshenko, Strength Of Materials: Elementary Theory and Problems-Vol.I,2004. 4. R.Subrahmanian, Strength of Materials, 3/e, Oxford University Press, 2016.
Reference Books
1. S.S. Rattan, Strength of Materials, 2/e, Tata McGraw Hill Education, 2011. 2. Gere and Timoshenko, Mechanics of Materials, 4/e, CBS Publishers, 2006. 3. Stephen Timoshenko, Strength of Materials, 3/e, CBS Publisher, 2002. 4. R.K. Rajput, Strength of Materials, S. Chand Publications, 2007
E- Resources & other digital material
1. http://nptel.ac.in/courses.php 2. http://jntuk-coeerd.in/

SOIL MECHANICS

Course Code	20CE5401B	**Year**	II	**Semester(s)**	II
Course Category	Minor in Civil Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	20BS1304-Applied Mechanics
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Classify** the soil based on particle-size characteristics, liquid limit, and plasticity index. (L2)
CO2	**Select** the clay and sandy soil for liner and filter (porous media) application based on theirhydraulic behavior (L2)
CO3	**Evaluate** the settlement behavior of the soil under the application of stress (L5)
CO4	**Calculate** the factor of safety and ultimate stress for any geotechnical structure (L3)
CO5	**Evaluate** the shear strength parameters for field conditions (L5)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Soil classification:** Soil formation; Introduction to soil classification; Particle size classification as per IS-code; Unified soil classification system; Indian standard soil classification system, **Clay Chemistry:** Primary minerals; Secondary minerals, Basic structure of clay mineral, Electrical charges on clay Adsorbed water, specific surface area, Diffuse double layer. **Atterberg Limits:** Shrinkage limit, Plasticity Chart, Block Diagram, Simple definitions; some important relationships.	**CO1**
II	**Hydraulic behaviour:** Fundamentals of fluid flow, Bernoulli's Equation, Laminar flow, Turbulent flow, Darcy's law and its Validity, Determination of coefficient of permeability constant and Variable head methods, Factors affecting permeability; Permeability of stratified soil deposits. **Seepage in soil:** Continuity Equation (3D and 2D), Properties of flow net, construction of flow net, use of flow net, Flow net in Anidtropic soil	**CO2**

III	**Compaction:** Mechanism of compaction, factors affecting compaction, effect of compaction on engineering properties of soils **Consolidation:** Oedometer Tests, e-p and e-log p curves – compression index, coefficient of compressibility and coefficient of volume change, Terzaghi's assumptions for one dimensional consolidation, equation and application, coefficient of consolidation, degree of consolidation vs time, initial compression, primary compression and secondary compression, normally consolidated, over consolidated and under consolidated clayey deposits,	**CO3**
IV	**Analysis of Stress-strain:** stress-strain behaviour of soils, Principal Stresses, State of stress, Definition and notation of stress, equations of equilibrium in differential form, stress components on an arbitrary plane, equality of cross shear, stress invariants, principal stresses, octahedral stress, planes of maximum shear, stress transformation, Theories of failure. **Analysis of Strain:** Strains in term of displacement field, engineering shear strains, strain invariants, principal strains, octahedral strains, plane state of strain, compatibility equations, strain transformation.	**CO4**
V	**Shear Strength of Soils:** Elastic and plastic deformations; Interpretation of triaxial test results; Significance of pore pressure parameters; Concept of drained and undrained loading; Unconsolidated undrained triaxial test; Consolidated undrained triaxial test; Consolidated drained triaxial test (CD); Direct shear test; Consolidated drained direct shear test on clay and sand; Shear strength of cohesive and cohesion less soils; Drained and Undrained shear strength of soils, Mohr circle of stress, Mohr-coulomb's failure theory; Determination of shear strength;. Stress path; Drained and Undrained stress path; Stress path with respect to different initial state of the soil; Effect of dilation in sands.	**CO5**

Learning Resources

Text Books

1. B.C. Punmia, Soil Mechanics and Foundations, (SI Modules), 16/e LaxmiPublications, Sixteenth edition (2017).
2. Gopala Ranjan and A.S.R, Rao, Basic and Applied Soil Mechanics, 2/e,New Age International Publishers, Third edition 2016.
3. Dr. K. R Arora, Soil Mechanics and Foundation Engineering, StandardPublisher Dist, 2009.

Reference Books

1. C. Venkataramaiah, Geotechnical Engineering, New Age International,2006..
2. M. Braja Das, Principles of Geotechnical Engineering,Cengage Learning,2013.
3. P. Donald, Coduto, Geotechnical Engineering, Prentice-Hall India, 2010.

E- Resources & other digital material

1. https://nptel.ac.in/courses/105/101/105101201/
2. http://jntuk-coeerd.in/

III B.TECH I SEMESTER SYLLABUS

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III B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE3501	Control Systems	3	3	0	0	30	70	100
20EE3502	Power Electronics	3	3	0	0	30	70	100
20EE3503	Electrical Power Generation, Transmission and Distribution	3	3	0	0	30	70	100
	Open Elective -I	3	3	0	0	30	70	100
20EE4501	Professional Elective-I	3	3	0	0	30	70	100
20EE3551	Control Systems Lab	1.5	0	0	3	15	35	50
20EE3552	Power Electronics Lab	1.5	0	0	3	15	35	50
20SA8552	JAVA Programming	1.5	1	0	2	-	50	50
20MC1502	Universal Human Values	0	2	0	0	30	70	100
20EE3581A	Summer Internship	1.5	0	0	0	-	-	-
Total		**21.5**	**18**	**0**	**8**			

L - Lecture T - Tutorial P – Practical

Professional Elective-I								
Course Code	**Title**	**Cre dits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4501A	Utilization of Electrical Energy	3	3	0	0	30	70	100
20EE4501B	Electrical Machine Design	3	3	0	0	30	70	100
20EE4501C	Renewable Energy Resources	3	3	0	0	30	70	100
20EE4501D	High Voltage Engineering	3	3	0	0	30	70	100
20EE4501E	Computer Organization & Architecture	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Open Elective -I								
Course Code	**Title**	**Cre dits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2501A	Air Pollution and Control	3	3	0	0	30	70	100
20EC2501A	Sensor Technology	3	3	0	0	30	70	100
20EC2501B	Electronic Instrumentation	3	3	0	0	30	70	100
20EE2501A	Electrical Safety	3	3	0	0	30	70	100
20IT2501A	Cyber Laws	3	3	0	0	30	70	100
20ME2501A	Design Thinking	3	3	0	0	30	70	100
20ME2501B	Logistic and Supply Chain Management	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HONORS -II								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE6501A	Computer Aided Power Systems Analysis	4	3	1	0	30	70	100
20EE6501B	Reactive Power Control in Electric Systems	4	3	1	0	30	70	100
20EE6501C	Power Systems Dynamics and Control	4	3	1	0	30	70	100
20EE6501D	EHVAC Transmission	4	3	1	0	30	70	100

L – Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks	Minor in
20CS5501	Data Structure and Algorithms using Java	3	3	0	0	30	70	100	CSE
20CS5551	Data Structure and Algorithms using Java Lab	1	0	0	2	15	35	50	CSE
20IT5501	Computer Networks	4	4	0	0	30	70	100	IT
20EC5501	Digital Design Using Verilog HDL	4	3	1	0	30	70	100	ECE
20EC5502	Sensors and Actuator Devices for IoT	4	3	1	0	30	70	100	IoT
20ME5501	Automotive Transmission System	4	3	1	0	30	70	100	Automobile Engineering
20ME5502	Basic manufacturing processes	4	3	1	0	30	70	100	Digital Manufacturing
20CE5501A	Analysis of Structures	4	3	1	0	30	70	100	Civil
20CE5501B	Transportation Engineering	4	3	1	0	30	70	100	Civil

L - Lecture   T - Tutorial   P – Practical

CONTROL SYSTEMS

Course Code	20EE3501	**Year**	III	**Semester**	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Signals and Systems
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

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

CO1	**Understand** various models to represent the linear time invariant systems. **(L2)**
CO2	**Apply** the knowledge of engineering fundamentals in control systems, modeling transferfunction/state space of the systems and characterize them. **(L3)**
CO3	**Interpret** the LTI system's performance in time and frequency domains. **(L3)**
CO4	**Analyze** the transfer function model of linear control system and stability using various tools **(L4)**
CO5	**Examine** the state of a linear control system using state space representation. **(L4)**
CO6	**Ability** to understand the concepts, investigate various problems of control systems and,submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1							2	1
CO3	3												2	1
CO4		3	1	1									2	1
CO5		3		1							1		2	1
CO6			3						3	3		2	2	

Unit No.	Syllabus	Mapped CO's
1	**Mathematical Modelling of Control Systems:** Classification of control systems, Mathematical models – mechanical systems (Translational and Rotational), Concept of transfer function - Finding Transfer functions for electrical networks and mechanical systems. Effects of feedback.	CO1, CO2, CO4, CO6
2	**Transfer function representation:** Transfer function of DC servo motor – AC servo motor. Construction and working of synchro transmitter and receiver. Block diagram algebra - reduction techniques, representation by signal flow graph – reduction using mason's gain formula.	CO1, CO2, CO4, CO6
3	**Time Response Analysis** (descriptive treatment only)**:** Step response of first order, second order systems, time domain specifications, steady state error and static error constants. **Stability Analysis:**	CO1, CO3,

	The concept of stability – Routh's stability criterion –limitations of Routh's stability, Root locus concept – construction of root loci (simple problems).	CO4, CO6
4	**Frequency Response Analysis & Stability:** Introduction, frequency domain specifications (descriptive treatment only). Stability analysis of Bode plots – Phase margin a Gain margin (simple problems).	CO1, CO3, CO4, CO6
5	**State Space Analysis of LTI Systems:** Concepts of state, state variables and state model, Conversion of state variable model to transfer function model and transfer function form to state variable form (controllable canonical form), solution of linear homogenous state equations - state transition matrix (Laplace transform method) and its properties, Kalman's test of controllability and observability.	CO1, CO2, CO5, CO6

Learning Resources

Text Books

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited 6th edition, 2009.

Reference Books

1. A. Nagoor Kani, "Control Systems", RBA Publications, 3rd edition, 2017.
2. Farid Golnaraghi and Benjamin C. Kuo, "Automatic Control Systems", John wiley and son's., 9th edition, 2010.
3. S.Palani, "Control Systems Engineering", Tata Mc Graw Hill Publications, 2nd edition, 2009.

e- Resources & other digital material

1. https://nptel.ac.in/courses/108106098
2. https://nptel.ac.in/courses/108107115
3. https://freevideolectures.com/course/2337/control-engineering

POWER ELECTRONICS

Course Code	20EE3502	**Year**	III	**Semester(s)**	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	1.Circuit Theory 2. Electronic Devices and Amplifier Circuits
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic operation of various power electronic devices and their characteristics, Various Power Converters, firing scheme, Snubber circuit, series and parallel connections of SCR. (L2)
CO2	**Apply** the basic knowledge to obtain the operation, waveforms and desired parameters of Two-Transistor analogy and characteristics of SCR, , Necessity of series and parallel connections of SCR, Rectifiers and Choppers.(L3)
CO3	**Apply** the basic knowledge to obtain the operation, waveforms and desired parameters of Snubber circuit ,Inverters and AC to AC converters. (L3)
CO4	**Analyze** the concepts of Two-Transistor analogy and characteristics of SCR, Necessity of series and parallel connections of SCR ,load voltage- current expressions for Rectifiers and Choppers (L4)
CO5	**Analyze** the concepts Snubber circuit ,load voltage-current expressions for Inverters and AC to AC converters. (L4)
CO6	**Submit a report** in Power Semiconductor Switches, Rectifiers, Choppers, Inverters and AC to AC converters.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1	1						2	2
CO3	3					1	1						2	2
CO4		2											2	2
CO5		3											2	2
CO6						3	3		3	3		3	2	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Power Semiconductor Switches:** Power Diode, Power MOSFET, Power IGBT, DIAC Principle of operation and characteristics. Principle of operation of SCR, static, dynamic characteristics, Two-Transistor analogy of SCR, Triggering methods of SCR, gate driver circuit with IGBT & MOSFET, Snubber Circuit, Necessity of series and parallel connections of SCR.	CO1 CO2 CO3 CO4 CO5 CO6
II	**AC –DC Converters(Rectifiers):** Phase angle control, single phase half wave and full wave(mid point) controlled rectifiers with R and RL load, half controlled (symmetrical configuration) and fully controlled bridge rectifiers with R, RL loads - effect of source inductance. Three phase half and fully controlled bridge converters-with R and RL loads, Single phase dual converters.	CO1 CO2 CO4 CO6
III	**DC to AC Converters (Inverters):** Series Inverter and Parallel Inverter ,single phase full bridge inverters, comparison between VSI & CSI, three phase VSI (180 &120-degree conduction modes). Introduction to Multi level Inverters-Cascaded H Bridge inverter (principle of operation). Voltage control techniques for inverters: Pulse-width modulation techniques - single pulse, multi-pulse, sinusoidal pulse width modulation techniques**(descriptive treatment only).**	CO1 CO3 CO5 CO6
IV	**DC to DC Converters (Choppers)** – Control strategies of chopper, Buck, Boost, Buck-boost choppers- Derivation of average load voltage and current expressions, Filter design**(derivation only),** Four quadrant chopper **(principle of operation).**	CO1 CO2 CO4 CO6
V	**AC to AC converters (AC Voltage controllers and Cyclo-converters) :** Two SCR's in anti-parallel with R and RL loads, derivation of RMS load voltage, current and power factor. Cyclo converters – single phase mid-point and bridge type cyclo-converters with resistive and inductive load **(Principle of operation only).**	CO1 CO3 CO5 CO6

Learning Resources

Text Books

1. P.S.Bhimbra,'PowerElectronics', Khanna Publications, 5th edition, 2018.
2. M.H. Rashid,' Power Electronic Circuits Devices and Applications', Pearson, 4th edition, 2017.

Reference Books

1. M.D.Singh and K.B.Kanchandani,'PowerElectronics',McGraw Hill Publications, 2nd edition ,2017.
2. NedMohan,ToreM.Undeland,WilliamP.Robbins,"PowerElectronicsConvertersApplications and Design", McGraw-Hill Education, 3rd edition, 2007
3. P.C.Sen Power Electronics , Tata McGraw-Hill Publishing, 2nd edition ,2006.
4. Vedam Subramanyam ,'Power Electronics-Devices Converter Applications', , New Age International (P) Limited, 2nd edition ,2018.

Web Links

1. https://nptel.ac.in/courses/108101038
2. https://nptel.ac.in/courses/108105066

ELECTRICAL POWER GENERATION, TRANSMISSION AND DISTRIBUTION

Course Code	20EE3503	**Year**	III	**Semester(s)**	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Circuit Theory
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of electrical power generation, transmission and distribution. (L2)
CO2	**Apply** the principles of physical sciences to understand the working of conventional and non-conventional power plants. (L3)
CO3	**Compute** the transmission line parameters, sag of an overhead transmission line and string efficiency of insulators. (L3)
CO4	**Analyze** the performance of various types of transmission lines and distribution system topologies. (L4)
CO5	**Illustrate** the different types of insulators, underground cables and effect of corona. (L3)
CO6	Get the ability to engage in independent study to make an effective presentation and submit report on generation, transmission and distribution concepts in various domains.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	1					1	1					1	2	1
CO3	2		1			1							2	1
CO4		2										2	2	1
CO5	2						1						2	1
CO6	3	3							3	3			2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Conventional and Non-conventional power Generation**: General layout, working and site selection of thermal power plant, hydroelectric power plant, nuclear power plant and pumped storage plants. Introduction to Non-Conventional Sources Solar Energy, wind Energy (descriptive treatment only)	**CO 1 CO 2 CO 6**

II	**Transmission Line parameters:** Calculation of resistance, Skin effect, Proximity effect. Calculation of inductance of single phase, three phase lines with symmetrical spacing. Inductance of composite conductor lines. Capacitance - Calculation for single phase two wire line, capacitance calculation for 3 phase lines with symmetrical spacing	**CO 1** **CO 3** **CO 6**
III	**Performance of Transmission Lines:** Classification of lines, Medium Transmission lines - nominal T method, nominal π method and long transmission lines – Rigorous solution method, ABCD constants of Transmission lines, calculation of voltage regulation and transmission efficiency, Ferranti effect. **Sag, Tension Calculations:** Sag and Tension Calculations with equal and unequal heights of towers, Effect of Wind and Ice on weight of Conductor, Numerical Problems.	**CO 1** **CO 3** **CO 4** **CO 6**
IV	**Insulators:** Types, potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency. **Corona:** Phenomena, disruptive and visual critical voltages and corona power loss (Descriptive treatment only). **Underground Cables:** Types, material used. Insulation resistance, Grading of cables - capacitance grading and inter sheath grading (Descriptive treatment only).	**CO 1** **CO 3** **CO 5** **CO 6**
V	**D.C. Distribution Systems:** Classification of Distribution Systems, Voltage Drop Calculations in D.C Distributors for the following cases: Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor. **A.C. Distribution Systems:** Voltage Drop Calculations in A.C. Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages.	**CO 1** **CO 4** **CO 6**

Learning Resources

Text Books

1. J.B.Gupta, Transmission and Distribution of Electrical Power -S.K.Kataria and sons,10th edition, 2012
2. Dr. S. N. Singh, Electric power generation Transmission & Distribution- PHI learning Pvt Ltd, New Delhi, 2nd Edition, 2010

Reference Books

1. Mehta, Rohit, et al. Principles of Power System: Including Generation, Transmission, Distribution, Switchgear and Protection, S. Chand, 4th Edition, 2005.
2. Generation, Distribution and Utilization of Electrical Energy, C.L.Wadhwa, New Age International publishers, 6th Edition 2018.
3. I.J.Nagarath & D.P. Kothari, “Power System Engineering”, 3e. N.p., McGraw-Hill Education, 2019.

Web Links

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

AIR POLLUTION AND CONTROL

Course Code	20CE2501A	**Year**	III	**Semester(s)**	I
Course Category	Open Elective-I	**Branch**	Common to all	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to:	
CO1	**Understand** the various types of air pollutants and their effects. (L2)
CO2	**Examine** the behaviour of air pollutants with reference to meteorological parameters (L3)
CO3	**Analyze** the samples, pollutants from atmosphere (L4)
CO4	**Identify and understand** the different methods to control the particulate matter (L4)
CO5	**Categorize and understand** the methods for the control of pollutants from gaseous emissions (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes
1- Low 2-Medium 3-High

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

Syllabus		
UNIT-1	**AIR POLLUTION & EFFECTS** Air pollution - definitions-scope, significance -air pollutants -classification – natural and artificial-primary and secondary air pollutants. Effect of air pollutants on man- material and vegetation-global effects of air pollution greenhouse effect, acid rains and ozone layer threat.	**CO1**
UNIT-2	**METEROLOGY AND PLUME DISPERSION** Properties of atmosphere-heat, pressure, wind forces, moisture and relativehumidity influence of meteorological phenomenon on air quality-wind rose diagram, inversions and Plume behavior, Gaussian model for plume dispersion.	**CO2**
UNIT-3	**SAMPLING OF AIR POLLUTION**: Stack sampler; Sampling Procedure- Sampling point – size – Isokinetic	**CO3**

	Conditions –Sampling of Particulate matter and Gases. Sampling methods–Indian standard methods of analysis of SO_2 and NO_x gases- Air Quality and Emission standards.	
UNIT-4	**METHODS OF CONTROLLING AIR POLLUTION**	**CO4**
	Different means of control of effluent discharges into the atmosphere. Control of Particulate matter by equipment -Settling chamber, inertial separators, fabricfilters, wet scrubbers, Electrostatic Precipitators	
UNIT-5	**CONTROL OF GASEOUS POLLUTANTS:** Controlling methods of Gaseous Emissions- combustion, adsorption, absorption, closed collections and recovery systems- Control of SO_2 and NO_x gases.	**CO5**

Learning Resources	
Text Books	1. Air Pollution and Control by Rao M.N and Rao, H.N., Tata McGraw Hill, New Delhi 2007. 2. Environmental Engineering and Management, (2nd Edition) by Suresh, S. K. Kartarai & Sons, 2005.
Reference Books	1. An Introduction to Air pollution by Trivedy, R.K., B. S. Publications, 2005. 2. Air pollution by Wark and Warner, Addison-Wesley Publications, 1998.
E-Resources & other digital material	https://nptel.ac.in/courses/105102089/8

SENSOR TECHNOLOGY

Course Code	20EC2501A	**Year**	III	**Semester**	I
Course Category	Open Elective-I	**Branch**	Common to all	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concept of sensors and its characteristics. (L2)
CO2	**Select** the physical principles of sensing based on sensor signals and systems (**L**3)
CO3	**Identify** the sensor interfacing with various electronics circuits (L3)
CO4	**Utilize** the practical approach in design of technology based on different sensors. (L3)
CO5	**List** various sensor materials and technology used in designing sensors. (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
*** - Average value indicates course correlation strength with mapped PO**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	2											2		
CO2	3												3	
CO3	2				2								2	
CO4	2				2								2	
CO5		2												2

Syllabus

Unit No.	**Contents**	**Mapped CO**
I	**Sensors Fundamentals and Characteristics** Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics	CO1, CO2
II	**Physical Principles of Sensing** Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements	CO1, CO2
III	**Interface Electronic Circuits** Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors	CO1, CO3

IV	**Sensors in Different Application Area** Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors	CO1, CO4
V	**Sensor Materials and Technologies** Materials, Surface Processing, Nano-Technology	CO1, CO5

Learning Resources
Text Books
1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer 2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi
Reference Books
1. Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited).
e- Resources & other digital material
1. http://www.infocobuild.com/education/audio-video-courses/electronics/IndustrialInstrumentation-IIT-Kharagpur/lecture-34.html

ELECTRONIC INSTRUMENTATION

Course Code	20EC2501B	**Year**	III	**Semester**	I
Course Category	Open Elective-I	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Comprehend** the concepts of electronic instrumentation (L2)
CO2	**Identify** the **Performance** characteristics of instruments (L3)
CO3	**Illustrate** the different types of Signal Generator, Wave Analyzers& Bridges (L3)
CO4	**Analyze** the various types of Oscilloscopes (L4)
CO5	**Illustrate** the concept of various types of Transducers. (L3)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	2									2			2	2
CO2	2									2			2	2
CO3	3									2			2	2
CO4		2								2			2	2
CO5	2									2			2	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Performance characteristics of instruments:** Static characteristics, Errors in Measurement, Dynamic Characteristics, DC Voltmeters- Multi range, Range extension, Thermo couple type RF ammeter, Ohmmeters series type, shunt type, Miltimeteres for Voltage, Current and resistance measurements.	CO1, CO2
II	**Signal Generator& Wave Analyzers :** Fixed and variable signal generators, AF oscillators, Standard signal generator, AF sine and	CO1, CO3

	square wave signal generators, Function Generators, Basic wave analyzers, Frequency selective wave analyzers, Hetero- dyne wave analyzer, Harmonic Distortion Analyzers, Spectrum Analyzers.	
III	**Oscilloscopes:** Dual trace oscilloscope, Measurement of amplitude, period and frequency, Sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope.	CO1, CO4
IV	**Bridges:** Wheatstone Bridge, AC Bridges Measurement of inductance- Maxwell's bridge, Measurement of capacitance - Schearing Bridge. Wien Bridge, Q-meter.	CO1, CO3
V	**Transducers:** Resistance, Capacitance, inductance, Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors, Sensistors, force, pressure, velocity, humidity, moisture, speed, Data acquisition system.	CO1, CO5

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Learning Resources
Text Books
1. Electronic instrumentation, - H.S.Kalsi, Tata McGraw Hill, 2nd edition 2004. 2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
Reference Books
1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2nd Edition,2003. 2. Electronic Test Instruments, Analog and Digital Measurements - Robert A.twitter, Pearson Education, 2nd Edition ,2004

ELECTRICAL SAFETY

Course Code	20EE2501A	**Year**	III	**Semester(s)**	I
Course Category	Open Elective-I	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the Indian power sector organization and Electricity rules, electrical safety in residential, commercial, agriculture, hazardous areas and use of fire extinguishers. **(L2)**
CO2	**Assess** the Electrical Safety measures in operation and maintenance. **(L3)**
CO3	**Apply** the **s**afety measures during installation, testing and commissioning. **(L3)**
CO4	**Analyze** the Electrical Safety, Electric Shocks and Their Prevention. **(L4)**
CO5	**Examine** the hazardous areas and the fire extinguishers. **(L4)**
CO6	**Submit** a report on safety measures.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1		1				1		
CO3	2							1				1		
CO4		3				1								
CO5		3												
CO6	3	3						3	3	3				

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction To Electrical Safety, Shocks And Their Prevention:** Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, principles of electrical safety, Approaches to prevent Accidents. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings andshop.	CO1, CO2 CO3, CO4, CO6
II	**Electrical Safety in Residential, Commercial and Agricultural Installations**: Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan giving shock –multi-storied building –	CO1, CO2

	Temporary installations – Agricultural pump installation –Do's and Don'ts for safety in the use of domesticelectrical appliances.	CO4, CO6
III	**Electrical Safety during Installation, Testing and Commissioning, Operation and Maintenance**: Preliminary preparations –safe sequence – risk ofplant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions –safeguards for operators –safety.	CO1, CO3 CO4, CO6
IV	**Electrical Safety in Hazardous Areas**: Hazardous zones –class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment's for hazardous locations **Equipment Earthing**: Introduction, Equipment earthing, Functional requirements of Earthing system, Neutral grounding, Protection against energized Metal parts.	CO1, CO2, CO5, CO6
V	**Fire Extinguishers**: Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO_2, Halogen gas and foam schemes.	CO1, CO5, CO6

Learning Resources
Text Books
1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 4th edition, 2020 2. John Codick, "Electrical safety hand book", McGraw Hill Inc., 3rd edition, 2006
Reference Books
1. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 3rd edition, 1998. 2. Kothari, D.P and Nagrath, I.J., "Power System Engineering", McGraw Hill, 3rd edition, 2019. 3. Wadhwa, C.L., "Electric Power Systems", New Age International, 8th edition, 2004.

CYBER LAWS

Course Code	20IT2501A	Year	III	Semester	I
Course Category	Open Elective-I	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	-
Continuous Internal Evaluation :	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic concepts of Section 80 of IT Act 2000, Cyber Crime, Computer Crime, Internet Theft/Fraud, Goods and Services. (L2)
CO2	Demonstrate the basic concepts of Cognizable and Non-Cognizable Offences, Hacking, Teenage Web Vandals, Prevalence and Victimology, Consumer Protection Act. (L3)
CO3	Analyze the concepts of Arrest for "About to Commit" an Offence Under the IT Act, A tribute to Draco, Cyber Fraud, Computer as Commodities, Consumer Complaint. (L4)
CO4	Explain the concepts of Arrest, But No Punishment, Cyber Cheating, Theft of Intellectual Property, Restrictive and Unfair Trade practices. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3	3					3	3
CO2						3	3	3					3	3
CO3						3	3	3					3	3
CO4						3	3	3					3	3

Syllabus		
Unit No	Contents	Mapped CO
I	**The IT Act, 2000:A Critique:** Crimes in Millennium, Section 80 of the IT Act, 2000-AWeapon or a Farce?, Forgetting the Line between Cognizable and Non-Cognizable Offences, Arrest for "About to Commit" an Offence Under the IT Act, A tribute to Draco, Arrest, But No Punishment	CO1, CO2, CO3, CO4
II	**Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000:** Concept of Cyber Crime and the IT Act, 2000, Hacking, Teenage Web Vandals, Cyber Fraud and Cyber Cheating.	CO1, CO2, CO3, CO4

III	**Traditional Computer Crime: Early Hacker and Theft of Components:** Traditional Problems, Recognizing and Defining Computer Crime, Phreakers: Yesterday's Hackers, Hacking, Computer as Commodities, Theft of Intellectual Property.	**CO1, CO2, CO3, CO4**
IV	**Identity Theft and Identity Fraud:** Typologies of Internet Theft/Fraud, Prevalence and Victimology, Physical Methods of Identity Theft.	**CO1, CO2, CO3, CO4**
V	**Protection of Cyber consumers in India:** Are Cyber consumers Covered under the Consumer Protection Act?, Goods and Services, Consumer Complaint, Restrictive and Unfair Trade practices	**CO1, CO2, CO3, CO4**

Learning Resources
Text books
1. Vivek Sood, "Cyber Law Simplified", Tata McGraw Hill. 2. Marjie T. Britz, "Computer Forensics and Cyber Crime", Person. 3. Ferrera, "Cyber Laws Texts and Cases", Cengage.
References
1. Vakul Sharma, "Handbook Of Cyber Laws" Macmillan India Ltd, 2 nd Edition,PHI,2003. 2. Justice Yatindra Singh, " Cyber Laws", Universal Law Publishing, 1 st Edition,New Delhi, 2003. 3. Sharma, S.R., "Dimensions Of Cyber Crime", Annual Publications Pvt. Ltd., 1st Edition, 2004. 4. Augastine, Paul T.," Cyber Crimes And Legal Issues", Crecent Publishing Corporation, 2007
e-Resources and other Digital Material
1. https://www.coursera.org/lecture/cyber-conflicts/introduction-to-cybercrime-and-fundamental-issues-xndSq 2. https://www.youtube.com/watch?v=F7mH5vz1qEI&list=PLf8YqCm9HoI6fb4LdoY2tFgJfM0PrgInS&ab_channel=ComputingforAll 3. https://www.youtube.com/watch?v=F7mH5vz1qEI&t=41s&ab_channel=ComputingforAll

DESIGN THINKING

Course Code	20ME2501A	Year	III	Semester	I
Course Category	Open Elective-I	Branch	Common to All	Course Type	Theory
Credits	3	L-T-P	3-0-0	Pre-requisites	-
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

CO	Statement
CO1	Understand the principles of design thinking and its approaches **[L2]**
CO2	Apply the empathy, the Define phase and develop an idea through ideation Techniques in human-centered design problems. **[L3]**
CO3	Apply the design thinking techniques for innovation processes **[L3]**
CO4	Analyze the prototype and test in a design thinking context. **[L4]**

Contribution of Course Outcomes towards achievement of Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3			2	2		3	3	2	2	2	3
CO2			3			2	2		3	3	2	2	1	3
CO3			3			2	2		3	3	3	2	1	3
CO4			3			2	2		3	3	2	2	1	3

Course Content

Unit No	Contents	Mapped CO
UNIT-1	**Introduction to Design Thinking** An insight into Design, Design Methodology, the origin of Design thinking, Design thinking Vs Engineering thinking, the importance of Design Thinking, Design Vs Design thinking, understanding Design thinking and its various process models or frameworks, Stanford process models and its five stages, features of design thinking,application of Design thinking	**CO1**
UNIT-2	**Empathize in Design Thinking:** Human-Centered Design (HCD) process, explanation of HCD design thinking with examples, Role of Empathy in design thinking, persona creation and its importance, tools of empathy: Empathy maps, advantages and disadvantages of empathy maps, Customer journey map and its advantages & disadvantages, Mind Maps, and its uses, understanding empathy tools.	**CO1, CO2**
UNIT-3	**Define Phase and Ideation:** Explore define phase in Design Thinking, Methods of Define phase. Introduction to ideation Methods, convention methods for ideation, intuitive methods: Brainstorming, storyboard telling, select ideas from ideation Methods: Bingo Selection, Six Thinking Hats.	**CO1, CO2**

UNIT-4	**Prototyping and Testing**:	**CO1,**
	Prototyping and methods of prototyping, Difference between low fidelity and high- fidelity prototypes, paper prototyping, techniques for implementing paper prototyping, Digital prototyping, user testing methods, Advantages, and disadvantages of user Testing/ Validation	**CO3**
UNIT-5	**Design Thinking for Innovation**: Innovation in Design Thinking, Definition of innovation, the art of innovation, types of innovations, product innovation, process innovation, and organizational innovation, characteristics of innovation, levels of innovation, Innovation towards design, Case studies	**CO1, CO3**
	Learning Resources	
Text books:	1. Change by design, Tim Brown,2009, Harper Collins 2. Engineering design, George E Dieter,4th Revisededition,2009 McGraw Hill.	
Reference books	1. Design Thinking for Strategic Innovation, Idris Mootee,2013, John Wiley & Sons 2. Design Thinking -The Guidebook–Facilitated by the Royal Civil service Commission, Bhutan 3. Design Methods: A Structured Approach for Driving Innovation in YourOrganization, Vijay Kumar, First Edition, 2012, Wiley 4. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the DevelopingWorld, IDEO, Second Edition ,2011, IDEO	
e-Resources & other digital material	1. https://www.interaction-desiqn.ora/literature/topics/desiqn-thinkinq 2. https://www.interaction-desiqn.prq/literature/article/how-tq-<eve'op-an empath\capproach-in-design-thinking	

LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Course Code	20ME2501B	**Year**	III	**Semester**	I
Course Category	Open Elective-I	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	--
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		Level	**Unit No**
Upon successful completion of the course, the student will be able to			
CO1	Identify the importance of Supply Chain Management	L2	1
CO2	Explain different Inventory control techniques	L1	2
CO3	Design various Supply Chain Networks suitable for various market conditions	L3	3
CO4	Discuss supply chain strategies and procurement strategies	L1	4
CO5	Identify various issues in Supply Chain Management	L2	5

CO'S /PO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1		2							2		3			1
CO 2		2							2		3			1
CO 3		2							2		3			1
CO 4		2							2		3			1
CO 5		2							2		3			1

Syllabus		
UNIT	**Content**	**MappedCO**
1	**Introduction to Supply Chain Management (SCM):** Concept of supply management and SCM, importance of supply chain flows, core competency, value chain, elements of supply chain efficiency, key issues in SCM, decision phases, supply chain integration, process view of a supply chain, competitive strategy and supply chain strategies, uncertainties in supply chain, supply chain drivers.	**CO1**
2	**Inventory Management**: Introduction, selective control techniques, cost involved in inventory system, single stage inventory control, economic lot size models, application to economic production quantity, effect of demand uncertainty, single period models, initial inventory, multiple order opportunities, deterministic models, quantity discounts. periodic and quantity review policies, mathematical modeling under known stock out	**CO2**

	costs and service levels, joint replenishment for multiple items, inventory system constraints, working capital restrictions, and storage space restrictions.	
3	**Designing Supply Chain Network:** Introduction, network design, factors influencing network design, data collection, data aggregation, transportation rates, warehouse costs, capacities and locations, models and data validation, key features of a network configuration, impact of uncertainty on network design, network design in uncertain environment, value of information: Bullwhip effect, information sharing, information and supply chain trade-offs, distribution strategies, direct shipment distribution strategies, transshipment and selecting appropriate strategies.	**CO3**
4	**Supply Chain Integration:** Introduction, push-pull supply chains, identifying appropriate supply chain strategy, Sourcing and procurement, outsourcing benefits, importance of suppliers, evaluating a potential supplier, supply contracts, competitive bidding and negotiation. Purchasing, objectives of purchasing, relations with other departments, centralized and decentralized purchasing, purchasing procedure, types of orders, e-procurement, tender buying, role of business in supply chains.	**CO4**
5	**Issues in Supply Chain Management:** Introduction, risk management, managing global risk, issues in international supply chain, regional differences in logistics. Local issues in supply chain, issues in natural disaster and other calamities, issues for SMEs, organized retail in India, reverse logistics.	**CO5**

Learning Resources

Text Books:

1. Simchi-Levi, D. Kaminsky, P.Simchi-Levi, E. and Ravi Shankar, Designing and Managingthe Supply Chain: Concepts, Strategies and Case Studies, 3/e, Tata McGraw-Hill, 2008.
2. Chopra, S. and Meindl, Supply Chain Management: Strategy, Planning and Operations,2/e, Pearson Education, 2004.

Reference Books:
1. Doebler, D.W. and Burt, D.N, Purchasing and Supply Management-Text and Cases, 6/e,McGraw- Hill, 1996.
2. Tersine, R.J, Principles of Inventory and Materials Management, 4/e, Prentice Hall, 1994.

e- resources:
1. https://ocw.mit.edu/courses/engineering-systems-division/esd-273j-logistics-and- supply-chain-management-fall-2009/lecture-notes/

2. **https://nptel.ac.in/courses/110/108/110108056/**

UTILIZATION OF ELECTRICAL ENERGY

Course Code	20EE4501A	**Year**	III	**Semester**	I
Course Category	Professional Elective-I	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	--
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the utilization of electrical systems and their advantages in industrial applications. (L2)
CO2	**Apply** the knowledge to select suitable motor for electric drives, appropriate heating / welding techniques and Illumination systems in various industrial applications. (L3)
CO3	**Apply** the knowledge to select suitable track electrification system and traction motors. (L3)
CO4	**Analyze** the concepts of electric drives, different heating/welding techniques and various Illumination systems for industrial applications. (L4)
CO5	**Analyze** the performance parameters of speed-time curves for different services and the mathematical concepts to design traction system. (L4)
CO6	**Submit a report** on electric drives, electric heating & welding, illumination and electric traction system.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1							2	2
CO3	3						1						2	2
CO4		3				1							2	2
CO5		3					1						2	2
CO6		3				3			3	3			2	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Electric Drives** Type of electric drive, choice of motor, starting and running characteristics, speed control, temperature rise of electrical machines, heating-time and cooling-time curves, selecting motor power rating for continuous, intermittent and short timeduty, types of industrial loads, applications of electric drives.	**CO1 CO2 CO4 CO6**

II	**Electric Heating & Electric Welding** Advantages and methods of electric heating, methods of heat transfer, Stefan's law, design of heating elements, resistance heating, construction and working principle of induction furnaces, arc furnaces and dielectric heating. Types of welding, resistance and arc welding, comparison between A.C and D.CWelding.	**CO1** **CO2** **CO4** **CO6**
III	**Illumination** Introduction, Terms used in illumination, laws of illumination, sources of light, Incandescent lamps, Discharge lamps, MV and SV lamps, fluorescent lamps-CFL-LED lamps, Types of lighting schemes, factory lighting, flood lighting and street lighting.	**CO1** **CO2** **CO4** **CO6**
IV	**Electric Traction-I** Systems of electric traction and systems of track electrification, special features of traction motors, methods of electric braking-plugging, rheostat braking and regenerative braking, Speed-time curves for different services-trapezoidal and quadrilateral speed time curves.	**CO1** **CO3** **CO5** **CO6**
V	**Electric Traction-II** Mechanics of train movement, Calculations of tractive efforts and power output of traction motor, Specific energy consumption for given run, effect of varying acceleration and braking retardation, dead weight, accelerating weight, adhesive weight and coefficient of adhesion, Current collectors for overhead system.	**CO1** **CO3** **CO5** **CO6**

Learning Resources
Text Books:
1. H. Partab, "Art & Science of Utilization of Electrical Energy", Dhanpat Rai & Sons, 12th edition, 2012. 2. E. Openshaw Taylor, "Utilization of Electrical Energy", Orient Longman, 15th edition, 2012.
Reference Books:
1. J.B.Gupta, "Utilization of Electric Power and Electric Traction", S.K.Kataria & Sons, 10th edition, 2012. 2. C.L.Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age international (P) Limited Publishers, 2015.
e- Resources
https://nptel.ac.in/courses/108105060

ELECTRICAL MACHINE DESIGN

Course Code	20EE4501B	**Year**	III	**Semester**	I
Course Category	Professional Elective-I	**Branch**	E.E. E	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Electrical Machines – I &II
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Classify** the materials used for construction of electrical machines(L2)
CO2	**Assess** the overall dimensions of a transformer. (L3)
CO3	**Examine** the design, performance of transformer (L4)
CO4	**Develop** the overall dimensions of a rotating machine. (L3)
CO5	**Analyze** the design and performance of rotating machines. (L4)
CO6	**Submit a report** on design of electrical machines

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3			3				1				1	2	1
CO3		3	3										2	1
CO4	3			3				1				1	2	1
CO5		3	3										2	1
CO6						1			3	3	1			

Syllabus

Unit No.	Contents	Mapped CO
I	**Fundamental Aspects of Electrical Machine Design** Design of machines - design factors - limitation in design - modern trends in electrical machine design – types of magnetic, electric and insulating materials – modes of heat dissipation – cooling of rotating machines – methods of cooling. **Computer Aided Design (CAD) of Electrical Machines** Limitations and assumptions in traditional designs, need of CAD, analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation	CO1 CO2 CO4 CO6

II	**Design of transformers** Transformer windings – output equation – design of main dimensions-– design of core - choice of flux density – determination of number of turns and length of mean turn - resistance and leakage reactance – no load current calculation –cooling of transformers- calculation of number of tubes.	CO1 CO2 CO3 CO6
III	**Design of DC Machines** Output equation –selection of specific magnetic and electric loadings - separation of D and L – estimation of number of conductors, armature slots and conduct dimensions – choice of number of poles and calculation of length of airgap – design of field systems, interpoles and brushes.	CO1 CO4 CO5 CO6
IV	**Design of Induction motors** output equation -main dimensions – choice of average flux density and ampere conduction per meter — design of stator slots and rotor slots- designof rotor bars end rings– design of wound rotor – design of no-load current.	CO1 CO4 CO5 CO6
V	**Design of Synchronous Machines** Types of construction – output equation - main dimensions – short circuit ratio and its effects on the performance – design of rotor –Design of field winding – Design of turbo alternators – Rotor design temperature rise and its effects.	CO1 CO4 CO5 CO6

Learning Resources

Text Books

1. A.K.Sawhney , "A Course in Electrical Machines Design" , Dhan path Rai & Co. 6th edition 2010.

Reference Books

1. AE Clayton and NN Hancock, "The Performance and Design of Direct Current Machines", CBS Publishers, 3rd edition, 2004.
2. M.G. Say, "Performance and Design of A.C. Machines", ELBS and Pitman & Sons, 4th edition, 2013.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Company Pvt. Ltd. New Delhi, 2nd edition,2006.
4. K. M. Vishnu Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 1st edition 2008.

Web Links

1. https://cusp.umn.edu/electric-machine-design-videos
2. https://nptel.ac.in/courses/108102146
3. https://nptel.ac.in/courses/108/105/108105017

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RENEWABLE ENERGY RESOURCES

Course Code	20EE4501C	Year	III	Semester(s)	I
Course Category	Professional Elective-I	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	--
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the process of energy collection, quantification, storage, conversion and applications of non-conventional sources. **(L2)**
CO2	**Apply** the knowledge of energy conversion techniques to harvest energy from different types of renewable sources. **(L3)**
CO3	**Apply** the basic laws of physics to interpret the constraints to efficiently extract energy from renewable sources. **(L3)**
CO4	**Analyze** the theory behind the design of wind mills, MHD, biomass plants. **(L4)**
CO5	**Examine** the performance of OTEC and Fuel cells. **(L4)**
CO6	**Ability** to apply the various energy generation techniques and to measure the **basic** parameters and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3						3						2	1
CO3	3						3						2	1
CO4		3											2	1
CO5		3					3						2	1
CO6									3	2		3	2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Principles of Solar Radiation and Solar Energy Collection** Role and potential of new and renewable source, the solar energy option, environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data. Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.	**CO1, CO2, CO3, CO6**

II	**Solar Energy Storage, Applications and Photovoltaic Energy Conversion** Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications solar heating/cooling technique, solar distillation and drying. Solar cell fundamentals, solar cell classification, performance of solar cell- power from solar module	**CO1, CO2, CO3, CO6**
III	**Wind Energy and Bio-Mass** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.	**CO1, CO2, CO3, CO4, CO6**
IV	**Ocean Energy** Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques.	**CO1, CO2, CO3, CO5, CO6**
V	**Energy Conversion** Principles DEC, MHD generators, principles, MHD power generation systems. Fuel cells, principles, of fuels and operating conditions, merits and demerits of different types of fuel cells, mini-hydel power plants and their economics	**CO1, CO2, CO3, CO4, CO5, CO6**

Learning Resources

Text Books

1. Non-Conventional Energy Sources by G.D. Rai, Khanna publishers, 5th edition,2014.
2. Renewable Energy resources, Tiwari and Ghosal, Narosa,2005
3. Science and Technology of Photo Voltaics by Jayarama Reddy, BS publications, 2nd edition,2012

Reference Books

1. Non-Conventional Energy by Ashok V Desai, New age, 2005.
2. Non-Conventional Energy Sources by B.H.Khan, Tata Mc Graw-hill Publishing Company, 2nd edition, 2013.

Web Links

1. https://www.coursera.org/learn/renewable-energy-technology-fundamentals
2. https://nptel.ac.in/courses/121106014

HIGH VOLTAGE ENGINEERING

Course Code	20EE4501D	**Year**	III	**Semester(s)**	I
Course Category	Professional Elective-I	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of high voltages in power system. **(L2)**
CO2	**Apply** the knowledge of conduction and breakdown in different types of dielectrics. **(L3)**
CO3	**Identify** various methods for generation and measurement of high voltages and currents in power system**. (L3)**
CO4	**Analyze** the generation and measurement of high voltages and currents in high voltage engineering. **(L4)**
CO5	**Identify** different techniques used for high voltage testing of electrical apparatus. **(L3)**
CO6	**Ability** to understand the concepts of high voltage engineering and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3							2					2	2
CO3	3				2							2	3	2
CO4		3				1	2						3	2
CO5	3										1	2	2	2
CO6									3	3			2	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Conduction and Breakdown in Dielectrics:** Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases. Liquid as insulator, Conduction and Breakdown in pure liquids, Conduction and Breakdown in commercial liquids. Breakdown in solid dielectrics: Intrinsic breakdown, Electromechanical breakdown and Thermal breakdown.	**CO 1** **CO 2** **CO 6**

II	**Generation of High Voltages and Currents:** Generation of high DC Voltages: Voltage doubler circuits, Voltage multiplier circuits and Van de graaff generators. Generation of high AC Voltages: Cascade transformers and Tesla coil arrangement. Generation of impulse voltages: Multistage impulse generators—Marx circuit. Generation of impulse currents, Tripping and control of impulse generators.	**CO 1** **CO 3** **CO 4** **CO 6**
III	**Measurement of High Voltages:** Measurement of high DC voltages: General concepts of high voltage measurements, Series resistance micro ammeter, Resistance potential divider, Generating Volt meters. Measurement of high AC and Impulse voltages: Series impedance ammeters, Capacitance potential dividers, Capacitance voltage transformers, Electrostatic voltmeters, Sphere gaps, Peak-Reading voltmeters for impulse voltages.	**CO 1** **CO 3** **CO 4** **CO 6**
IV	**Measurement of High Currents:** Measurement of high direct currents, Measurement of high alternating currents and Measurement of Impulse currents.	**CO 1** **CO 3** **CO 4** **CO 6**
V	**High Voltage Testing of Electrical Apparatus:** Testing of Insulators andBushings, Testing of Isolators and Circuit breakers, Testing of Cables,Testing of Transformers and Testing of Surge arrestors.	**CO 1** **CO 5** **CO 6**

Learning Resources
Text Books
1. M.S. Naidu, V.Kamaraju, "High Voltage Engineering" McGraw Hill, Fifth Edition, 2017. 2. E. Kuffel, W.S. Zaengl, J. Kuffel, "High Voltage Engineering Fundamentals" Elsevier, Second Edition, 2000
Reference Books
1. Wadhwa C.L.", High Voltage Engineering, New Age International, Third Edition, 2012. 2. Ravindra Arora, Bharat Singh Rajpurohit, "Fundamentals of High-Voltage Engineering" Wiley India, 2019.
Web Links 1. https://nptel.ac.in/courses/108104048 2. https://bharatsrajpurohit.weebly.com/high-voltage-engineering-course.html

COMPUTER ORGANIZATION AND ARCHITECTURE

Course Code	20EE4501E	**Year**	III	**Semester(s)**	I
Course Category	Professional Elective-I	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic functional units of a computer system and its organization. (L2)
CO2	Apply appropriate instructions for processing various types of computers operations. (L3)
CO3	Apply various types of organizations on registers. (L3)
CO4	Analyze memory hierarchy, I/O communication and pipelining. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Register Transfer and Micro-Operations:** Register Transfer Language, Register Transfer, memory Transfers, Bus construction with Multiplexers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.	**CO1, CO2**
II	**Basic Computer Organization:** Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output and Interrupt.	**CO1, CO2**
III	**Central Processing Unit:** General registers Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control.	**CO1, CO3**
IV	**Computer Arithmetic:** Introduction, Addition and Subtraction, Booth Multiplication Algorithm. **Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual Memory.	**CO1, CO2, CO4**

V	**Input-Output Organization:** Peripheral Devices, Input-output Interface, Asynchronous Data Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor. **Pipeline and Parallel Processing:** Parallel processing, Pipelining, Arithmetic pipeline, Instruction pipeline.	**CO1, CO4**

Learning Resources
Text Books
1. Morris M. Mano, Computer System Architecture, Pearson., Third Edition, 1992,
Reference Books
1. William Stallings, Computer Organization and Architecture, PHI, Eighth Edition, 2010. 2. Carl Hamachar, Vranesic, Computer Organization, McGraw Hill, 2002.
Web Links 1. https://nptel.ac.in/courses/106/106/106106092/

UNIVERSAL HUMAN VALUES

Course Code	20MC1502	**Year**	III	**Semester**	I
Course Category	Mandatory Course	**Branch**	CE,CSE,ECE, EEE,IT,ME	**Course Type**	Theory
Credits	0	**L-T-P**	2-0-0	**Prerequisites**	--
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	**Describe** more aware of themselves, and their surroundings (family, society, nature)	L2
CO2	**Illustrate** more responsibility in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.	L2
CO3	**Show** better critical ability	L3
CO4	**Exhibit** sensitivity to their commitment towards what they have understood (human values, human relationship and human society)	L3
CO5	**Apply** what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Introduction - Need, Basic Guidelines, Content and Process for Value Education** Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- thebasic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	**CO1**

II	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer),Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity indetail, Programs to ensure Sanyam and Health.	**CO2**
III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	**CO3**
IV	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.	**CO4**
V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.	**CO5**

Learning Resources
Text Books
1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.
Reference Books
1. Jeevan Vidya: Ek 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 Karamchand Gandhi

CONTROL SYSTEMS LAB

Course Code	20EE3551	**Year**	III	**Semester(s)**	I
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	NIL
Continuous Internal Evaluation:	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Analyze** the performance characteristics and working of Magnetic amplifier, DC & AC servo motors and synchros. **(L4)**
CO2	**Determine** the transfer functions of DC Motor and DC generator **(L3)**
CO3	**Demonstrate** the time response analysis and performance of PID controllers **(L3)**
CO4	**Develop** MATLAB programming and construct the truth table of logic gates using PLC **(L3)**
CO5	Conduct experiments as a **team / individual** by using equipment available in the laboratory
CO6	Make an effective **report** based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3		3									2	1
CO2	3			3									2	1
CO3	3			3									2	1
CO4	3		3	3	3						3	3	2	1
CO5									3				1	
CO6										3			1	

Syllabus

Expt. No.	Contents	Mapped CO
	Part-A (Any eight experiments)	
1	Time response of Second order system	CO1, CO3, CO5, CO6
2	Characteristics of AC servo motor	CO1, CO5, CO6
3	Effect of P, PD, PI, PID Controller on a second order systems	CO1, CO3, CO5, CO6
4	Transfer function of DC motor	CO1, CO2, CO5, CO6
5	Temperature controller using PID	CO1, CO3, CO5, CO6
6	Characteristics of magnetic amplifiers	CO1, CO5, CO6
7	Characteristics of Synchros	CO1, CO5, CO6
8	Characteristics of DC servo motor	CO1, CO5, CO6

9	Transfer function of DC generator	CO1, CO2, CO5, CO6
10	Programmable logic controller – Study and verification of truth tables of logic gates	CO4, CO5, CO6
Part-B (Any two experiments)		
11	Time response of first order systems for standard test signals using MATLAB	CO1, CO3, CO4, CO5, CO6
12	Kalman's test of Controllability and Observability using MAT LAB.	CO4, CO5, CO6
13	Bode Plot, Root locus for the transfer functions of systems using MATLAB.	CO1, CO4, CO5, CO6
14	State space model for classical transfer function and vice versa using MATLAB – Verification.	CO4, CO5, CO6

Learning Resources
Text Books
1. James C. Squire, Julie Phillips Brown, "Programming for Electrical Engineers: MATLAB and Spice", Academic Press; 1st edition, 2020. 2. JR.Hackworth & F.DHackworth Jr., "Programmable Logic Controllers-Programming Methods and Applications", Pearson, 1st edition 2003

POWER ELECTRONICS LAB

Course Code	20EE3552	**Year**	III	**Semester**	I
Course Category	Professional core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	ED&AC Lab
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Study and observe the characteristics of SCR MOSFET and IGBT. (L3)
CO2	Analyze theoretically and practically Rectifiers and Choppers. (L4)
CO3	Analyze theoretically and practically inverters. (L4)
CO4	Analyze theoretically and practically AC to AC converters. (L4)
CO5	Conduct experiments as a **team / individual** by using equipment available in the laboratory
CO6	Make an effective **report** based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium,1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3								2	2	1
CO2		3		3		1	1					2	2	1
CO3		3		3		1	1					2	2	1
CO4		3		3		1	1					2	2	1
CO5									3				2	1
CO6										3			2	1

Syllabus		
Expt. No.	Contents	Mapped CO
	PART-A (Any Eight Experiments)	
1	Study of characteristics of SCR	CO1 CO5 CO6
2	Study of characteristics of MOSFET	
3	Study of characteristics of IGBT	
4	Single phase fully controlled bridge converter with R and RL loads	CO2 CO5 CO6
5	Three phase half-controlled bridge converter with RL-Load	
6	VSI fed three phase induction motor drive	CO3 CO5 CO6
7	Single phase Series inverter	
8	Single phase AC Voltage controller with R and RL loads	CO4 CO5
9	Single phase cyclo-converter with R and RL loads	

		CO6
10	IGBT based four quadrant chopper controlled DC motor drive	CO2 CO5 CO6
11	Buck Converter	
PART-B:(Any Two Experiments)		
12	Single phase dual converter with R, RL and RLE loads	CO2 CO5 CO6
13	Boost Converter	CO2 CO5 CO6
14	Single phase Parallel inverter	CO3 CO5 CO6
15	Single phase bridge inverter	
16	Cascaded H Bridge inverter	

Learning Resources
Text Books
1. P.S.Bhimbra,'PowerElectronics',5th edition, Khanna Publications,2018. 2. M.H. Rashid,' Power Electronic Circuits Devices and Applications',4th edition, Pearson,2017.

JAVA PROGRAMMING

Course Code	20SA8552	**Year**	III	**Semester(s)**	I
Course Category	Skill Oriented	**Branch**	EEE	**Course Type**	Lab
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Programming with C
Continuous Internal Evaluation:	-	**Semester End Evaluation:**	**50**	**Total Marks:**	**50**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Apply object-oriented principles/ Java constructs for solving problems (L3)
CO2	Implement programs as an individual on different IDE/ online platforms. (L3)
CO3	Develop an effective report based on various programs implemented. (L3)
CO4	Apply technical knowledge for a given problem and express with an Effective oral communication. (L3)
CO5	Analyze outputs using given constraints/test cases. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3											2	2	2
CO2	3													
CO3	3								3	3				
CO4	3													
CO5		2												
CO6	3											2	2	2

Syllabus		
Expt No.	**Contents**	**Mapped CO**
1	Implement Java Programs by using Conditional Statements, Switch and loops with suitable examples.	**CO1, CO2,CO3,CO4,CO5**
2	Develop Java Programs Using 1D Arrays and 2D arrays.	**CO1, CO2,CO3,CO4,CO5**
3	Use String, String Buffer and String Tokenizer classes to develop Java programs.	**CO1,CO2,CO3,CO4,CO5**
4	Implement the concept of static variables, static methods and static block.	**CO1,CO2,CO3,CO4,CO5**
5	Implement the concept of instantiation of objects using Classes.	**CO1,CO2,CO3,CO4,CO5**

6	Implement reusability concept through inheritance.	**CO1,CO2,CO3,CO4,CO5**
7	Implement concept of Polymorphism usingmethod Overloading and overriding.	**CO1,CO2,CO3,CO4,CO5**
8	Develop Java programs using Abstract Class to achieve Partial abstraction.	**CO1,CO2,CO3,CO4,CO5**
9	Use interfaces to develop Java programs with complete Abstraction.	**CO1,CO2,CO3,CO4,CO5**
10	Create a package and access members from the package to Avoid naming conflicts.	**CO1,CO2,CO3,CO4,CO5**
11	Implement Exception handling to build robust programs.	**CO1,CO2,CO3,CO4,CO5**
12	Develop Java programs using Multithreading for process Synchronization.	**CO1,CO2,CO3,CO4,CO5**
13	Implement various data structures usingCollection Framework.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Java - The Complete Reference, Herbert Schildt, Ninth Edition, 2014, McGraw-Hill.
2. Introduction to Java Programming 10th Edition by Y. Daniel Liang Pearson.

e-Resources & other digital material

1. https://www.javatpoint.com/java-tutorial
2. http://www.learnjavaonline.org/
3. http://vtc.internshala.com/signup/course_details2.php?course=java101
4. https://nptel.ac.in/courses/106/105/106105191/
5. https://www.udemy.com/course/java-tutorial/
6. https://www.decodejava.com/
7. https://www.codecademy.com/learn/learn-java
8. https://www.w3schools.com/java/

COMPUTER AIDED POWER SYSTEMS ANALYSIS

Course Code	20EE6501A	**Year**	III	**Semester**	I
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the incidence matrices, power system faults, power system security and stability.**(L2)**
CO2	**Apply** the knowledge of graph theory, form the incidence and network matrices using singular transformation and bus impedance matrix **(L3).**
CO3	**Analyze** the power system faults using Z-bus. **(L4)**
CO4	**Apply** numerical integration methods, sensitivity factors for stability and contingency analysis. **(L3)**
CO5	**Analyze** the stability and security of the power system. **(L4)**
CO6	**Submit a report on** incidence matrices, fault analysis, power system stability and security.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3		3		3									2	1
CO4	3											1	2	1
CO5		3					1						2	1
CO6						1		1	3	3				

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Network Topology** Introduction, graphs, incidence matrices, primitive matrices, formation of network matrices by singular transformation, examples of formation of incidence matrices.	**CO 1 CO 2 CO 6**
II	**Algorithms for formation of Z-bus matrix** Step by Step algorithm for formation of Z-bus-Addition of branch, addition of link with and without mutual impedance, Modification of Z-bus matrix for changes in the network, numerical Problems.	**CO 1 CO 2 CO 6**
III	**Short circuit Calculations** Short circuit calculations using Z_{Bus}, short circuit calculations for balanced three phase network using Z_{Bus} –Transformation to symmetrical components - Z_{Bus}^{012},Z_f^{abc}, Y_f^{abc} ,Z_f^{012}, Y_f^{012} matrices for various faults.	**CO 1 CO 3 CO 6**

IV	**Security and Contingency Analysis** Introduction, factors affecting power system security, contingency analysis-linear sensitivity factors, Contingency Analysis using DC Power flow model.	**CO 1** **CO 4** **CO 5** **CO 6**
V	**Stability Analysis** Classification of power system stability, classical model of synchronous machines (SMIB) - excitation and power system stabilizer (PSS) representation. Numerical integration methods -Runge Kutta fourth order methods and modified Euler's method. Transient stability algorithm using modified Euler's method and fourth order Runge Kutta method.	**CO 1** **CO 4** **CO 5** **CO 6**

Learning Resources
Text Books:
1. Stagg G.Ward, El–Abiad, Computer methods in power system analysis, McGraw Hill ISE. 1987 2. K.U.Rao, Computer Techniques and Models in Power Systems, I.K.International Pvt.Ltd,2013
Reference Books:
1. Singh, L. Advanced Power System Analysis and Dynamics, New Age International (P) Ltd, New Delhi, 2001, 5th Edition. 2. HadiSaadat, Power system analysis, MH publications, 2nd Edition, 2009. 3. Pai, M. A, Computer Techniques in Power System Analysis, MH Publishers, 2nd edition, 2006. 4. D.P.Kothari and I.J.Nagrath, Modern power system analysis, MH publications, 4th Edition, 2011.
E-Resources: 1. https://archive.nptel.ac.in/courses/108/105/108105067/ 2. https://nptel.ac.in/courses/108107127

REACTIVE POWER CONTROL IN ELECTRIC SYSTEMS

Course Code	20EE6501B	Year	III	Semester(s)	I
Course Category	Honors	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	3-1-0	Prerequisites	-
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** necessity of reactive power compensation.(L2)
CO2	**Apply** various types of reactive power compensation in transmission systems.(L3)
CO3	**Analyze** the impact of various reactive power compensation methods (L4)
CO4	**Demonstrate** reactive power coordination and management in power system. (L3**)**
CO5	**Investigate** importance of reactive power compensation and submit a report

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Load Compensation:** Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples	**CO1 CO2 CO3 CO5**
II	**Steady–State Reactive Power Compensation in Transmission System:** Uncompensated line – types of compensation – Passive shunt, series and dynamic shunt compensation –examples	**CO1 CO2 CO3 CO5**
III	**Reactive Power Coordination:** Objective – Mathematical modeling – Operation planning – transmission benefits – Role of capacitor in quality control of Electric power – disturbance –steady state variations –frequency –Harmonics, radio frequency interference and electromagnetic interference.	**CO1 CO3 CO4 CO5**

IV	**Demand Side Management:** Load patterns – basic methods load shaping –System losses –loss reduction methods – examples	**CO1** **CO2** **CO3**
	Distribution Side Management Reactive power planning – objectives – Methods followed by the Electricity boards in India.	**CO4** **CO5**
V	**User Side Reactive Power Management:** KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitors, characteristics and Limitations	**CO1** **CO2** **CO3** **CO4** **CO5**

Learning Resources
Text Books
1. T.J.E. Miller, "Reactive power control in Electric power systems", John Wiley and sons, 2017. 2. D. M. Tagare,"Reactive power Management", Tata McGraw Hill, 2004.
Reference Books
1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, Wilely publication, 2012
e-Resources
1. https://nptel.ac.in/courses/108107113

POWER SYSTEM DYNAMICS AND CONTROL

Course Code	20EE6501C	**Year**	III	**Semester(s)**	I
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Electrical Machines -II
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the power system stability and its impact on the system. (L2)
CO2	**Analyze** theory and practice of modeling main power system components, such as synchronous machines. (L4)
CO3	**Interpret** the results of system stability studies by the concepts of modelling and simulating the dynamic phenomena of power systems. (L3)
CO4	**Analyze** the power system small signal and dynamic stability. (L4)
CO5	**Establish** the concept of Power System Stabilizers and excitor with AVR. (L4)
CO6	**Learn** the fundamental dynamic behavior and control of power systems to perform basic stability analysis and **submit the report**.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	2	3	3			2	2					2	2	2
CO3	3	3	2	2				2				2	2	2
CO4		3			3							2	2	2
CO5		3	2								2	2	2	2
CO6	3	3							3	3		3	2	2

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Power System Operations:** Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.	**CO1, CO3, CO6**
II	**Synchronous Machine Theory and Modelling:** Armature and field structure, parks transformation, machine with multiple pole pairs-mathematical description, d-q transformation, per unit representation, equivalent circuit for d-q axes, steady state analysis	**CO1, CO2, CO3, CO6**

	voltage-current and flux linkage, phasor representation.	
III	**Analysis of Single Machine System:** Classification of Power System Stability and Power System security states and state diagram. Swing equation and its block diagram representation for stability studies. Characteristic equation and application of Routh Hurwitz criterion for small signal stability. Synchronous and damping torque analysis, small signal model and state equations of SMIB System.	**CO1, CO3, CO4, CO6**
IV	**Dynamic Stability:** System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact - linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals - dynamic performance measure - small signal performance measures.	**CO1, CO3, CO4, CO6**
V	**AVR and PSS**: Phillips Heffron model, block diagram representation with exciter and AVR (Automatic Voltage Regulator) and effect of AVR on synchronising and damping torque components. **Power System Stabilizer**: structure and tuning of Power System Stabilizer (PSS), block diagram with and without PSS.	**CO1, CO3, CO5, CO6**

Learning Resources

Text Books

1. P.M. Anderson and A. A. Fouad, 'Power System Control and Stability', IEEE Press Power Engineering Series second edition, 2002.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc. first edition, 2006.

Reference Books

1. Power System Dynamics Stability and Control, K. R. Padiyar, BS Publications, Hyderabad, first edition, 2006
2. R. Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, first edition, 2009.
3. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, first edition, 2005.
4. J. Machowski, J. Bialek & J. R. W. Bumby, Power System Dynamics and Stability, John Wiley & Sons, 3rd Edition 2020
5. E. W. Kimbark, Power System Stability, Vol. I, II& III, John Wiley & Sons, New York 2007
6. L. P. Singh, Advanced Power System Analysis and Dynamics, New Age International Private Limited; Sixth edition 2012

e-Resources

1. https://nptel.ac.in/courses/108101004

EHV AC TRANSMISSION

Course Code	20EE6501D	**Year**	III	**Semester(s)**	I
Course Category	Honor	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Electrical Power Generation, Transmission & Distribution
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of EHV AC transmission system **(L2)**
CO2	**Analyze** the various transmission line parameters **(L4)**
CO3	**Apply** the basic knowledge of voltage gradients of conductor and effect of electro static field on EHV transmission lines **(L3)**
CO4	**Analyze** corona effects on EHV transmission lines **(L4)**
CO5	**Identify** various compensating devices for voltage control **(L3)**
CO6	**Get the ability** to understand the concepts of EHV AC transmission system and **submit a report**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2		3						2					2	2
CO3	2						3						2	2
CO4		3				2							2	2
CO5	3										2	2	2	2
CO6									3	3			2	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Necessity of EHV AC transmission, advantages and problems, power handling capacity and line losses. Mechanical considerations. Resistance of conductors, Temperature rise of conductors and current-carrying capacity, properties of bundled conductors.	**CO 1** **CO 2** **CO 6**
II	**Line and Ground Parameters:** Inductance of EHV line configurations, Line capacitance calculation, Sequence inductances and capacitances, Line parameters for modes of propagation, Resistance and inductance of ground return.	**CO 1** **CO 2** **CO 6**
III	**Voltage Gradients of Conductors and Electro Static Field:** Electrostatics, Field of sphere gap, Field of line changes and properties, Charge – potential relations for multi-conductors lines. Surface voltage gradient on conductors, Effect of high electro static field on humans, animals and plants.	**CO 1** **CO 3** **CO 6**
IV	**Corona Effects:** Corona loss formulas, Charge-voltage diagram, Audible noise (AN) generation and characteristics, Limits and measurements AN, Relation between single phase and three phase AN levels. Radio interference (RI), Corona pulses generation, properties and limits of RI	**CO 1** **CO 4** **CO 6**
V	**Voltage Control:** Generalized constants, Power circle diagram and its use, Voltage control using synchronous condensers, Cascade connection of components, Sub synchronous resonance in series capacitor compensated lines and static VAR compensating system.	**CO 1** **CO 5** **CO 6**

Learning Resources
Text Books
1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering" New Age International Publishers, Fourth Edition, 2011 2. S. Rao, "EHV-AC, HVDC Transmission & Distribution Engineering" Khanna Publishers, Third Edition, 2008
Reference Books
1. E. Kuffel, W. S. Zaengl, J. Kuffel, "High Voltage Engineering Fundamentals" Elsevier, Second Edition, 2000.
Web Links 1. https://nptel.ac.in/courses/108108099 2. http://files.hostgator.co.in/hostgator253199/file/extrahighvoltageactransmissionbybegamudre.pdf

DATASTRUCTURES AND ALGORITHMS USING JAVA

Course Code	20CS5501	**Year**	III	**Semester(s)**	I
Course Category	Minor in CSE	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic concepts of data structures and algorithms. (L2)
CO2	Apply a suitable data structure to solve a given problem. (L3)
CO3	Analyze the given problem and select suitable algorithm design techniqueto provide a feasible solution. (L4)
CO4	Analyze the time and space complexity of a given problem. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Introduction to algorithms**: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving. Algorithm Specification, Asymptotic Notations, and Basic Efficiency Classes. **Introduction to data structures**: Linear - Introduction to linked list. Singly-linked list, Single Circular linked list, and doubly linked list. Time and space complexity of operations.	**CO1, CO2, CO4**
II	**Stacks, Queue**: Definition, operations: array implementation ofstack and queue, Circular Queue. Time and space complexity of operations.	**CO1, CO2, CO4**
III	**Trees**: Introduction- Terminology, representation of trees. Binary tree traversal - in order, Preorder, post order. Time and space complexity of operations. Binary search trees - Definition, searching BST, insert into BST, delete from a BST, Height of a BST.	**CO1, CO2,**

	Graph: Adjacency matrix and list representation, BFS and DFS traversal. Time and space complexity of operations.	**CO4**
IV	**Divide and Conquer**: Binary search, Merge sort, Quick Sort. **Greedy Method:** Fractional knapsack problem, Single SourceShortest path (Dijkstra's). Time and space complexities the problems.	**CO1, CO3, CO4**
V	**Dynamic Programming**: 0/1 Knapsack problem, All-pairs shortest paths, Travelling salesman problem. Time and space complexitiesof the problems.	**CO1, CO3, CO4**

Learning Resources
Text Books
1. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Second Edition, 2002, Pearson. 2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2010, PHI. 3. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 2020, CareerMonk Publication 4. Introduction to the Design & Analysis of Algorithms, Anany Levitin, Third Edition, 5. 2011, Pearson Education.
Reference Books
1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2012, MIT Press. 2. Fundamentals of computer algorithms, Ellis Horowitz, Sartaj Sahni, S. Rajasekharan, Second Edition, 2008, Universities Press. 3. Fundamental of Data Structures in C, Horowitz, Sahani, Anderson-Freed, Second Edition, 2008, Universities Press. 4. Classic Data Structures, Debasis Samantha, Second Edition, 2009, PHI.
E- Resources & other digital material
1. https://www.geeksforgeeks.org/data-structures/ 2. https://www.youtube.com/watch?v=0IAPZzGSbME 3. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html 4.https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_VZKxRKrxgFyOutPJpoLFBaQMOpK- 5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/ 6. https://www.javatpoint.com/collections-in-java

ADVANCED JAVA PROGRAMMING LAB

Course Code	20CS5551	**Year**	III	**Semester(s)**	I
Course Category	Minor in CSE	**Branch**	EEE	**CourseType**	Practical
Credits	1	**L-T-P**	0-0-2	**Prerequisites**	Basic Java Programming
Continuous Internal Evaluation:	**15**	**Semester End Evaluation:**	**35**	**Total Marks:**	**50**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Apply generics, collections, lamda expressions and regular expressions to solve problems in an efficient way. (L3)
CO2	Implement programs as an individual on different IDEs/ online platforms. (L3)
CO3	Develop an effective report based on various tasks that are implemented. (L3)
CO4	Apply technical knowledge for a given problem and express with an effective oral communication. (L3)
CO5	Analyze outputs using given constraints/test cases. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Expt .No.	**CONTENTS**	**Mapped CO's**
1.	Demonstrate generic methods with suitable examples.	CO1,CO2,CO3,CO4 ,CO5
2.	Develop a generic class with suitable examples.	CO1,CO2,CO3,CO4 ,CO5
3.	Develop a generic program for ordered collection of elements.	CO1,CO2,CO3,CO4 ,CO5
4.	Implement an efficient data structure for storing and processing non-duplicate elements.	CO1,CO2,CO3,CO4 ,CO5
5.	Implement a Map-data structure that provides a quick look up to retrieve a value using a key.	CO1,CO2,CO3,CO4 ,CO5
6.	Use a data structure to prevent data corruption, when two or more threads running concurrently.	CO1,CO2,CO3,CO4 ,CO5

7.	Take a Java file that contains number of methods. Replace them with lambda expressions. How many lines did it save? Was the code easier to read? Were you able to use method references?	CO1,CO2,CO3,CO4,CO5
8.	Implement various applications using regular expressions.	CO1,CO2,CO3,CO4,CO5

Learning Resources
Text Books
1. The Java Complete Reference, Herbert Scheldt, 10/e, TMH Publications, 2018.
Reference Books
1. Java 8 in Action: Lambdas, streams, and functional-style programming, Manning publications. 2. Java 9 Regular Expressions by Anubhava Srivastava, Packt Publishing. 3. Java generics and collections by Naftalin and Philip Wadler , O'Reilly.
E- Resources & other digital material
1. https://docs.oracle.com/javase/tutorial/java/javaOO/lambdaexpressions.html 2. https://docs.oracle.com/javase/8/docs/api/java/util/regex/Pattern.html 3. https://www.javatpoint.com/generics-in-java 4. https://www.javatpoint.com/collections-in-java

COMPUTER NETWORKS

Course Code	20IT5501	Year	III	Semester(s)	I
Course Category	Minor in IT	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	4-0-0	Prerequisites	NIL
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basics of computer networks and the functions of OSI andTCP/IP reference model. (L2)
CO2	Analyze various protocols in Data link layer, Transport Layer, andtheir mechanisms. (L3)
CO3	Implement routing and congestion control algorithms. (L3)
CO4	Analyze the real applications like electronic mail, www and multimedia. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Introduction:** Uses of Computer Networks, Network hardware, Network software, Networks Topologies, OSI, TCP/IP Reference models. **Physical Layer:** Guided Transmission media: twisted pairs, coaxial cable,fiber optics, Wireless transmission.	**CO1**
II	**Data link layer:** Design issues, framing, Error detection and correction. **Elementary data link protocols:** simplex protocol, A simplex stop and waitprotocol for an error-free channel, A simplex stop and wait protocol for noisychannel. Sliding Window protocols: A one-bit sliding window protocol, A protocol using Go-Back-N, A protocol using Selective Repeat.	**CO1,CO2**
	Network Layer: Design issues, Routing algorithms: shortest path routing, distance vector routing, Link State routing, Broadcast routing, Multicast routing.	**CO1,CO3**

III	**Congestion Control Algorithms**, Internetworking, The Network layer in the internet.	
IV	**Transport Layer:** The transport service, Elements of Transport protocols, The internet transport protocols: UDP, The internet transport protocols: TCP.	**CO1,CO2**
V	**Application Layer**: Domain name system, Electronic Mail; The World WEB, Streaming audio and video.	**CO1,CO4**

Learning Resources
Text Books
1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI
Reference Books
1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education. 2. Computer Networks, A Top-Down Approach –Behrouz A Forouzan, FirouzMosharraf. 3. Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.
E- Resources & other digital material
1. https://www.youtube.com/watch?v=O--rkQNKqls&list=PLbRMhDVUMngf-peFloB7kyiA40EptH1up

DIGITAL DESIGN USING VERILOG HDL

Course Code	20EC5501	**Year**	III	**Semester(s)**	I
Course Category	Minor in ECE	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Digital Logic Design
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the language constructs and programming fundamentals of Verilog HDL. (L2)
CO2	Choose the suitable abstraction level for a particular digital design (L3).
CO3	Construct Combinational and sequential circuits in different modelling styles using Verilog HDL (L3).
CO4	Analyse and Verify the functionality of digital circuits/systems using test benches (L4).

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2									2				
CO2	2									2				
CO3	2								2	2		2		2
CO4		3							2	2		2		2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Verilog HDL:** Verilog as HDL, Levels of Design Description, Concurrency, Program structure, Top-down and Bottom- up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block, Verilog Data types and Operators, system tasks, compiler directives.0	CO1, CO2
II	**Gate-Level Modelling:** Modelling using basic Verilog gate Primitives, Description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in Gate-level Modelling.	CO1, CO3
III	**Dataflow Modelling:** Continuous assignments, Delay specification, expressions, operators, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in dataflow model.	CO1, CO3
IV	**Behavioral Modelling: Procedural Assignments,** Initial and always blocks, blocking and non-blocking statements, delay control, conditional statements, Multiway branching, loops, sequential and parallel blocks, Design of Decoders, Multiplexers, Flip-flops, Registers	CO1, CO3

	& Counters in Behavioral model.	
V	**Components Test and Verification:** Test Bench - Combinational Circuits Testing, Sequential Circuits Testing, Test Bench Techniques, Design Verification, Assertion Verification.	CO1, CO4

Learning Resources
Text Books
1. Samir Palnitkar-Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2^{nd} Ed., 2009. 2. Michel D. Ciletti- Advanced Digital Design with Verilog HDL, 2^{nd} Ed., PHI, 2009
Reference Books
1 Padmanabhan, Tripura Sundari -Design through Verilog HDL, Wiley, 2016 2. S.Brown, Zvonko – Vranesic, Fundamentals of Digital Logic with Verilog Design, TMH, 3^{rd} Ed., 2014.
E- Resources & other digital material
1. http://www.ece.ubc.ca/~saifz/eece256.html 2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/digital_circuit /frame/index.html

SENSORS AND ACTUATOR DEVICES FOR IOT

Course Code	20EC5502	**Year**	III	**Semester(s)**	I
Course Category	Minor in IoT	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Illustrate** the working principles of different types of sensors and actuators (L2)
CO2	**Analyse** the phenomena that define behaviour of various sensors and actuators. (L4)
CO3	Apply the concepts in common methods for converting a physical parameter into an electrical quantity. (L3)
CO4	**Identify** suitable sensors and actuator for real time applications. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**Sensors/Transducers**, Principles, Classification, Characterization. Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Inductive Sensors, Capacitive Sensors- Parallel plate & serrated plate types, Ultrasonic Sensors.	CO1-CO3
II	**Thermal Sensors**: Introduction, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Junction Semiconductor Types, Magnetic Sensors: Introduction, Sensors and the Principles Behind, Force & displacement Sensors.	CO1-CO3
III	**Radiation Sensors**: Introduction – Basic Characteristics – Types of Photo sensistors /Photo detectors– X-ray and Nuclear Radiation Sensors – Fiber Optic Sensors.	CO1-CO3
IV	**Smart Sensors**: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, , Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. **Sensors Applications**: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Medical Diagnostic Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring	CO1-CO4

V	**Actuators**: Pneumatic and Hydraulic Actuation Systems, Valves, Rotary actuators, Mechanical Actuation Systems Electrical Actuation Systems.	CO1, CO2, CO4

Learning Resources
Text Books
1. D. Patranabis-Sensors and Transducers, PHI Learning Private Limited. 2. W. Bolton-Mechatronics, Pearson Education Limited.
Reference Books
1. Patranabis-Sensors and Actuators- 2^{nd} Ed., PHI, 2013. 2. Robert H. Bishop-The Mechatronics Handbook, 2^{nd} Ed., Mechatronic Systems, Sensorsand Actuators, fundamentals and modelling
E- Resources & other digital material
1. https://nptel.ac.in/content/syllabus_pdf/108108147.pdf

AUTOMOTIVE TRANSMISSION SYSTEMS

Course Code	20ME5501	**Year**	III	**Semester(s)**	I
Course Category	Minor in Automobile Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the fundamentals and existing technology of variouscomponents of Automobiles (L2)
CO2	Illustrate the significance, operational functions of Clutch and Geartransmission systems. (L3)
CO3	Contrast the common types of special transmission and drive axlesused in heavy duty commercial vehicles. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**CLUTCH:** Necessity of clutch in an automobile, different types of clutches, friction clutches namely Single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, hydraulic clutches, **Clutch adjustment**/troubles and their causes, requirements, Clutch materials, lining, Vacuum operated clutch, Fluid coupling	**CO1, CO2**
II	**GEAR BOX:** The need for transmissions, Necessity of gear box, Desirable ratios of 3-speed & 4-speed gear boxes Constructional details of sliding-mesh gear box, constant-mesh gear box, synchromesh gear box, automatic and semi-automatic transmission, overdrive	**CO1, CO2**
III	**TORQUE CONVERTER AND AUTOMATIC TRANSMISSION:** Principal of torque conversion, single, multi stage and polyphase torque converters, performance characteristics, constructional and operational details of typical hydraulic transmission drives. Automatic transmission: relative merits and demerits when compared to conventional transmission	**CO1, CO2, CO3**

	epicyclic and hydromatic transmission continuously variable transmission.	
IV	**SPECIAL TRANSMISSION SYSTEMS:** Hydrostatic drives: principles, construction and working of hydrostatic drives, Janney Hydrostatic drive, advantages and limitations Electrical drives: principles of Ward Leonard system of control Modern electric drive for buses and performance characteristics, advantages and limitations	**CO1, CO3**
V	**DRIVE LINE:** Effects of driving thrust and torque reaction. Hotchkiss drive. Torque tube drive, radius rods. Propeller shaft Universal joints. Final drives – different types, double reaction final drive. Two speed rear axles. Rear axle construction – full floating, three quarter floating and semi-floating arrangements. Differential conventional type, no-slip type. Differential locks	**CO1, CO3**

Learning Resources
Text Books
1. Fischer and Pollack, "The automotive transmission book", Springer, 2014 2. Light and Heavy Vehicle Technology, M.J. Nunney, Elsevier, Fourth Edition
Reference Books
1. Newton K and Steeds. W. "The Motor Vehicle", Butter Worth's & Co., Publishers Ltd, 2001. 2. Automatic vehicle transmission, John Wiley Publications 1995 3. Crouse. W.H., Anglin. D.L., "Automotive Transmission and Power Trains construction ",McGraw-Hill 4. Heldt P.M - Torque converters- Chilton Book Co.-1992
E- Resources & other digital material
1.https://nptel.ac.in/courses/107/106/107106088/ 2.https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-de06 3.https://nptel.ac.in/courses/116/102/116102012/

BASIC MANUFACTURING PROCESSES

Course Code	20ME5502	**Year**	III	**Semester(s)**	I
Course Category	Minor in Digital Manufacturing	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Physics
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand basic principles of various manufacturing process. (L2)
CO2	Illustrate moulding and casting process. (L2)
CO3	Discuss various metal forming processes. (L3)
CO4	Identify various Metal joining process for different products (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**INTRODUCTION TO FOUNDRY:** **Introduction:** Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved. Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance. **Sand Molding**: Basic steps in mold preparation, materials used for mould, typesof molds. **Special casting processes**: Shell moulding, Investment casting, die casting, Centrifugal casting, Casting defects and remedies. Advantages and applications of casting.	**CO1, CO2**
II	**Introduction to metal forming processes** classification of metal forming processes. Hot working & cold working of metals. **Forging:** Classification of forging processes. Forging machines equipment. Expressions for forging pressures& load in open die forging and closed die	**CO1, CO3**

	forging by slab analysis. Smith forging, drop forging & press forging. ForgingEquipment, Defects in forging.	
III	**Rolling**: Classification of rolling processes. Types of rolling mills, Variables of rolling process, expression for rolling load. Roll separating force, Rolling defects. **Drawing & Extrusion:** Drawing of wires, rods &drawing pipes, Variables of drawing process. Difference between& extrusion. Types of Extrusion: Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock penetration. Extrusion ratio of force equipment (with and without friction)	**CO1, CO3**
IV	**Sheet Metal Operations:** Blanking, piercing, punching, drawing, draw ratio, drawing force, variables in Drawing, Trimming, and Shearing. Bending - types of bending dies, bending force calculation, Embossing and coining. Types of dies: Progressive, compound and combination dies.	**CO1, CO 3**
V	**Metal Joining Processes:** Classification of welding processes, types of welds and welded joints, Arc Welding, Submerged Arc Welding, Gas Tungsten Arc Welding, Gas Metal Arc Welding, Electron Beam Welding, Laser Welding, Forge welding, Resistance welding, Friction welding, Explosive welding, Thermit welding and Plasma Arc welding. Soldering and brazing. Adhesive Bonding. Welding defects: causes and remedies	**CO1, CO 4**

Learning Resources
Text Books
1. Amitabha Ghosh and Mallick A. K., Manufacturing Science. Affiliated East-West Press Pvt. Ltd.2010. 2. M. P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems,Third edition. Wiley India Private Limited, 2009. 3. S. Kalpakjian, Manufacturing Processes for Engineering Materials, Fifth edition. PearsonEducation, 2009.
Reference Books
1. G. K. Lal and S. K. Choudhury, Fundamentals of Manufacturing Process, 2009. Boca Raton, FL:CRC Press, 2011. 2. J.P. Holman, Experimental Methods for Engineers, McGraw Hills Int. Edition.
E- Resources & other digital material
1.https://nptel.ac.in/courses/112107219

ANALYSIS OF STRUCTURES

Course Code	20CE5501A	**Year**	III	**Semester(s)**	I
Course Category	Minor in Civil Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	20CE3404-Mechanics of Solids
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Evaluate** the slopes and deflection in beams and pin jointed frames. (L5)
CO2	**Evaluate** the fixed end moments in fixed beams and can analyze two span continuous beams by slope deflection method. (L5)
CO3	**Analyze** the two span continuous beams by Moment distribution Method and Kani's method. (L4)
CO4	**Evaluate** the stresses for both concentrically loaded and eccentrically loaded Columns. (L5)
CO5	**Evaluate** the stress strain behavior of both the thin and thick cylinders. (L5)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Deflection of Statically Determinate Structures:** Introduction, Pure bending, Relation between curvature, slope and deflection, Deflection curves, Maculay's Method, Moment area method, Slopes anddeflection for cantilevers and simply supported beams. **Deflection Of pin jointed frames:** Deflection of trusses by Unit load method (having 9 members or less)	CO1
II	**Analysis of Indeterminate Beams** **Fixed beams**: Shear force and bending moment diagrams for Fixed beams subjected to U.D.load, central point load, eccentric point load. Number of point loads, uniformly varying load, couple and combination of loads, effect of sinking of support, effect of rotation of a support. **Two span continuous beams**: Shear force and bending moment diagrams	CO2.

	for two span continuous beams with and without sinking of supports using Slope deflection method.	
III	**Analysis of two span continuous beams** **Moment distribution method**: Shear force and bending moment diagrams for two span continuous beams with and without sinking of supports using MomentDistribution Method. **Kani's method**: Shear force and bending moment diagrams for two span continuous beams with and without sinking of supports using Kani's Method.	CO3
IV	**Columns and Struts**: Introduction, Column with one end free and other fixed, Column with both ends hinged, column with both ends fixed, column with one end fixed and the other hinged, Limitation of Euler's formula, column carrying eccentric load, Rankine-Gordon formula, Perry's formula **Combined bending and direct stresses**–Introduction, Limit of eccentricity for no tension in the section, kernel of a section for rectangular, circular sections.	CO4
V	**Thin Cylinders -** Introduction, Stresses and strains in thin cylinders, volumetricchange in cylinder. **Thick cylinders: T**hick cylinders subjected to internal pressure and externalpressure, compound cylinders.	CO5

Learning Resources
Text Books
1. Pandit.G , Gupta.S and Gupta.R, Theory of Structures Vol.I & II, McGrawHill Education, 2017. 2. V.N Vazirani and M.M Ratwani, Analysis of Structures Vol-II, KhannaPublishers, 2012
Reference Books
1. C.K.Wang, Statically Indeterminate Structures, TataMcGrawHill, 2010. 2. R.C. Hibbeler, Structural Analysis, 6/e, Pearson, 2011.
E- Resources & other digital material
1. https://nptel.ac.in/courses/105101085/25-31 2. https://onlinecourses.nptel.ac.in/noc17_ce25/preview **3.** https://www.edx.org/learn/structural-engineering

TRANSPORTATION ENGINEERING

Course Code	20CE5501B	Year	III	Semester(s)	I
Course Category	Minor in Civil Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	20BS1101 – Engineering Mathematics – I
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Choose** the highway development and planning in India. (L3)
CO2	**Analyze** geometric design of highway alignment and management of traffic. (L4)
CO3	**Demonstrate** traffic intersection and choose material for highway. (L3)
CO4	**Discriminate** with the design procedures of flexible and rigid pavements. (L4)
CO5	**Focus** on the construction and maintenance issues related to highways. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**HIGHWAY DEVELOPMENT** Highway development in India–Highway Alignment- Factors affecting Alignment-Engineering Surveys – Drawings and Reports. **HIGHWAY PLANNING** Necessity for Highway Planning- Different Road Development Plans-Classification ofRoads- Road Network Patterns – Planning Surveys.	**CO1**
II	**HIGHWAY GEOMETIC DESIGN** Importance of Geometric Design- Highway Cross Section Elements-Stopping sight Distance, Overtaking Sight Distance and Intermediate Sight Distance- Design of Super elevation and Extra widening- Design of Vertical alignment-Gradients- Vertical curves. **TRAFFIC ENGINEERING AND MANAGEMENT** Traffic Volume Studies- Speed studies- Parking Studies – Road Accidents-Causes and Preventive measures – Road Traffic Signs – Types – Road markings-Types of RoadMarkings	**CO2**

III	**INTERSECTION DESIGN** Types of Intersections –Traffic Islands – Design of Traffic Signals – Webster Method –IRC Method. Types of Grade Separated Intersections-Rotary Intersection –Advantages and Disadvantages of Rotary Intersection. **HIGHWAY MATERIALS** Subgrade soil: California Bearing Ratio – Modulus of Subgrade Reaction. Stone aggregates: Tests for Road Aggregates – Bituminous Materials: Tests on Bitumen – Marshall Method of Mix Design.	**CO3**
IV	**DESIGN OF FLEXIBLE PAVEMENTS** Objects & Requirements of pavements – Types – Functions of pavement components –Design factors – Flexible Pavement Design Methods – CBR method – IRC method **DESIGN OF RIGID PAVEMENTS** Design Considerations – wheel load stresses – Temperature stresses – Frictional stresses –Combination of stresses – Design of Joints – IRC method	**CO4**
V	**HIGHWAY CONSTRUCTION** Types of Highway Construction – Construction of Gravel Roads – Construction of Water	**CO5**

Learning Resources
Text Books
1. Highway Engineering, (9th edition) by Khanna, S.K. and Justo ,C.E.G., NemChand Bros, Roorkee, 2010. 2. Traffic Engineering and Transportation Planning, (7th edition) by Kadiyali, L.R., Khanna Publishers, New Delhi, 2010. 3. Specifications for Roads and Bridges – Manual for Maintenance of roads, Most publications, 1976.
Reference Books
1. Fundamentals of Transportation Engineering, (3rd edition) by Papacostas, C.S.,Prentice Hall of India Pvt.Ltd, New Delhi, 2009. 2. Principles of Highway Engineering by Kadiyali, L.R., Khanna Publishers, NewDelhi, 2012. 3. Traffic Planning and Design by Saxena, Dhanpat Rai Publishers, New Delhi, 2010. 4. Transportation Engineering – An Introduction, (3rd edition) by Jotin Khisty. C, Prentice Hall, Englewood Cliffs, New Jersey, 2012. 5. IRC Code for flexible pavement – IRC – 37 -2001. 6. IRC Code for Rigid pavement – IRC – 58 – 2002.
E- Resources & other digital material
1. https://nptel.ac.in/courses/ 105/101/105101087 2. https://nptel.ac.in/courses/ 105/104/105104098

III B.TECH II SEMESTER SYLLABUS

III B.Tech., II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE3601	Switchgear & Protection	3	3	0	0	30	70	100
20EE3602	Microprocessors and Microcontrollers	3	3	0	0	30	70	100
20EE3603	Power Systems Analysis	3	3	0	0	30	70	100
20EE4601	Professional Elective-II	3	3	0	0	30	70	100
	Open Elective -II	3	3	0	0	30	70	100
20EE3651	Power Systems Lab	1.5	0	0	3	15	35	50
20EE3652	Microprocessors and Microcontrollers Lab	1.5	0	0	3	15	35	50
20EE3653	Electrical Simulation Lab	1.5	0	0	3	15	35	50
20SS8651	Soft skills	2	1	0	2	-	50	50
20MC1601	Constitution of India	0	2	0	0	30	70	100
	Community Service Project	4	0	0	0	-	100	100
Total		**25.5**	**18**	**0**	**11**			

L - Lecture T - Tutorial P – Practical

Professional Elective-II								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4601A	Distribution System Planning & Automation	3	3	0	0	30	70	100
20EE4601B	Electrical Drives	3	3	0	0	30	70	100
20EE4601C	Digital Signal Processing	3	3	0	0	30	70	100
20EE4601D	Optimization Techniques	3	3	0	0	30	70	100
20EE4601E	Computer Networks	3	3	0	0	30	70	100

L – Lecture T - Tutorial P – Practical

Open Elective -II								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2601A	Ecology and Environment	3	3	0	0	30	70	100
20EC2601A	MAT Lab Programming	3	3	0	0	30	70	100
20EC2601B	TV Engineering	3	3	0	0	30	70	100
20EE2601A	Energy Management	3	3	0	0	30	70	100
20IT2601A	Introduction to Data Mining	3	3	0	0	30	70	100
20ME2601A	Value Engineering	3	3	0	0	30	70	100
20ME2601B	Human Factors in Engineering	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HONORS -III								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE6601A	Industrial Automation & Robotics	4	3	1	0	30	70	100
20EE6601B	Advanced Power System Protection	4	3	1	0	30	70	100
20EE6601C	Power System Reliability	4	3	1	0	30	70	100
20EE6601D	Restructured Power Systems	4	3	1	0	30	70	100

L - Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**	**Minor in**
20CS5601	Web Technologies	3	3	0	0	30	70	100	CSE
20CS5651	Web Technologies Lab	1	0	0	2	15	35	50	CSE
20IT5601	Software Engineering	4	4	0	0	30	70	100	IT
20EC5601	Circuit Analysis	4	3	1	0	30	70	100	ECE
20EC5602	Industrial and Medical IoT	4	3	1	0	30	70	100	IoT
20ME5601	Modern Technology in Automobile Engineering	4	3	1	0	30	70	100	Automobile Engineering
20ME5602	Design for Additive Manufacturing	4	3	1	0	30	70	100	Digital Manufacturing
20CE5601A	Basic Mechanics of Fluids	4	3	1	0	30	70	100	Civil

L – Lecture T - Tutorial P – Practical

SWITCHGEAR & PROTECTION

Course Code	20EE3601	**Year**	III	**Semester(s)**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Circuit Theory
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the operation of switchgear equipment and Protective relays and the grounding practices **(L2)**
CO2	**Apply** electromagnetic principles in switchgear equipment and in protective relays. **(L3)**
CO3	**Apply** protective relays for Protection of electrical equipment and grounding practices for Protection against Over Voltages. **(L3)**
CO4	**Analyze** switchgear equipment, protective relays and protection of various electrical equipment. **(L4)**
CO5	**Examine** various grounding practices and Protection against Over Voltages in the power system. **(L4)**
CO6	**Ability** to understand the concepts of switchgear devices, protective relays, protection of power system components, various grounding practices, Protection against Over Voltages and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1							3	3
CO3	3												3	3
CO4		3											3	3
CO5		2				1							3	3
CO6	3	3						3	3	3			3	3

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Circuit Breakers** Circuit Breakers: Elementary principles of arc interruption, Restriking voltage and Recovery voltages – Restriking phenomenon, average and max. RRRV, numerical problems – current chopping and resistance switching – CBratings and specifications, auto reclosures – Numerical Problems. Types of circuit breakers: Minimum oil circuit breakers, Air blast circuit breakers, Vacuum and SF6 circuit breakers.	CO1, CO2 ,CO4,CO6

II	**Fundamentals of Protective Relaying** Fundamental principles of protective relaying, protection against other abnormal conditions, functional characteristics of protective relaying, evaluation of protective relaying. Principle of operation and construction of attracted armature, balanced beam, induction disc and induction cup relays. Introduction to static relays and Numerical relays. Comparison of electromagnetic, static and numerical relays.	CO1, CO2 CO4, CO6
III	**Application of Relays** Universal torque equation, over current relay, direction relays, differential relays and percentage differential relays. Relays Classification: Instantaneous, DMT, IDMT types and under voltage relays. Distance relays: impedance, reactance, mho. Characteristics of distance relays and comparison-Electromagnetic only.	CO1, CO2 CO4, CO6
IV	**Generator, Transformer and Bus bar Protection** Protection of generators against stator faults, rotor faults, and abnormal conditions. Restricted earth fault and inter-turn fault protection. Numerical Problems on percentage winding unprotected. Protection of transformers: Percentage differential protection, Buchholtz relay protection. Protection of Lines: Over current, three-zone distance relay, protection using impedance relays. Protection of bus bars – differential protection	CO1,CO3, CO4,CO6
V	**Protection Against Over Voltages** Grounded and ungrounded neutral systems.- Effects of ungrounded neutral on system performance. Methods of neutral grounding: solid, resistance, reactance – arcing grounds and grounding practices. Protection of transmission lines, stations and substations against direct lightning strokes.	CO1,CO3, CO5, CO6

Learning Resources
Text Books
1. Sunil S Rao , "Switchgear Protection and Power Systems" , Khanna Publishers, 1st edition, 2002 2. Badari Ram, D N Viswakarma, "Power System Protection and Switchgear" , TMH Publications, 2nd edition, 2014
Reference Books
1. Paithankar and S.R.Bhide, "Fundamentals of Power system protection" , Prentice Hall of India Pvt. Ltd., 2nd edition, 2003 2. Ravindranth. B and Chander, "Power System Protection and Switch Gear", New Age International (P) Ltd., 2nd edition, 2014. 3. Ravindra P. Singh, "Switch Gear and Power system Protection", Prentice Hall of IndiaPvt. Ltd., 2nd edition, 2014 4. J.B.Gupta, "Switchgear and Protection" , S.Chand publications, 2nd edition, 2013
Web Links 1. https://nptel.ac.in/courses/108101039 2. https://nptel.ac.in/courses/108107167

MICROPROCESSORS AND MICROCONTROLLERS

Course Code	20EE3602	**Year**	III	**Semester**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Digital and Analog Circuits
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	**Understand** the basic features and hardware details of 8086 Microprocessors and 8051 Microcontrollers.	L2
CO2	**Demonstrate** architecture, signal description, addressing modes and instruction set of 8086 microprocessors and 8051 microcontrollers.	L3
CO3	**Develop** 8086 and 8051 assembly language programs to perform a given task.	L3
CO4	**Analyze** interfacing of various peripherals and memories with 8086 and 8051.	L4
CO5	**Illustrate** real-time application of 8086 Microprocessors and 8051 Microcontrollers.	L4
CO6	**Submit** a report on 8086 Microprocessors and 8051 Microcontrollers	--

Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	
CO3	3				1								3	2
CO4		3				1						1	3	2
CO5		3			1	1	1						3	3
CO6								1	3	3	1			

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Intel 8086** Introduction and evolution of Microprocessors, Architecture of 8086, Register Organization of 8086, Memory Organization of 8086, Pin diagram of 8086. Minimum and Maximum mode operations of 8086, General Bus	CO1, CO2, CO6

	Operation of 8086, Read and Write cycle timing diagram.	
II	**ASSEMBLY LANGUAGE PROGRAMMING** Addressing Modes and Instruction set, Assembler Directives, Procedures and Macros, simple assembly language programming – Factorial of a number, Logical, Shift and Rotate operations and sorting numbers in ascending and descending order.	CO1, CO2, CO3, CO6
III	**Basic Peripherals** 8255 PPI, Architecture of 8255 PPI, Various modes of operation of 8255. Programmable DMA Controller 8257, Programmable Interrupt Controller8259, Serial Communication Interface USART 8251.	CO1, CO4, CO6
IV	**8051 Microcontrollers** Intel 8051 architecture, memory organization, flags, stack, and special function registers, I/O, ports counters and timers, serial data I/O, interrupts. Addressing modes, instructions set.	CO1, CO2, CO6
V	**8051 Assembly Language Programming** Simple assembly language Programming – Arithmetic operations, Swap,set and reset a bit/byte. **Interfacing and Applications** Interfacing external memory, Interfacing of LED's, ADC (ADC 0808)	CO1, CO3, CO4, CO5, CO6

Learning Resources

Text Books

1. Douglas V. Hall, "Microprocessors and Interfacing", TMH-Revised 2nd edition,2006.
2. A. K. Ray and K. M. Burchandi, "Advanced Microprocessors and interfacing", Tata McGraw Hill, 2nd edition, 2006.
3. Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Thomson Publishers, 2nd Edition, 2004

Reference Books

1. Ajay V. Deshmukh, "Microcontrollers – Theory & Applications", Tata McGraw Hill, 2005.
2. M.A. Mazidi, R.D. McKinlay, J.G. Mazidi, "The 8051 Microcontroller: A Systems Approach", Pearson, 2013.
3. Kenneth J Ayala, "The 8086 Microprocessors Architecture, Programming and Interfacing the PC", West Publishers, 1995.

e- Resources & other digital material

1. **https://nptel.ac.in/courses/108/103/108103157/**
2. **https://nptel.ac.in/courses/108/107/108107029/ (Web Content)**
3. **https://nptel.ac.in/courses/108/105/108105102/**

POWER SYSTEMS ANALYSIS

Course Code	20EE3603	**Year**	III	**Semester**	II
Course Category	Professional core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	EPG T&D
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the single line diagram of the power system, types of faults, different load flow techniques and stability. **(L2)**
CO2	**Apply** the knowledge of per unit quantities and impedance diagram to calculate the fault current. **(L3)**
CO3	**Apply** iterative techniques for load flow analysis**. (L3)**
CO4	**Analyze** various load flow techniques and Power system Stability**(L4)**
CO5	**Analyze** symmetrical and unsymmetrical faults that occur in a power system. **(L4)**
CO6	**Submit a report on** per unit quantities, faults occurring in power system, load flow studies and power system stability.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3	3											1	2	1
CO4		3		3				1					2	1
CO5		3				1							2	1
CO6					1		1		3	3	1			

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Per unit Representation** Single line diagram, per unit quantities, per unit impedance diagram of a power system, Symmetrical fault analysis: Short circuit current and MVA calculations, fault levels, application of series reactors, Numerical problems.	**CO1** **CO2** **CO5** **CO6**

II	**Power Flow Studies-I** Y bus formation by direct inspection method. Necessity of power flow studies – Data for power flow studies-Derivation of static load flow equations– Load flow solutions using Gauss Seidel Method, acceleration factor, algorithm and flowchart, Numerical Problems (max. 3-buses and one iteration only), DC load Flow.	**CO1** **CO3** **CO4** **CO6**
III	**Power Flow Studies-II** Newton Raphson method in polar co-ordinates form, Derivation of Jacobian elements, algorithm and flowchart, Numerical Problems (max. 3-buses and one iteration only).	**CO1** **CO3** **CO4** **CO6**
IV	**Short Circuit Analysis** Necessity of fault studies, Types of faults, symmetrical components – positive, negative and zero sequence components of voltage, current and impedance. Sequence Networks-positive, negative and zero sequence networks, Unsymmetrical fault analysis-LG, LL, LLG faults with and without fault impedance – Numerical Problems.	**CO1** **CO2** **CO5** **CO6**
V	**Stability Analysis** Concepts of steady state, dynamic and transient stabilities – transfer reactance, synchronizing power coefficient, power angle curve – determination of steady state stability and methods to improve steady state stability – Derivation of swing equation – equal area criterion to sudden change in mechanical input, effect of clearing time on stability – Methods to improve transient stability, Numerical Problems.	**CO1** **CO4** **CO6**

Learning Resources
Text Books:
1. D.P.Kothari and I.J.Nagrath, Modern power system analysis, MH publications, 4thEdition, 2011. 2. J.J.Grainger & W.D.Stevenson. Gary W. Chang, Power system analysis, MH publications, 2016.
Reference Books:
1. T.K.Nagsarkar M.S.Sukhija,Power System Analysis, OXFORD press, 2nd Edition,2016 2. A.R.Bergen, Power System Analysis, Prentice Hall, India, 2nd Edition, 2002. 3. J Duncan Glover, M.S.Sarma, T.J.Overbye, Power System Analysis and design, Cengage Learning Publications, 5th Edition, 2011. 4. Hadi Saadat, Power system analysis, MH publications, 2nd Edition, 2009.
E-Resources: https://archive.nptel.ac.in/courses/108/105/108105067/ https://archive.nptel.ac.in/courses/108/104/108104051/

ECOLOGY AND ENVIRONMENT

Course Code	20CE2601A	**Year**	III	**Semester(s)**	II
Course Category	Open Elective -II	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	30	**SemesterEnd Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to:	
CO1	**Integrate** information related to structure and functions of ecological units. [L3]
CO2	**Analyze** and communicate the concepts of environment. [L4]
CO3	**Analyze** various environmental components and demonstrate using technology. [L4]
CO4	**Analyze** and evaluate policies and frame works for welfare of environment & social sustainability. [L4]
CO5	**Apply** system concepts for bio-monitoring environmental issues. [L3]

Contribution of Course Outcomes towards achievement of Program Outcomes

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

1- Low **2-Medium** **3-High**

Course Content

UNIT-1	**ECOLOGY:** Introduction – Biosphere, scope, organization and significance. Ecosystem concept-structure &function, Factors affecting ecosystem. Evolution: Natural Selection and its ecological significance. Population parameters-growth regulation, relationshipsbetween organisms.	CO1 CO2
UNIT-2	**NATURAL RESOURCES & MANAGEMENT:** Resource- Definition, category, concept and scarcity of resource. Forests & wild life- Global productivity & human activities (Exploitation). Land Resource- use pattern in India, soil & soil Conservation. Water resource-potentials and use with special reference to India, Concept of Integrated Water Resources Management (IWRM). Remote Sensing and GIS: Applications in conserving resources.	CO1 CO2
UNIT-3	**ENVIRONMENTAL GEOSCIENCES & COMPUTER APPLICATIONS**: Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Scale of meteorology, pressure, temperature, atmospheric stability. Graphical representation of Data, creating Database tables.	CO3
UNIT-4	**ENVIRONMENTAL POLICY, EDUCATION AND ETHICS:** Important National policies: National environmental policy, 2006 & National agricultural policy etc.Legislation: Environment Protection Act,	CO4

	1986.Environmental education: Goals and objectives of environmental education. Environment awareness and action: Role of NGOs in environmental awareness. Environmental movements in India- silent valley movement, Chipko movement, Narmada Bachao Andolan, Environmental movements in the West- Green Peace.	
UNIT-5	**ENVIRONMENTAL MONITORING AND MANAGEMENT:** Environmental impact analysis and EMP; Analytical approaches and instrumentation in environmental monitoring; Bio-monitoring of air pollution – plants as bio monitors; Bio monitoring of running water pollution.(Software's)Organic Farming and its ecological significance.	CO4 CO5

Learning Resources

Text Books	1) Singh, J.S; Singh, S.P. and Gupta S.R. (2014) Ecology, Environmental Science and Conservation. S. Chand & Company Pvt. Ltd. New Delhi. 2) Sharma, P.D. (2011) Ecology and Environment (11th edition) Rastogi Publication, Meerut. 3) Bharucha, E. (2013) Text Book of Environmental Studies (2nd edition.). Universities Press, Hyderabad.
Reference Books	1) Nobel, B.J. and Wright, R.T. (1995) Environmental Science. Prentice Hall. 2) Agarwal, S.K. (1991) Pollution Ecology. Himanshu Publication, Udaipur. 3) S.V.S.Rana, Essentials of Ecology and Environmental Science, Prentice HallIndia, New Delhi, 2011.
E-Resources & other digital material	http://nptel.ac.in

MATLAB PROGRAMMING

Course Code	20EC2601A	**Year**	III	**Semester**	II
Course Category	Open Elective-II	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Outline the basic concepts of MATLAB. (L2)
CO2	Develop programs for scientific and mathematical problems. (L3)
CO3	Analyze an engineering system/Problem through graphical representation and numerical analysis. (L4)
CO4	Build optimized code for various applications in Engineering and Technology. (L3)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2									1			2	2
CO2	3									2			3	3
CO3		2								2			2	2
CO4	3									2			3	3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Starting MATLAB, Working in command window, Arithmetic operations, Display formats, Elementary Math Built-in functions, Defining scalar variables, useful commands for managing variables, Script files, Examples of MATLAB applications	CO1, CO2
II	**Creating arrays and Mathematical operations with arrays:** Creating 1-dimensional and 2- dimensional arrays, The Transpose operator, Array addressing, using a colon: in addressing arrays, Adding elements to existing variables, Deleting elements, Built in functions for handling arrays, Strings and strings as variables, Addition and Subtraction, Array Multiplication and Division, Element-by-Element operations, using arrays in MATLAB built-in math functions, Built in functions for orton ng arrays, Generation of Random Numbers, Examples of MATLAB applications.	CO1, CO2, CO4

III	**Two Dimensional and Three-Dimensional Plots:** plot, fplot commands, Formatting a plot, plots with logarithmic axes, error bars, special graphics, Histograms, Polar plots, putting multiple plots on the same page, Multiple figure windows, Examples, Line plots, Mesh and surface plots, plots with special graphics, The view command, Examples of MATLAB applications	CO1,CO2,CO3,CO4
IV	**Programming in MATLAB:** Relational and Logical operators, conditional statements, The switch-case statement, Loops, Nested Loops and Nested conditional statements, The break and continue commands, creating a function file, structure of a function file, Local and Global variables, saving a function file, using a User-defined function, Examples of simple User-defined functions, comparison between script files and function files.	CO1,CO2,CO4
V	**Polynomial, Curve-fitting, Interpolation, Numerical Analysis**: Polynomials, curve fitting, Interpolation, The Basic fitting interface, Examples, solving equation of one variable, Finding minimum or maximum of a function, Numerical integration, ordinary differential equations.	CO2,CO3, CO4

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Learning Resources
Text Books
1. MATLAB: An Introduction with applications – Amos Gilat, Wiley India Pvt. Ltd, 4th Ed., 2012.
Reference Books
1. Getting started with MATLAB – Rudra Pratap, Oxford University Press, 2010 2. MATLAB and SIMULINK for Engineers – Agam Kumar Tyagi, Oxford University Press, 2012.

TV ENGINEERING

Course Code	20EC2601B	Year	III	Semester	II
Course Category	Open Elective-II	Branch	Common to All	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	--
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Compare Digital TV transmission standards and performance parameters (L2)
CO2	Analyse channel coding, errors, interferences and modulation techniques for Digital TV (L4)
CO3	Make use of RF amplifiers, modules and systems for Digital TV (L3)
CO4	Identify Transmission lines for Digital TV(L3)
CO5	Test for a Digital TV Transmitter (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

* - Average value indicates course correlation strength with mapped PO

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

Syllabus		
Unit No.	Contents	Mapped CO
I	Digital Television Transmission Standards ATSC terrestrial transmission standard, vestigial sideband modulation, DVB-T transmission standard, ISDB-T transmission standard, channel allocations, antenna height and power, MPEG-2 Performance Objectives for Digital Television: System noise, external noise sources, transmission errors, error vector magnitude, eye pattern, interference, cochannel interference, adjacent channel interference, analog to digital TV, transmitter requirements	CO1, CO2
II	Channel Coding and Modulation for Digital Television: Data synchronization, randomization/scrambling, forward error correction, interleaving, inner code, frame sync insertion, quadrature modulation, 8 VSB, bandwidth, error rate, COFDM,	CO1, CO2

	flexibility, bandwidth	
III	**Transmitters for Digital Television**: Precorrection and equalization, up conversion, precise frequency control, RF amplifiers, solid-state transmitters, RF amplifier modules, power supplies, cooling, automatic gain or level control, ac distribution, transmitter control, tube transmitters, performance quality.	CO1, CO3
IV	**Transmission Line for Digital Television:** Fundamental parameters, efficiency, effect of VSWR, system AERP, rigid coaxial transmission lines, dissipation, attenuation, and power handling, higher-order modes, peak power rating, frequency response, standard lengths, corrugated coaxial cables, wind load, waveguide, bandwidth, waveguide attenuation, power rating, frequency response, size trade-offs, waveguide or coax pressurization	CO1, CO4
V	**Test and Measurement for Digital Television:** Power measurements, average power measurement, calorimetry, power meters, peak power measurement, measurement uncertainty, testing digital television transmitters.	CO1, CO5

Learning Resources
Text Books
1. Gerald w. Collins, Fundamentals of Digital Television Transmission, John Wiley, 2001.
Reference Books
1 R. R. Gulati, Modern Television Practice, Principles, Technology and servicing, 2/e, New Age International Publishers, 2001. 2 John Arnold, Michael Frater, Mark Pickering, Digital Television Technology and Standards, John Wiley, 2007.
e- Resources & other digital material
1.https://www.youtube.com/watch?v=_nGnRvyHMEI&list=RDCMUCdlnqMpRrMcClK2fT6z8Eew&index=2 2. https://www.rfwireless-world.com/Tutorials/digital-television-DTV-basics.html

ENERGY MANAGEMENT

Course Code	20EE2601A	**Year**	III	**Semester(s)**	II
Course Category	Open Elective-II	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basics of Electrical & Electronics Engineering
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the fundamentals of energy scenario, energy management, power factor, lighting and energy instrument, electric energy and economic aspects. **(L2)**
CO2	**Apply** the knowledge of energy scenario and energy management in electrical energy. **(L3)**
CO3	**Apply the** knowledge of Power Factor, Lighting and Energy Instruments use in electrical energy systems. **(L3)**
CO4	**Analyze the** methods to improve efficiency of electrical energy systems. **(L4)**
CO5	**Analyze** the economic aspects for energy conservation. **(L4)**
CO6	**Ability** to apply the various laws of energy management tools to measure the **basic** parameters and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					2	2							
CO3	3		2		2									
CO4		3										2		
CO5		3		2							2			
CO6									3	3		2		

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Energy Scenario** Commercial and non-commercial energy, primary and secondary energy resources, global primary energy reserves, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, sector wise energy consumption in India, energy and environment.	**CO1,CO2, CO6**

II	**Energy Management** Introduction to energy management and objectives, principles of energy management, organizational structure, energy management program, energy policy, energy planning, controlling, ownership, reporting, summary.	**CO1, CO2, CO6**
III	**Power Factor Improvement, Lighting and Energy Instruments** Power factor –causes of low PF, effects of low PF, advantages of PF improvement, PF with non-linear loads, Lighting fundamentals, process to improve lighting efficiency– List of Instruments for energy audit- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers (working principle and measurement).	**CO1, CO3, CO6**
IV	**Electric Energy Management** Introduction, power supply, effects of unbalanced voltages on the performance of motors, electric motor operating loads, determining electric motor operating loads, power meter, slip measurement, electric motor efficiency, sensitivity of load to motor rpm, theoretical power consumption, motor efficiency management. **Energy efficient transformers**: Introduction, transformer loading/efficiency analysis.	**CO1, CO4, CO6**
V	**Economic Aspects and Analysis** Economics analysis introduction, objectives, general characteristics of capital investment, depreciation methods-straight line, unit production and double declining, time value of money-simple and compound interests, internal rate of return, net present value method, calculation of simple payback method.	**CO1,CO5,CO6**

Learning Resources
Text Books
[1] Wayne C.Turner, ―Energy management Hand book, John Wiley and son, 8th Edition 2012. [2] S.C. Tripathy, Electric ―Energy Utilization and Conservation, Tata McGraw Hill, 1991. [3] Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online).
Reference Books
[1] John. C. Andres, Energy Efficient Electric Motors, Marcel Dekker Inc. Ltd – 3rd Edition, 2005. [2] Paul W.O. Callaghan, ―Energy Management, McGraw hill Book Company,1st Edition, 2005.
Web Links 1. https://www.routledgehandbooks.com/doi/10.1201/9781315374178-4 (Economic Aspects) 2. https://www.yourelectricalguide.com/2019/05/lux-meter-working-principle.html 3. https://electricalfundablog.com/clamp-meter-tong-tester-types-operating-principle-how-to-operate/ 4. https://www.elprocus.com/what-is-pyrometer-working-principle-and-its-types/ 5. http://www.dspmuranchi.ac.in/pdf/Blog/qqqqgmailcomthemocouple1.pdf 6. https://www.profitbooks.net/what-is-depreciation/

INTRODUCTION TO DATA MINING

Course Code	20IT2601A	**Year**	III	**Semester**	II
Course Category	Open Elective-II	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Database Management Systems
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to:	
CO1	Understand the basic principles, process and techniques of data mining. [L2]
CO2	Use pre-processing techniques on different datasets. [L3]
CO3	Apply techniques and algorithms for Mining frequent patterns, classifying and clustering data. [L3]
CO4	Analyze the data for mining frequent patterns, associations, classification and outlier detection in a real scenario. [L4]

Contribution of Course Outcomes towards achievement of Program Outcomes
1- Low 2-Medium 3-High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3												3	
CO2	3			3									3	
CO3	3			3									3	3
CO4	3	3											3	3
Avg.	**3**	**3**		**3**									**3**	**3**

SYLLABUS

Unit No.	**Content**	**Mapped PO**
I	Introduction: What is data mining? What kinds of data can be mined? What kinds of pattern can be mined? Which technologies are used? Whichkinds of applications are targeted?, Major Issues in Data Mining.	CO1
II	Getting to Know Your Data: Data objects and Attribute Types, Basicstatistical descriptions of data, Measuring Data Similarity and Dissimilarity. Data Preprocessing: An overview, Data Cleaning, Data integration, DataReduction, Data Transformation and Discretization.	CO1 CO2
III	Mining frequent patterns, Associations and Correlations- Basic Concepts,Frequent itemset Mining methods- Apriori Algorithm, Generating association rules from frequent itemsets, improving the efficiency of Apriori.	CO1 CO3 CO4
IV	Classification: Basic Concepts – Basic concepts, Decision Tree Induction,Rule Based Classification, Model evaluation and Selection.	CO1 CO3,CO4

V	Cluster Analysis: Basic Concepts and Methods- Cluster Analysis, partitioning methods, Hierarchical Methods and evaluation of Clustering	CO1 CO3,CO4

Learning Resources
Text Books
1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques” Third Edition, Elsevier, 2012.
Reference Books
1. Michael Steinbach, Vipin Kumar, Pang-Ning Tan, Introduction to data mining, First Edition, Addison Wesley, 2006 2. Margaret H. Dunham, Data Mining Introductory and Advanced Topics, 1/e, Pearson Publishers, 2006
E-Resources & other digital material
1. https://www.coursera.org/lecture/code-free-data-science/introduction-to-data-mining-hbb2V 2. https://onlinecourses.swayam2.ac.in/cec19_cs01/preview

VALUE ENGINEERING

Course Code	20ME2601A	**Year**	III	**Semester**	II
Course Category	Open Elective-II	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	--
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic concepts, techniques and applications of value engineering [L2]
CO2	Describe job plan of value engineering. [L2]
CO3	Illustrate different value engineering techniques and versatility of value engineering. [L3]
CO4	Illustrate the efforts of value engineering team during the process of value engineering [L3]

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H:High(3), M: Medium(2), L:Low(1))														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2			3			3		3			3
CO2	1	2	2			3			3		3			3
CO3	1	2	2			3			3		3			3
CO4	1	2	2			3			3		3			3

Syllabus		
UNIT	**Content**	**Mapped CO**
1	**Introduction**: Value engineering (VE) concepts, advantages, applications, problem recognition, and role in productivity, criteria for comparison, element of choice. **Organization**: Level of value engineering in the organization, size and skill of VE staff, small plant, VE activity, unique and quantitative evaluation of ideas.	**CO1**
2	**Value engineering job plan**: Introduction, orientation, information phase, speculation phase analysis phase. Selection and Evaluation of value engineering Projects, Project selection, methods selection, value standards, application of value engineering methodology.	**CO1,CO2**

3	**Value engineering techniques** : Selecting products and operation for value engineering action, value engineering programmes, determining and evaluating function(s) assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, use of decision matrix, queuing theory and Monte Carlo method make or buy, measuring profits, reporting results, Follow up, Use of advanced technique like Function Analysis System.	**CO1,CO3**
4	**Versatility of value engineering**: Value engineering operation in maintenance and repair activities, value engineering in non hardware projects. **Initiating a value engineering programme**: Introduction, training plan, career development for value engineering specialties.	**CO1,CO3**
5	**Value engineering level of effort**: Value engineering team, co-coordinator, designer, different services, definitions, construction management contracts, value engineering case studies.	**CO1,CO4**

TEXT BOOK:

1. Anil Kumar Mukhopadhyaya, "Value Engineering: Concepts Techniques and applications", SAGE Publications 2010.

REFERENCES:

1. Alphonse Dell'Isola, "Value Engineering: Practical Applications for Design, Construction, Maintenance & Operations", R S Means Co., 1997.
2. Richard Park, "Value Engineering: A Plan for Invention", St. Lucie Press,1999.
3. Del L. Younker, "Value Engineering analysis and methodology", Marcel Dekker Inc, New York, 2004.
4. Miles, L.D., "Techniques of Value Analysis and Engineering", McGraw Hillsecond Edition, 1989.
5. Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai & Sons, 1993.
6. Anil Kumar Mukhopadhyaya, "Value Engineering Mastermind: From concept to Value Engineering Certification", SAGE Publications, 2003

HUMAN FACTORS IN ENGINEERING

Course Code	20ME2601B	**Year**	III	**Semester**	II
Course Category	Open Elective-II	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

CO	**Statement**
CO1	Discuss the fundamentals of Human factors, Physical work, Anthropometry, Ergonomics, Machine controls, Seating design, Colour – Light, Temperature – Humidity –Illuminations and Measurement of sound. **[L2]**
CO2	Identify the role of Anthropometry and Ergonomics in product design. **[L3]**
CO3	Choose the effective seating design and Machine controls for improvement of human workplace. **[L3]**
CO4	Represent the importance of colour and light, Temperature – Humidity – Illumination, Measurement of sound in human workplace. **[L3]**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H: High(3), M: Medium(2), L:Low(1))														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		2	1	1	2			1		3	1	2	3
CO2	1		2	1	1	2			1		3	1	2	3
CO3	1		2	1	1	2			1		3	1	2	3
CO4	1		2	1	1	2			1		3	1	2	3

Syllabus		
UNIT	**Content**	**Mapped CO**
I	**Fundamentals of Human Factors Engineering**: Human Biological, Ergonomic and psychological capabilities and limitations, Concepts of human factors engineering and Ergonomics, Man-Machine system and Design philosophy. **Physical work and energy expenditure**: Manual lifting, Work posture, Repetitive motion, Provision of energy for muscular work, Heat stress, Role of oxygen physical exertion, Measurement of energy expenditure, Respiration, Pulse rate and blood pressure during physical work, Physical work capacity and its evaluation.	**CO1**
II	**Anthropometry**: Physical dimensions of the human body as a working machine, Motion size relationships, Static and dynamic anthropometry, Anthropometric design principles, Using anthropometric measures for industrial design.	**CO1, CO2**

III	**Machine controls:** Improvement of human work place through controls, Displays and Controls, Shapes and sizes of various controls and displays, Multiple display and control situations, Design of major controls in automobiles and machine tools, Principles of hand tool design. **Work place and seating design**: Design of office furniture, Redesign of instruments, Work process: Duration of rest periods, Design of visual displays, Design for shift work.	**CO1, CO3**
IV	**Color and light:** Color and the eye, Color consistency, Color terms, Reactions to color and color continuation, Color on engineering equipments. **Temperature-Humidity-Illumination and Contrast**: Use of Photometers, Recommended illumination levels, the ageing eye, Use of indirect (Reflected) lighting, Cost efficiency of illumination. Special purpose lighting for illumination and quality control.	**CO1, CO4**
V	**Measurement of sound**: Noise exposure and hearing loss, Hearing protectors, Analysis and reduction of noise, Effects of noise, Performance annoyance of noise and interface with communication, Sources of vibration and performance effect of vibration.	**CO1, CO4**

Learning Recourse(s)

Text Book(s)

1. . M. S. Sanders and E. J. McCormick, Human Factors in Engineering Design, VII Edition, McGraw Hill International, 1993.

Reference books

1. P. V. Karpovich and W. E. Sinning, Physiology of Muscular Activity”, VII Edition, Saunders (W.B.) Co Ltd., 1971.
2. Applied Ergonomics Handbook, I.P.C. Science and Technology Press Limited, 1974.
3. M. Helander, A Guide to the Ergonomics of Manufacturing, II Edition, CRC Press, 1997.
4. K. H. E. Kroemer, H. B. Kroemer, K. E. Kroemer Elbert, Ergonomics: How to design for ease and efficiency, II Edition, Pearson Publications, 2001.

DISTIBUTION SYSTEM PLANNING & AUTOMATION

Course Code	20EE4601A	**Year**	III	**Semester(s)**	II
Course Category	Professional Elective –II	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Electrical Power Generation, Transmission and Distribution
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of distribution system planning and automation. **(L2)**
CO2	**Apply** the knowledge of distribution system planning and forecasting. **(L3)**
CO3	**Apply** the concepts of sub transmission lines, distribution substations, primary and secondary Systems. **(L3)**
CO4	**Analyze** the theory of distribution automation and SCADA systems. **(L4)**
CO5	**Examine** the mechanism of network reconfiguration, improvement in voltage profile,Capacitor placement in distribution system. **(L4)**
CO6	**Show** the ability to apply the various distribution system planning and automation concepts and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**3**
CO2	**3**												**3**	**3**
CO3	**2**					**2**							**3**	**3**
CO4			**2**				**2**						**3**	**3**
CO5		**2**				**2**							**3**	**3**
CO6									**3**	**3**		**3**	**3**	**3**

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Distribution Systems Planning:** Introduction, Distribution system planning, Factors affecting system planning, Present distribution planning techniques, Distribution system planning in the future, Future nature of distribution planning, Central role of the computer in distribution planning, Impact of Dispersed Storage and Generation , Load characteristics, Load forecasting, Long term forecasting, Technological forecasting.	**CO1** **CO2** **CO6**

II	**Design Of Sub transmission Lines and Distribution substations:** Sub-transmission, Distribution substations, Sub-station bus schemes, Sub-station location, Rating of distribution substation, Substation service area with ‘n’ primary feeders, Comparison of four and six feeder patterns.	**CO1 CO3 CO6**
III	**Design Considerations of Primary and Secondary Systems:** Radial type and loop type primary feeders, Primary network, Primary feeder voltagelevels, Primary feeder loading, Radial feeders with uniformly distributed load and non-uniformly distributed loads, Secondary voltage levels, Secondary banking, and Secondary networks-Secondary mains Voltage drops and power loss calculations- three phase balanced primary lines, non-three phase primary lines.	**CO1 CO3 CO6**
IV	**Distribution Automation** Problems of existing Distribution System, Need for Distribution Automation, Characteristics of Distribution System, Distribution Automation (Objectives, Functions, Benefits), Communication Requirements for DA, Remote Terminal Unit (RTU) ,Network reconfiguration, Improvement in Voltage Profile, Capacitor Placement in Distribution System for Reactive Power Compensation, Algorithm for location of capacitor..	**CO1 CO4 CO5 CO6**
V	**SCADA SYSTEM** Introduction, Block Diagram, Components of SCADA, Functions of SCADA, and SCADA applied to Distribution Automation, Advantages of DA through SCADA, Requirements and Feasibility, DA Integration Mechanisms, Communication Protocols in SCADA Systems.	**CO1 CO4 CO6**

Learning Resources
Text Books
1. Dr M K Khedkar and Dr G M Dhole, “A Textbook of Electric Power Distribution automation”, University Science Press, 1st Edition 2011.
2. Turan Gonen , “Electric Power Distribution system Engineering”, CRC press, 3rd edition, 2014
Reference Books
1. A.S. Pabla, “Electric Power Distribution “ Tata Mc Graw-hill Publishing Company, 6 th edition, 2011.
2. Control and Automation of Electrical Power Distribution systems by James North cote and Robert Wilson, CRC press, 1st edition 2006.
Web Links
1. https://www.youtube.com/playlist?list=PLwdnzlV3ogoWKGs1XqdyB0qcgijA1PfYJ 2. https://www.youtube.com/watch?v=DlGSGJISxUI&list=PLLy_2iUCG87DxrqJr3dBhSruMiRHK0rNr

ELECTRICAL DRIVES

Course Code	20EE4601B	**Year**	III	**Semester(s)**	II
Course Category	Professional Elective-II	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Power Electronics, Electrical Machines-1, Electrical Machines-2
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic Power Converters to drives Classification of Electrical Drives, choice of electric drives and selection of drives ,braking and motoring operations of converters fed to drives.(L2)
CO2	**Apply** the basic knowledge to obtain the operation, multi-quadrant operation, speed torque characteristics ,applications of Rectifiers and Choppers fed to DC drives ,Various parts of Electric Drive,.(L3)
CO3	**Apply** the basic knowledge to obtain the operation, speed torque characteristics, applications for Inverters and AC to AC converters fed to AC drives, fundamental torque equation. (L3)
CO4	**Analyze** the concepts of Rectifiers and Choppers fed to DC drives.(L4)
CO5	**Analyze** the concepts of Inverters and AC to AC converters fed to AC drives, fundamental torque equation. (L4)
CO6	**Submit a report** in Fundamentals, Rectifiers, Choppers, Inverters and AC to AC converters of Electric Drives**.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1	1						2	1
CO3	3					1	1						2	1
CO4		2											2	1
CO5		2											2	1
CO6						3	3		3	3		3	2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Fundamentals of Electric Drives** Introduction of Electric drives and various parts, Classification of Electrical Drives, choice of electric drives and selection of drives for various applications; fundamental torque equation, multi-quadrant operation of a motor driving hoist, Equivalent values of Drive Parameters.	CO1 CO2 CO3 CO5 CO6
II	**DC Drives-Rectifiers** Controlled rectifier fed dc drives, single phase half controlled rectifier control, single phase fully controlled rectifier control of dc separately excited motor, rectifier control of dc series motor. Three phase half controlled rectifier control, Three phase fully controlled rectifier control of dc separately excited motor, multi quadrant operation of separately excited motor fed from fully controlled rectifier.	CO1 CO2 CO4 CO6
III	**DC Drives- Choppers** Buck and Boost converter fed DC Drives, types of braking, Control of chopper fed dc separately excited, series motor and speed-torque characteristics. Converter ratings and closed loop control.	CO1 CO2 CO4 CO6
IV	**AC Drives** Stator voltage control, variable frequency control from voltage sources, VSI fed induction motor drives, rotor resistance control, slip power recovery schemes-static scherbius, static Kramer drive.	CO1 CO3 CO5 CO6
V	**Essential Applications of Electrical Drives** Solar powered Pump Drives, Battery Powered Electrical Vehicles, Drive requirements for machine tools, Brushless DC motor drive for Servo Applications. AC Traction using converter controlled dc Motors and DC Traction Using Chopper controlled dc Motors.(Block diagram only-no problems)	CO1 CO2 CO3 CO6

Learning Resources

Text Books

1. G K Dubey ,Fundamentals of Electric Drives, Narosa Publications,2nd edition,2011
2. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice Hall of India, 2nd edition, 2001.

Reference Books

1. G.K. Dubey, Power Semiconductor Controlled Drives, Alpha Science International Ltd. 1st edition,2002.
2. Bimal K. Bose, Modern Power Electronics and AC Drives, Prentice-hall of India Pvt. Ltd,2nd edition, 2005.
3. P.S.Bhimbra,‘PowerElectronics’, Khanna Publications, 5th edition, 2018.
4. Vedam Subramanyam, Electric Drives Concepts and Applications, Tata McGraw Hill Education Private Limited, 2nd edition, 2011

Web Links

1. https://nptel.ac.in/courses/108104140

DIGITAL SIGNAL PROCESSING

Course Code	20EE4601C	**Year**	III	**Semester(s)**	II
Course Category	Professional Elective-II	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Signals & Systems
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the fundamentals of discrete-time systems and decimation, interpolation in multi rate digital signal processing (L2).
CO2	**Apply** Fourier Transforms to develop DFT,FFT and construct direct, cascade form structures of digital systems (L3).
CO3	**Apply** various mapping techniques, window methods to find transfer function of digital filters and sampling rate conversion in DSP applications (L3).
CO4	**Analyze** causality, stability of LTI systems and circular convolution using DFT (L4).
CO5	**Analyze** the IIR and FIR digital filters for the given specifications (L4).
CO6	Submit a report on various concepts of Digital signal processing .

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3	3						2						2	1
CO4		3											2	1
CO5		3	3			2		2					2	1
CO6									3	3	3	3	2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Transform Analysis of Discrete time LTI Systems** Analysis of Discrete-time Linear Time-Invariant Systems, review of convolution-matrix method, system function of LTI systems characterized by linear constant coefficient difference equations: Stability, Causality, Impulse response and Step response for rational system functions**.**	CO1,C04, CO6

II	**The Discrete Fourier Transform (DFT)** Introduction to DFT, Properties of the DFT, Circular Convolution, Relationship among DTFT, DFT and ZT, Inverse FFT, computation of DFT and IDFT **FFT Algorithms** Radix-2 Decimation-In-Time(DIT)and Decimation-In Frequency (DIF) FFT Algorithms	CO1,CO2, CO4, CO6
III	**Design of IIR Digital Filter** Design procedure for Analog Butterworth and Chebyshev filters, Design of IIR Digital Filters using Impulse Invariant method and Bilinear Transformation, examples. Realization of IIR systems – Direct, Cascade forms	CO1,CO2, CO3,CO5, CO6
IV	**Design of FIR Digital Filters** Introduction to FIR Filters, Design of Linear phase FIR digital filters using Window method, Frequency Sampling Method. Realization of FIR systems-Direct, Cascade forms	CO1,CO2,CO3 ,CO5, CO6
V	**Multi rate Digital Signal Processing** Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion, Applications of Multi rateSignal processing.	CO1,CO3, CO6

Learning Resources
Text Books
1. John G Proakis &D.G.Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, PEARSON , 4th Edition, 2007. 2. AlanV.Oppenheim, Ronald W.Schafer, Descrete time signal processing ,PEARSON,3rd Edition,2014
Reference Books
1. Lonnie C Ludeman ,Fundamentals of Digital Signal Processing, John Wiley & Sons, 2013 2. Lawrence R Rabiner& BernardGold ,Theory and Application of Digital Signal Processing, Prentice Hall of India, 3rd series 1975
Web Links 1. https://nptel.ac.in/courses/108106151

OPTIMIZATION TECHNIQUES

Course Code	20EE4601D	**Year**	III	**Semester(s)**	II
Course Category	Professional Elective-II	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** basics and theoretical concepts of optimization techniques.(L2)
CO2	**Apply** mathematical principles to formulate optimization problems. (L3)
CO3	**Investigate** the different classical methods to solve linear, non-linear programming problems and transportation problems. (L4)
CO4	**Solve** Linear Programming Problem using dynamic programming. (L3)
CO5	**Analyze** the performance of modern heuristic methods to solve optimization problems. (L4)
CO6	Get the ability to engage in independent study to make an effective presentation and submit report on optimization techniques concepts in various domains.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3		1									2	2	
CO3		3	1										2	
CO4	3		1										2	
CO5		3	1		2							2	2	
CO6	3								3	3			2	

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to optimization:** Statement of an optimization problem, classification of optimization problems, optimization techniques, Engineering applications of optimization	**CO 1 CO2 CO 6**
II	**Linear Programming (LP):** Introduction and formulation of models, standard form of Linear Programming Problem(LPP), assumptions in LPP, simplex method, simplex method using artificial variables, degeneracy in simplex method, duality, dual simplex method and sensitivity analysis-change in coefficients of objective function.	**CO 1 CO 3 CO 6**

III	**Transportation Problem:** Vogel"s approximation method, modified distribution method. **Non-linear Programming:** Unconstrained problems of maxima and minima and constrained problems of maxima and minima, Lagrangian method and Kuhn Tucker conditions.	**CO 1** **CO 3** **CO 6**
IV	**Dynamic Programming:** Solution of linear programming problem, simple problems. **Modern Methods of Optimization-I**: Simulated Annealing: Introduction, Procedure, Algorithm, Features of the Method, Particle Swarm Optimization**:** Introduction, Computational Implementation of PSO, Improvement to the Particle Swarm Optimization Method, Solution of the Constrained Optimization Problem	**CO 1** **CO 4** **CO 5** **CO 6**
V	**Modern Methods of Optimization-II** Ant Colony Optimization: Basic Concept, Ant Searching Behavior, Path Retracing and Pheromone Updating, Pheromone Trail Evaporation, Algorithm Firefly Optimization Algorithm: Firefly Behavior, Assumptions, Procedure, Algorithm Teaching-Learning-Based Optimization (TLBO) – Algorithm	**CO 1** **CO 5** **CO 6**

Learning Resources

Text Books

[1] S.S.Rao, "*Engineering Optimization: Theory and Practice*",New Age International publishers, 5th edition., 2019

[2] S.D.Sharma, "*Operations Research*", Kedar Nath Ram Nath and Co, 4th Edition, 2014.

[3] K.Deb, "*Optimization for Engineering Design: Algorithms and Examples*", Prentice Hall of India Learning Pvt. Ltd., 2nd edition. 2012.

Reference Books

[1] K.V.Mittal, C. Mohan, "*Optimization Methods in Operations Research and Systems Analysis*", New Age International, 1st edition, 1996.

[2] H.A.Taha, "*Operations Research: An introduction*", Prentice Hall of India Learning Pvt. Ltd., 10th edition, 2019.

[3] D.P.Kothari, J.S.Dhillon, "*Power System Optimization*", Prentice Hall of India Learning Pvt. Ltd., 2ndedition, 2011.

Web Links

1. https://nptel.ac.in/courses/111105039

COMPUTER NETWORKS

Course Code	20EE4601E	**Year**	III	**Semester(s)**	II
Course Category	Professional Elective-II	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Illustrate the OSI and TCP/IP reference model. (L2)
CO2	Analyze various protocols in Data link layer, Transport Layer, and their mechanisms. (L3)
CO3	Implement routing and congestion control algorithms. (L3)
CO4	Analyze the real applications like electronic mail, www and multimedia. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Uses of Computer Networks, Network hardware, Network software, Networks Topologies, OSI, TCP/IP Reference models. **Physical Layer:** Guided Transmission media: twisted pairs, coaxial cable, fiber optics, Wireless transmission.	**CO1**
II	**Data link layer:** Design issues, framing, Error detection and correction. **Elementary data link protocols:** simplex protocol, A simplex stop and wait protocol for an error-free channel, A simplex stop and wait protocol for noisy channel. Sliding Window protocols: A one-bit sliding window protocol, A protocol using Go-Back-N, A protocol using Selective Repeat.	**CO1,CO2**

III	**Network Layer: Design issues, Routing algorithms:** shortest path routing, distance vector routing, Link State routing, Broadcast routing, Multicast routing. **Congestion Control Algorithms**, Internet working, The Network layer in the internet.	**CO1,CO3**
IV	**Transport Layer:** The transport service, Elements of Transport protocols, The internet transport protocols: UDP, The internet transport protocols: TCP.	**CO1,CO2**
V	**Application Layer: Domain name system, Electronic Mail;** The World WEB, Streaming audio and video.	**CO1,CO4**

Learning Resources
Text Books
1. Computer Networks – Andrew S Tanenbaum, David. J. Wetherall, 5th Edition. Pearson Education/PHI
Reference Books
1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education. 2. Computer Networks, A Top-Down Approach –Behrouz A Forouzan, Firouz Mosharraf. 3. Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.
Web Links 1. http://home.iitk.ac.in/~navi/sidbinetworkcourse/lecture1.ppt. 2. http://nptel.iitm.ac.in/courses/IIT-MADRAS/Computer_Networks/index.php

CONSTITUTION OF INDIA

Course Code	20MC1601	**Year**	III	**Semester(s)**	II
Course Category	Mandatory Course	**Branch**	EEE	**Course Type**	Theory
Credits	0	**L-T-P**	2-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Enable** the student to **understand** the importance of constitution (L2)
CO2	**Understand** philosophy of fundamental rights and duties (L2)
CO3	**Understand** the structure of Union government and central and state relation, with respect to financial and administrative, executive, legislature and judiciary (L2)
CO4	**Understand** the structure of State and local government with respect to financial and administrative, executive, legislature and judiciary (L2)
CO5	**Understand** the autonomous nature of constitutional bodies like Supreme Court and high court, comptroller and auditor general of India and election commission of India, UPSC, SPSCs and NHRC etc., (L2)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**INTRODUCTION TO INDIAN CONSTITUTION** Constitutional history, constituent assembly, salient features of the constitution, significance of preamble, amending process of the constitution.	**CO1**
II	**RIGHTS AND DUTIES** Citizenship, fundamental rights and directive principles, fundamental duties	**CO2**

III	**UNION GOVERNMENT** President and vice president, election, removal and powers, prime minister and council of ministers, parliament, supreme court, union, state relations, emergency provisions.	**CO3**
IV	**STATE AND LOCAL GOVERNMENTS** Governor, state legislature, assembly and council, chief minister and council of ministers, high court, rural and urban local governments with special reference to 73^{rd} and 74^{th} constitutional amendment acts.	**CO4**
V	**OTHER CONSTITUTIONAL AND STATUTORY BODIES** Comptroller and auditor general, election commission, finance commission, attorney general and advocate general, union public service commission (UPSC), state public service commissions (SPSCs), tribunals, national human rights commission (NHRC).	**CO5**

Learning Resources
Text Books
1. J. C. Johari, Indian Government and Politics, Vishal Publications, Delhi, 2009. 2. M. V. Pylee, Introduction to the Constitution of India, 5/e, Vikas Publishing House, Mumbai, 2007.
Reference Books
1. D.D. Basu, Introduction to the Indian Constitution, 21/e, Lexis Nexis, Gurgaon, India, 2011. 2. Subhas C. Kashyap, Our Constitution, 2/e, National Book Trust India, New Delhi, 2013
e-Resources & other digital material
1. http://nptel.ac.in/courses.php 2. http://jntuk-coeerd.in/

POWER SYSTEMS LAB

Course Code	20EE3651	**Year**	III	**Semester(s)**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	--
Continuous Internal Evaluation:	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes	
Upon **successful completion of the course, the student will be able to**	
CO1	**Demonstrate** the practical power transmission network and calculate various parameters.(L3)
CO2	**Determine** the parameters and fault calculations of synchronous machine.(L3)
CO3	**Analyse** the characteristics of different relays used in electrical power systems.(L4)
CO4	**Analyse** the modern power system networks by using software tools.(L4)
CO5	Conduct experiments as a **team/individual** by using equipment available in the Laboratory.
CO6	Make an effective **report** based on experiments.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations(3:High, 2:Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3								3	2	1
CO2	3			3								3	2	1
CO3		3		3								3	2	1
CO4		3	3	3	3							3	2	1
CO5									3				2	1
CO6										3			2	1

Syllabus

Expt. No.	Contents	Mapped CO
	Conduct any ten experiments	
1	Evaluation of ABCD parameters for transmission line.	CO1, CO5, CO6
2	Evaluation of surge impedance loading of transmission line.	CO1, CO5, CO6
3	Determination of sub-Transient reactance of a salient pole machine.	CO2, CO5, CO6
4	Determination of sequence impedances of a cylindrical rotor alternator.	CO2, CO5, CO6
5	Fault Analysis under occurrence of LG Fault & LL Fault.	CO2, CO5, CO6
6	Characteristics of electromagnetic type IDMT over current relay.	CO3, CO5, CO6

7	Characteristics of electro mechanical type over voltage relay.	CO3, CO5, CO6
8	Characteristics of static negative sequence relay.	CO3, CO5, CO6
9	Characteristics of static biased differential relay.	CO3, CO5, CO6
10	Characteristics of microprocessor based under voltage relay.	CO3, CO5, CO6
11	Characteristics of microprocessor based over voltage relay.	CO3, CO5, CO6
12	Formation of Y-Bus by direct inspection method using MATLAB.	CO4, CO5, CO6
13	Transient stability studies using MATLAB.	CO4, CO5, CO6
14	Simulation of power system stabilizer using SIMULINK.	CO4, CO5, CO6
15	Simulation of single area and two area systems using SIMULINK.	CO4, CO5, CO6

Learning Resources

Text Books

1. J.B. Gupta, "Fundamentals of Switchgear and Protection", S.K. Kataria & Sons, 1st edition 2011.
2. Hadi Saadat, "Power System Analysis", PSA publishing, 3rd edition, 2011.

Reference Books

1. D.P.Kothari and I.J.Nagrath, "Modern power system analysis", TMH Publications, 4th edition, 2011.
2. C.L.Wadhwa, " Electrical power systems", New Age International (P) Limited, 6th edition, 2018.

MICROPROCESSORS AND MICROCONTROLLERS LAB

Course Code	20EE3652	**Year**	III	**Semester**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	NIL
Continuous Internal Evaluation:	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Develop assembly language programs to perform various arithmetic and logical operationswith 8086 micro-processors. (L3)
CO2	Develop assembly language programs to perform various arithmetic and logical operationswith 8051 micro-controllers. (L3)
CO3	Experiment various interfacing techniques related to real time applications. (L4)
CO4	Conduct experiments as a team / individual by using equipment available in the laboratory.
CO5	Make an effective report based on experiments.

Strength of correlations (3: High, 2: Medium, 1:Low)

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

Syllabus

List of Experiments

Any Five Experiments from the following list of experiments

Expt. No.	**Contents**	**Mapped CO**
1	Introduction to MASM/TASM. Factorial of a number Sum of squares GCD of two numbers	CO1, CO4, CO5
2	Arithmetic operations using 8086 Microprocessors – Multi byte addition and subtraction, Multiplication and Division, ASCII – arithmetic operation	CO1, CO4, CO5
3	Logic operations using 8086 Microprocessors – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.	CO1, CO4, CO5
4	Sorting of numbers using 8086 Microprocessors.	CO1, CO4, CO5
5	Arithmetic operations using 8051 Microcontrollers.	CO2, CO4, CO5

6	Programs using special instructions like swap, bit/byte, set/reset etc. using 8051 Microcontrollers	CO2, CO4, CO5
7	Reading and Writing on a parallel port.	CO3, CO4, CO5
Any Five Experiments from the following list of experiments		
8	Generation of Sine wave	CO3, CO4, CO5
9	PWM generation	CO3, CO4, CO5
10	Traffic light Interface	CO3, CO4, CO5
11	Stepper Motor Interface	CO3, CO4, CO5
12	8259 – Interrupt Controller	CO3, CO4, CO5
13	Keyboard Interface	CO3, CO4, CO5
14	ADC Interface	CO3, CO4, CO5
15	Serial communication implementation using 8051 Microcontrollers	CO3, CO4, CO5

Learning Resources

Text Books

1. Douglas V. Hall, "Microprocessors and Interfacing", TMH-Revised 2nd edition, 2006.
2. A. K. Ray and K. M. Burchandi, "Advanced Microprocessors and interfacing", Tata McGraw Hill, 2nd edition, 2006.
3. Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Thomson Publishers, 2nd Edition, 2004

Reference Books

1. Ajay V. Deshmukh, "Microcontrollers – Theory & Applications", Tata McGraw Hill, 2005.
2. M.A. Mazidi, R.D. McKinlay, J.G. Mazidi, "The 8051 Microcontroller: A Systems Approach", Pearson, 2013.

ELECTRICAL SIMULATION LAB

Course Code	20EE3653	**Year**	III	**Semester (s)**	II
Course Category	Professional Core	**Branch**	EEE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Circuit theory, Power Electronics, Power Systems
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks:**	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Determine** the performance of Power System networks in various software tools. (L3)
CO2	**Analyse** the performance of Power Electronics circuits in simulation Softwares. (L4)
CO3	**Determine** the performance of basic electrical, electronics and Control System circuits in the software tools. (L3)
CO4	Conduct experiments as a team / individual by using the software available in the laboratory
CO5	Make an effective report based on experiments.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3	3				3			3	3	1
CO2		3			3				3			3	3	1
CO3	3		3		3				3			3	3	1
CO4				3	3				3				3	1
CO5										3			3	1

S. No.	Experiment	Mapped Cos
1	Analysis of three phase power system representing the generator, transmission line and load.	CO1, CO4, CO5
2	Fault analysis of a power system.	
3	Power Flow solution of a power system by Newton Raphson method.	
4	Simulation of single – phase full converter using R, RL & RLE loads.	CO2, CO4, CO5
5	Simulation of single phase AC voltage controller using R, RL & RLE loads.	
6	Simulation of Buck Chopper.	
7	Simulation of Resonant Pulse Commutation Circuit.	
8	Simulation of single phase inverter with PWM control.	
9	Modelling of electrical machine (DC motor).	

10	Simulation of D. C. circuit for determining thevenin‘s equivalent & norton‘s equivalent.	CO3, CO4, CO5
11	Response of an RLC circuit by parametric analysis.	
12	Simulation of op- Amp based integrator & differentiator circuits.	
13	PID –open loop & closed loop control.	

Learning Resources
Text Books
1. Schaum’s outline series—Basic circuit analysis, McGraw-Hill Professional, 2012 2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009. 3. M. H. Rashid, Power Electronic Circuits Devices and Applications, 4th edition, Pearson.
Reference Books
1. Handbook on MATLAB, Getting Started Guide, The Mathworks 2. PSCAD User’s Guide, Manitoba HVDC Research Centre
e- Resources & other digital material
1. https://in.mathworks.com/help/physmod/simscape/ug/op-amp-circuit-inverting-amplifier.html 2. https://www.pscad.com/software/pscad/overview 3. https://powersimtech.com/

SOFT SKILLS

Course Code	20SS8651	Year	III	Semester(s)	II
Course Category	Skill oriented	Branch	Common to All	Course Type	Lab
Credits	2	L-T-P	1-0-2	Prerequisites	-
Continuous Internal Evaluation:	--	Semester End Evaluation:	50	Total Marks:	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Develop** logical and **Analytical** skill set through Case Studies(L3)
CO2	**Proficient** in giving Presentations (L3)
CO3	**Understand** the corporate etiquette (L2)
CO4	**Develop** Competency in group discussion & Interviews(L3)
CO5	**Present** themselves with corporate readiness(L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								2		2				
CO2									3	3		2		
CO3								2	1	2		1		
CO4									3	3				
CO5										3				
CO6								2		2				

SYLLABUS		
Unit No.	Contents	Mapped CO
UNIT-1	• Soft Skills- Need & Importance. Intra & Inter Personal Skills • Campus to Corporate- Employability Skills- Need of the hour • SWOT Analysis. • Attitude- Developing Professional & Positive Attitude Perception – Importance of analytical thinking.	
UNIT-2	• Communication Skills – Need and Methods • Body-Language –I; How to interpret and understand other’s bodylanguage • Body Language-II; How to improve one’s own Body Language	

	Presentation Skills (Seminar Talk & Power Point Presentation)	
UNIT-3	• Goal Setting- Need & Importance • Magic of Team Work. • Leadership Qualities. Six Thinking Hats.	
UNIT-4	• Accountability towards Work. • Paragraph Writing – Descriptive and Analytical with illustrations • Email Writing Work Etiquette	
UNIT-5	• Group Discussion (Open & Monitored) • Resume Preparation • Interview Skills Mock Interviews	
UNIT-6	• Vocabulary- Root Words (A representative Collection of 50) • Vocabulary for Competitive Exams (A list of 500 high frequency Words) • Idioms & Phrases • Verbal Analogies • Correction of Sentences • Sentence Completion – Course of Action • Cloze Test • Reading Comprehension (Skimming, Scanning & tackling different kinds of questions) • Phrasal Collocations (Representative collection of 50 meanings along with sentential illustrations) • SWAR/ VERSANT Test	

Learning Resources
Text Books
1. The ACE of Soft Skills by Gopalaswamy Ramesh & Mahadevan Ramesh –Pearson 2. Working with Emotional Intelligence – David Goleman. 3. Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd.,Delhi.
Reference Books
1. Soft Skills: Meenakshi Raman. 2. Audio—Visuals / Hand Outs (Compiled/Created by T&P Cell, P.V.P.Siddhartha Institute of Technology), Board & Chalk and Interactive Sessions
Semester End Evaluation • **15 marks for Report- Which includes** 5marks for Resume 20 Marks for PPT (5M for PPT preparation & Presentation, 5M for Report Preparation on PPT) • **35 Marks for External Exam – Which includes** 21 marks for Viva with external examiner, 22 marks for Vocab test (Which is essential in Recruitment written test) 5 marks for E-mail Writing (which is important for the student to apply for the job through online, to give consent to job offer and to communicate in the work environment)

INDUSTRIAL AUTOMATION & ROBOTICS

Course Code	20EE6601A	**Year**	III	**Semester**	II
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	-
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of automation and robotics. (L2)
CO2	**Assess** the basic idea on automation, material handling and Storage Systems. (L3)
CO3	**Analyze** the automation, different material transport and Storage Systems. (L4)
CO4	**Illustrate** the knowledge on social issues and future applications of robotics. (L3)
CO5	**Determine** the different issues and applications of robotics in real time. (L4)
CO6	**Ability** to submit a report on industrial automation and robotics.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3		2									1	2	1
CO3		3	2			1						1	2	1
CO4	3				1		1						2	1
CO5		3						1					2	1
CO6									3	3	1			

Syllabus

Unit No.	Contents	Mapped CO
I	**Introduction to automation:** Definition, automation principles and strategies, scope of automation, socio-economic consideration, low cost automation, Types of automation, basic elements of advanced functions Levels of automation.	CO1 CO2 CO3 CO6
II	**Automated material transport system:** Types of equipment, Design considerations in material handling, material transport equipment, - Industrial Trucks conveyor systems, automated guided vehicle systems. Analysis for Material Handling Systems- conveyor analysis.	CO1 CO2 CO3 CO6
III	**Automated Storage Systems:** Storage System Performance, Storage Location Performance, Conventional storage methods and equipment, Fixed-Aisle Automated Storage/Retrieval Systems, Carousel Storage Systems.	CO1 CO2 CO3 CO6
IV	**Fundamentals Concepts :**Introduction to Robot, Classification of Robots, History of Robotics ,Advantages and Disadvantages of Robots ,Robot Components ,Robot Degrees of Freedom ,Robot Joints , Robot Coordinates ,Robot Reference Frames , Programming Modes , Robot Characteristics,	CO1 CO4 CO5 CO6

	Robot Workspace ,Robot Languages ,Robot Applications ,Other Robots and Applications.	
V	**Social Issues and Future Applications:** **Social Labor Issues:** Productivity and Capital Formations, Robotics and Labor, Education and Training, International Impacts. **Future Applications:** Robot Intelligence, Characteristics of future Robot Tasks, Future Manufacturing Applications of robots, Service Industry and Similar Applications.	CO1 CO4 CO5 CO6

Learning Resources
Text Books:
1. M.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", PHI,3rd Edition,2009. 2. M.P.Groover"Industrial Robotics Technology Programming and Applications", McGraw-Hill 2nd Edition, 2017.
Reference Books:
1. John J. Craig, Addison Wesley "Introduction to Robotics", Prentice Hall, 3rd Edition, 2005. 2. A K Gupta "Industrial Automation and Robotics", Laxmi Publications,3rd Edition, 2007.
E- Resources :
https://nptel.ac.in/courses/112105249 http://engineering.nyu.edu/mechatronics/smart/Archive/intro_to_rob/Intro2Robotics.pdf https://nptel.ac.in/courses/112101098

ADVANCED POWER SYSTEM PROTECTION

Course Code	20EE6601B	**Year**	III	**Semester(s)**	II
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Switchgear and Protection
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** various static and numerical relays, protection of generator, transformer and transmission lines. **(L2)**
CO2	**Apply** basic concepts of static and numerical relays to protection system. **(L3)**
CO3	**Apply** wavelet transform, Fourier transform and Digital relaying algorithms to protection system**. (L3)**
CO4	**Analyze** Principle of Operation of; over current and directional relays, distance protection and pilot relaying. **(L4)**
CO5	**Examine** Principle of Operation of different micro processor based relays and protection of generator, transformer and transmission lines. **(L4)**
CO6	**Ability** to understand the concepts of various static and numerical relays, protection of generator, transformer and transmission lines and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1							3	3
CO3	3												3	3
CO4		2											3	3
CO5		2				1							3	3
CO6	3	3						3	3	3			3	3

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**STATIC RELAYS** Basic construction of static relays, review of electromagnetic relays, static relays, Comparison of Static relays with electromagnetic relays, Amplitude comparator and Phase comparator, Over current relays, time current characteristic, current setting, time setting, directional relay, static over current relays.	CO1, CO2, CO6

II	**DISTANCE PROTECTION** Impedance Relay: operating principle – relay Characteristic –Protective Schemes – Static Impedance Relay – Static reactance relay – static MHO relay – effect of arc resistance, effect of power surges, effect of transmission line length and source impedance on performance of distance relays – Quadrilateral relay – Elliptical relay – Swivelling characteristics.	CO1, CO2 CO4, CO6
III	**PILOT RELAYING SCHEMES** Wire pilot protection, circulating current scheme, balanced voltage scheme, transley scheme, carrier current protection, phase comparison carrier current protection, carrier aided distance protection. **NUMERICAL PROTECTION** Digital relaying algorithms, differential equation technique, discrete fourier transform technique, wavelet transform technique, removal of dc offset.	CO1, CO2, CO3, CO4, CO6
IV	**MICROPROCESSOR BASED PROTECTIVE RELAYS:** general block diagram of Microprocessor based protective relays, Microprocessor based over current relay, Microprocessor based distance relays- impedance relay, reactance relay, Mho relay, offset Mho relay.	CO1, CO2, CO5, CO6
V	**DIGITAL PROTECTION OF AC MACHINES** Faults in synchronous generator, protection schemes for synchronous generator, digital protection of synchronous generator. Faults in a transformer, schemes used for transformer protection, digital protection of Transformer	CO1, CO2, CO5, CO6

Learning Resources

Text Books

1. MadhavaRao T.S, “Power System Protection, Static Relays with Microprocessor Applications”, TMH , 2nd edition, 2012
2. Badriram and D N VishwaKarma, “Power System Protection and Switchgear”, TMH, 2nd edition, 2014

Reference Books

1. Ravindranth. B and Chander, “Power System Protection and Switch Gear”, New Age International (P) Ltd., 2nd edition, 2014.
2. Ravindra P. Singh, “Switch Gear and Power system Protection”, Prentice Hall of India Pvt. Ltd., 2nd edition, 2014.
3. Ravindra P. Singh, “Digital Power System Protection” , Prentice Hall of India Pvt. Ltd., 1st edition, 2007

Web Links

1. https://nptel.ac.in/courses/108101039
2. https://nptel.ac.in/courses/108107167

POWER SYSTEM RELIABILITY

Course Code	20EE6601C	**Year**	III	**Semester**	II
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	EPGT&D
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the different probability distributions, Monte Carlo simulation, reliability of Power System. **(L2)**
CO2	**Apply** the knowledge of different probability distributions for power system reliability and Monte Carlo simulation for composite System reliability. **(L3)**
CO3	**Illustrate** Operating reserve Evolution and Distribution Systems **(L3)**
CO4	**Analyse** the reliability of the Power System and Operating Reserve. **(L4)**.
CO5	**Submit a report** on probability distributions, Monte Carlo simulation, Operating Reserve and reliability of Power system.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Basic Probability Theory:** Basic probability Concepts, Random variables, Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Monte Carlo Method- Random numbers generation, Random variables Simulation output analysis.	**CO1 CO2 CO5**
II	**Generating System Reliability Analysis**: Generation system model, Capacity outage probability tables, Recursive relation for Capacitive model building, Unit removal, Evaluation of Loss of Load and energy indices.	**CO1 CO2 CO4 CO5**

III	**Operating Reserve Evaluation**: General concepts, PJM method, Extension to PJM method, Modified PJM method, Postponable outages.	**CO1 CO3 CO4 CO5**
IV	**Reliability Evaluation of Composite System** General concepts , State selection , Calculation of the system and load points indices , Required data for composite system reliability evaluation , Application of the Monte Carlo method to composite system reliability evaluation.	**CO1 CO2 CO4 CO5**
V	**Distribution Systems Basic Techniques & Radial Networks:** Evaluation techniques, Additional interruption indices, effect of lateral distributor protection, Effect of disconnect, Effect of protection failures, effect of transferring loads.	**CO1 CO3 CO4 CO5**

Learning Resources

Text Books

1. R. Billinton, R.N.Allan, Reliability Evaluation of Power systems, Springer/BS Publications, Second Editioin 2008.
2. M. Cepin, Assessment of Power System Reliability: Methods and Applications, Springer Publications, 2011.

Reference Books:

1. Richard Elect. Brown, Electric Power Distribution Reliability, CRC Press Publications, Second Edition 2017.
2. Dhillan, B.S., Power System Reliability, Safety and Management, Ann Arbor Science Pubications, 1983.

E- Resources:

1. https://www.udemy.com/course/power-system-reliability-concepts
2. https://ekeeda.com/degree-courses/electrical-engineering/power-system-planning-and-reliability

RESTRUCTURED POWER SYSTEMS

Course Code	20EE6601D	**Year**	III	**Semester(s)**	II
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	EPGT&D
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of restructuring of power systems. (L2)
CO2	**Interpret** the basic knowledge on deregulation and fundamentals of economics (L3)
CO3	**Apply** the engineering knowledge on electricity market models, transmission pricing and ancillary service management (L3)
CO4	**Analyze** the issues related to different aspects of power system restructuring (L4)
CO5	**Learn** various concepts of restructured power system and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to restructuring of power industry** Introduction, reasons for restructuring of power industry, different entities involved in deregulation, objectives of deregulation of various power systems across the world, different models of competition-monopoly model, purchasing agency model, wholesale competition model, retail competition model, benefits from competitive electricity market.	CO1 CO2 CO4 CO5
II	**Fundamentals of Economics** Modeling the consumers, modeling the producers, market equilibrium, pareto efficiency, global welfare and deadweight loss, short-run costs, long-run costs, spot market, forward contracts and forward markets.	CO1 CO2 CO4 CO5

III	Power system operation in competitive environment Introduction, bilateral trading, electricity pools, comparison of pool and bilateral trading. Role of independent system operator (ISO). Operational planning activities of ISO – in pool markets and bilateral markets, markets participation issues- Market clearing price (MCP).	CO1 CO3 CO4 CO5
IV	Transmission open access and pricing issues Introduction, power wheeling, types of transmission services in open access, cost components, pricing of power transactions, embedded cost based transmission pricing, incremental cost based transmission pricing (descriptive treatment only).	CO1 CO3 CO4 CO5
V	Ancillary Service Management Introduction to ancillary services, types of ancillary services, classification of ancillary services, load-generation balancing related services, voltage control and reactive power support services, provisions of ancillary services, co-optimization of energy and reserve services.	CO1 CO3 CO4 CO5

Learning Resources

Text Books

1. Kankar Bhattacharya, Math H.J. Bollen, Jaap E. Daalder, " Operation of restructured power systems", Springer publication,1st edition, 2012.
2. Daniel S. Kirschen and Goran. Strbac, "Fundamentals of power system economics", John wiley sons, Ltd., 2nd edition, 2018.

Reference Books

1. Mohammad Shahidehpour, Hatim Yamin, Zuyi Li, "Market operations in electric power systems: Forecasting, Scheduling and Risk Management", Wiley Interscience publication 1st edition, 2002.
2. Loi Lei Lai, "Power System Restructuring and Deregulation: Trading, Performance and Information Technology", Indian Edition, Wiley India Ltd., 1st edition, 2001.

e- Resources

https://nptel.ac.in/courses/108/101/108101005/

WEB TECHNOLOGIES

Course Code	20CS5601	**Year**	III	**Semester(s)**	II
Course Category	Minor in CSE	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Programming with Java
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the fundamental concepts of web application development. (L2)
CO2	Apply basic Front-End Technologies to create static and dynamic web pages. (L3)
CO3	Apply JDBC Driver to design application and manipulate databases. (L3)
CO4	Apply the concepts of server side technologies for creating dynamic web applications. (L3)
	Analyze static and dynamic web pages using Front-End Technologies and server side technologies for posting and retrieving data. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**HTML:** Understanding 3-tier Web Architecture, Overview of HTTP, Introducing HTML document structure, Creating Headings on a webpage, Working with links, Creating a Paragraph, Working with images, Working with tables, working with frames, Introduction to Forms and HTML controls. **Cascading Style Sheets:** Inline, Internal and External Style Sheets, Style class, Multiple styles.	**CO1, CO2, CO5**
II	**JavaScript:** Introducing DHTML, Introducing JavaScript, Client Side benefits of using JavaScript, Embedding JavaScript in an HTML page, Using Variables, Using Operators, Working with Control Flow statements, Working with functions, Handling Events, Using Arrays, Creating objects in JavaScript. **XML**: Introduction to XML: Syntax of XML, document structure, and	**CO1, CO2, CO5**

	document type definition.	
III	**JDBC:** Java Database Connectivity: JDBC Connectivity, Types of JDBC drivers, Steps to write a JDBC application, JDBC Statements, Manipulations on the database.	**CO1, CO3, CO5**
IV	**Servlets :** Introduction to Servlets: Lifecycle of a servlet, the servlet api, the javax.servlet package, the javax.servlet.http package, handling http request & responses, Servlets with database connectivity. Introduction to Model View Controller (MVC): Architecture.	**CO1, CO4, CO5**
V	**JSP:** Introduction to JSP: The problem with servlet, the anatomy of a JSP page, JSP processing, JSP applications, JSP components, comments, expressions, scriptlets, JSP database connectivity	**CO1, CO4, CO5**

Learning Resources

Text Books

1. Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press.
2. Java Servlet Programming, Jason Hunter, William Crawford, Second edition, 2003, O'Reilly,2003
3. Programming the World Wide Web, Robert W.Sebesta, Fourth edition, 2007, Pearson.

Reference Books

1. Internet and World Wide Web - How to program, Dietel and Nieto, 2006, PHI/PearsonEducation.
2. JAVA The Complete References, Herbert Schildt, Eighth edition, 2014, McGraw Hill.
3. Web Technologies, UttamK.Roy, 2004, Oxford Higher Education publication.
4. Web Warrior Guide to Web Programming, Bai Ekedaw, 2012, Thompson Publications.

E- Resources & other digital material

1. www.w3schools.com
2. Prof. I. Sengupta. (14th, May, 2017), Department of Computer Science & Engineering, I.I.T.,Kharagpur, “Internet Technologies", NPTEL videos.

WEB TECHNOLOGIES LAB

Course Code	20CS5651	**Year**	III	**Semester(s)**	II
Course Category	Minor in CSE	**Branch**	EEE	**Course Type**	Theory
Credits	1	**L-T-P**	0-0-2	**Prerequisites**	Java Programming
Continuous Internal Evaluation:	**15**	**Semester End Evaluation:**	**35**	**Total Marks:**	**50**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Apply web technologies to develop applications. (L3)
CO2	Implement various applications as an individual or team member. (L3)
CO3	Develop an effective report based on various programs implemented. (L3)
CO4	Apply technical knowledge for a given problem and express with an effectiveoral communication. (L3)
CO5	Analyze outputs of web based applications. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Expt. No.	**Contents**	**Mapped CO**
1	Design static web sites with html tags by taking different examples.	**CO1, CO2, CO3,CO4, CO5**
2	Design web pages using different types of CSS.	**CO1, CO2, CO3, CO4, CO5**
3	Apply Client side validations using JavaScript	**CO1, CO2, CO3,CO4, CO5**
4	Create an XML file for student/employee/book data andvalidate against DTD	**CO1, CO2, CO3,CO4, CO5**

5	Develop different JDBC applications to interact withdatabase.	**CO1, CO2, CO3,CO4, CO5**
6	Create different web applications using servlets	**CO1, CO2, CO3, CO4, CO5**
7	Develop different web applications using JSP	**CO1, CO2, CO3,CO4, CO5**
8	Build web applications (case studies) based on the **choice of student/faculty**	**CO1, CO2, CO3,CO4, CO5**

Learning Resources
Text Books
1. Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press, 2009 2. JavaServer Pages,Hans Bergsten, Thirrd Edition, 2017, O'Reilly Media
Reference Books
1. The Complete reference to J2EE, Jim Keogh, 2017, Tata McGrawHill. 2. Advanced Java 2 Platform How to Program‖, H. M. Deitel, P.J. Deitel, S.E. Santry,ThirdEdition, 2016, Prentice Hall Publications. 3. Java Servlet Programming, Jason Hunter, William Crawford, Second edition, 2003 O'Reilly.
E- Resources & other digital material
1. www.w3schools.com 2. Prof. I. Sengupta. (14th , May, 2017), Department of Computer Science & Engineering,I.I.T.,Kharagpur, "Internet Technologies", NPTEL videos

SOFTWARE ENGINEERING

Course Code	20IT5601	**Year**	III	**Semester(s)**	II
Course Category	Minor in IT	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Basics of IT
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the process of software engineering and various processModels. (L2)
CO2	Design the requirements of software system. (L3)
CO3	Use various design elements to prepare software system. (L3)
CO4	Analyze various testing techniques. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Software and Software Engineering:** The Nature of Software, The Unique Nature of Web Apps, Software Engineering, Software Process, Software Engineering Practice, Software Myths. **Process Models:** A Generic Process Model: Defining a framework activity, Prescriptive Process Models: The Waterfall Model, Incremental Process Model, Evolutionary Process Model, The Unified Process, What is an Agile Process?, XPProcess.	**CO1**
II	**Requirements Analysis And Specification:** Requirements Gathering and Analysis, Software Requirement Specification (SRS): Characteristics of goodSRS, Functional Requirements, Organization of SRS. **Software Design:** Overview of the Design Process, How to Characterize of a Design? Cohesion and Coupling, Approaches to Software Design.	**CO2, CO3**
III	**Function-Oriented Software Design:** Overview of SA/SD Methodology, Structured Analysis, Structured Design, Detailed Design, Design Review.	**CO1,**

	User Interface Design: Characteristics of Good User Interface, Basic Concepts, Types of User Interfaces, A User Interface Design Methodology.	**CO3**
IV	**Coding And Testing:** Coding, Code Review, Software Documentation, Testing, Unit Testing, Black-Box Testing, White-Box Testing, Debugging, IntegrationTesting, System Testing.	**CO1, CO4**
V	**Software Reliability And Quality Management:** Software Reliability, Statistical Testing, Software Quality, Software Quality Management System. **Software Maintenance:** Software maintenance, Maintenance Process Models, Maintenance Cost. **Software Reuse**: what can be reused? Why almost No Reuse So Far?Basic Issues in Reuse Approach.	**CO1, CO4**

Learning Resources
Text Books
1. Software Engineering-A Practitioner's Approach, RogerS.Pressman, Seventh Edition McGraw Hill International Edition. 2. Fundamentals of Software Engineering, Rajib Mall, Third Edition,PHI.
Reference Books
1. Software Engineering: A Primer,Waman SJawadekar,TataMc Graw-Hill,2008 2. Software Engineering, A Precise Approach, Pankaj Jalote,Wiley India,2010. 3. Software Engineering, Principles and Practices, DeepakJain, Oxford University Press.
E- Resources & other digital material
1.https://nptel.ac.in/courses/106101061/

CIRCUIT ANALYSIS

Course Code	20EC5601	**Year**	III	**Semester(s)**	II
Course Category	Minor in ECE	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand active and passive elements used in electrical networks (L2)
CO2	**Solve** problems on networks by applying different network analysis techniques (L3)
CO3	**Analyze** networks using methods like mesh analysis, nodal analysis and network theorems to **make inferences/ find evidence** to support solutions/ conclusions (L4)
CO4	**Inspect** the given circuit and situation to find the bandwidth, selectivity and quality factor of a series and parallel resonant circuits (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Electrical Circuits:** Basic Concepts of active and passive elements and their V-I relations, Ohm's Law, Sources (dependent and independent), Kirchhoff's laws– Resistors in series and parallel circuits– Mesh current and node voltage method of analysis for D.C circuits.	CO1- CO3
II	**Network Reduction and Network Theorems for DC Circuits:** Network reduction techniques (series, parallel, series - parallel, star-to- delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis, Super node and Super mesh analysis, Thevenin's and Norton's theorems – Superposition theorem–Maximum power transfer theorem–Reciprocity Theorem.	CO1-CO3
III	**Sinusoidal Steady-State Analysis:** Periodic waveforms (determination of RMS, average value, peak factor and form factor), concept of phase angle, phase difference – waveforms and phasor diagrams, rectangular and polar formsof representations, power factor, real, reactive and apparent power.	CO1- CO3

IV	**Resonance and Coupled circuits:** Series and parallel resonance, the frequency response–Quality factor and Bandwidth	CO1-CO4
V	**Two port Networks Analysis:** Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and their inter relations.	CO1,CO2, CO4

Learning Resources
Text Books
1. W. Hayt and Jack E.Kemmerley -Engineering Circuit Analysis, McGraw HillCompany, 6th Ed**.**. 2. Van Valkenburg - Network Analysis; Prentice-Hall of India Private Ltd.
Reference Books
1. C. K. Alexander and Mathew N.O. Sadiku-Fundamentals of Electrical Circuits, Mc.Graw Hill Education. 2. Carlo, Lin, Linear Circuit Analysis, Oxford publications. 3. M. Nahvi & J.Edminister, Electric Circuits – (Schaum's outlines) 5th Ed., McGraw Hill. 4. David A. Bell, Electric Circuits, Oxford publications.
E- Resources & other digital material
1. 1.https://www.youtube.com/playlist?list=PLC7D3EAEFA0CC0420&app=desktop 2. https://www.tutorialspoint.com/network_theory/network_theory_quick_guide.htm **3.** https://nptel.ac.in/courses/108/105/108105159/

INDUSTRIAL AND MEDICAL IoT

Course Code	20EC5602	**Year**	III	**Semester(s)**	II
Course Category	Minor in IoT	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basics of Industrial IOT and Medical IOT (L2)
CO2	Identify the technical and industrial requirement procedures for IIOT applications (L3)
CO3	Develop various applications using IIOT architectures (L3)
CO4	Choose selected IOT devices for understanding the system architecture of medical IOT (L3)
CO5	Analyze privacy and security measures for industry and medical standard solutions (L4).

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Industrial IoT**: Technical requirements, IoT background-History and definition, IoT enabling factors, IoT applications, IoT key technologies, I-IoT, IoT and I-IoT – similarities and differences, Industry environments and scenarios covered by I-IoT.	CO1, CO2
II	**Understanding the Industrial Process and Devices Technical requirements:** The industrial process-Automation in the industrial process, Control and measurement systems, Types of industrial processes.	CO1, CO2
III	**Industrial Data Flow and Devices** : Technical requirements, The I-IoT data flow in the factory , Measurements and the actuator chain .Sensors , The converters - Digital to analogical , Analog to digital, Actuators, Controllers - Microcontrollers, Embedded microcontrollers , Microcontrollers with external memory, DSP’s. Industrial protocols - Automation networks, The fieldbus, Developing Industrial IoT and	CO1,

	Architecture- Introduction to the I-IoT platform and architectures, OSGi, microservice, containers, and server less computing, The standard I-IoT flow.	CO3
IV	**Internet of Medical Things Introduction and system architecture**: Introduction, IoMT Devices-On-Body Devices, In- Home Devices, Community Devices, In-Clinic Devices, In- Hospital Devices ,IoMT System Architecture-Data Collection Layer, Data Management Layer, Medical Server Layer.	CO1-CO4
V	**Internet of Medical Things Security Threats, Security Challenges and Potential Solutions:** IoMT Attack Types,Challenges in IoMT Security Schemes, Current Security Plans for IoMT, Potential Solutions for Security Vulnerabilities.	CO1-CO5

Learning Resources
Text Books
1. Veneri, Giacomo, and Antonio Capasso- Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1stEd., Packt Publishing Ltd, 2018. 2. D. Jude Hemanth and J. Anitha George A. Tsihrintzis- Internet of Medical Things Remote Healthcare Systems and Applications, covered by Scopus.
Reference Books
1. Alasdair Gilchrist- Industry 4.0: The Industrial Internet of Things, 1st Ed., Apress, 2017. 2. Reis, Catarina I., and Marisa da Silva Maximiano, eds.- Internet of Things and advancedapplication in Healthcare, 1st Ed., IGI Global, 2016.
E- Resources & other digital material
1. https://www.coursera.org/specializations/developing-industrial-iot#courses 2. https://www.coursera.org/learn/industrial-internet-of-things. 3. https://www.coursera.org/learn/internet-of-things-sensing-actuation

MODERN TECHNOLOGY IN AUTOMOBILE ENGINEERING

Course Code	20ME5601	**Year**	III	**Semester(s)**	II
Course Category	Minor in Automobile Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the current technologies in the automobile industry (L2)
CO2	Apply fundamental concepts on digitalizing the engine controlssystem and subsystem arrangements in automobiles. (L3)
CO3	Apply fundamental knowledge of automobile engineering fordesign of Electronic sensor and comfort systems. (L3)
CO4	Analyse state of art technology in automobile field for design ofsafety and security systems. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**Recent Trends:** Common rail direct injection diesel engine, dual fuel and multi fuel engine, free piston engine, gasoline direct injection engine, homogeneous charge compression ignition engine, lean burn engine, stratified charge ignition engine, variable compression ratio engine, Wankel engine.	**CO1**
II	**Digital Engine Control System:** Open loop and closed loop control system; engine cooling and warm-up control; acceleration, deceleration and idle speed control; integrated engine control system; exhaust emission control engineering; on-board diagnostics; future automotive electronic systems.	**CO1, CO2, CO3**
III	**Basic sensor arrangements:** Types of sensors – oxygen sensor, hot wire anemometer sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, crank position sensor. Microprocessor and microcomputer controlled devices in automobiles such as travel information system, keyless entry system, automatic transmission system, electronic steering system.	**CO1, CO2, CO3**

IV	**Warning and alarm instruments :** Brake actuation warning system, traficators, flash system, oil pressure warning system, engine over heat warning system, air pressure warning system, speed warning system, door lock indicators, neutral gear indicator, horn design, permanent magnet horn, air & music horns. Wind shield wiper. window washer, instrument wiring system and electromagnetic interference suppression, wiring circuits for instruments, electronic instruments, dash board illumination.	**CO1, CO3, CO4**
V	**Safety system:** Antilock braking system, air bag restraint system, voice warning system, seat belt system, road navigation system, anti theft system.	**CO1, CO4**

Learning Resources
Text Books
1. Heinz Heisler, Advanced Engine Technology, SAE International Publications, USA, 1998. 2. A.W. Judge, Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992. 3. William B. Ribbens -Understanding Automotive Electronics, 5th edition- Butter worthHeinemann, 1998 4. A.P. Young, &L.Griffiths, Automobile Electrical Equipment, English Language Book Society& New Press, 1990.
Reference Books
1. W.H.Crouse, Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980. 2. Robert N Brady, Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle WoodCliffs, New Jersey, 1988. 3. P L. Kohli, Automotive Electrical Equipment, Tata McGraw Hill Publishing Co., Delhi, 2004
E- Resources & other digital material
1.https://nptel.ac.in/courses/107/106/107106088/ 2.https://nptel.ac.in/courses/107/103/107103084/ 3.https://www.avnet.com/wps/portal/apac/resources/article/automotive-electronics-top-5-tech-trends-tomorrows-smart-cars/

DESIGN FOR ADDITIVE MANUFACTURING

Course Code	20ME5602	Year	III	Semester(s)	II
Course Category	Minor in Digital Manufacturing	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	3-1-0	Prerequisites	Basic Manufacturing Processes
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Illustrate the need of design for additive manufacturing andrepresent synthetic curves and surfaces using mathematical models. (L2)
CO2	Apply design for additive manufacturing guidelines indesigning of mass customized products. (L2)
CO3	Discuss design for minimal material, functionality latticestructures using topology optimization. (L2)
CO4	Identify methods of powder handling and standardsrelated to Additive Manufacturing. (L2)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Introduction to Design for Additive Manufacturing (DfAM):** Introduction to geometric modelling, Modelling of Synthetic curves like Hermite, Bezier and B-spline, Parametric Representation of freeform surfaces, Design freedom with AM, Need for Design for Additive Manufacturing (DfAM), CAD tools vs. DfAM tools, Requirements of DfAM methods, General Guidelines for DfAM, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post-processing.	**CO1**
II	**Design Guidelines for Part Consolidation:** Design for Function, Material Considerations, Number of Fasteners, Knowledge of Conventional DFM/DFA, Assembly Considerations, Moving Parts, Part redesign, Opportunities for part consolidation, challenges with part consolidation.	**CO2**

III	**Design for Improved Functionality:** Multi scale design for Additive manufacturing, Mass customization, Biomimetics, Generative design, Design of multi-materials and functionally graded materials	**CO3**
IV	**Design for Minimal Material Usage:** Topology Optimization, Modelling of Design space, defining design and manufacturing constraints, performing analysis for weight reduction, maximize stiffness, minimize displacement, Post-processing and Interpreting Results, Applications of Topology Optimization, Topology Optimization Tools, Design of cellular and lattice structures, Design of support structures.	**CO3**
V	**Other AM Considerations:** Designer Machine Operator Cooperation, Health and Safety, Material Exposure, Gas Monitoring, Gas Exhaust, Material Handling, Risk of Explosion, AM Part Standardization and Certification.	**CO1, CO4**

Learning Resources
Text Books
1. A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf, Axel Nordin, andDamien Motte, Springer, 2020. 2. The 3D Printing Handbook: Technologies, Design and Applications, Redwood, Ben, FilemonSchoffer, and Brian Garret, 3D Hubs, 2017.
Reference Books
1. Design for Advanced Manufacturing: Technologies and Process, Laroux K, Gillespie,McGrawHill, 2017. 2. Additive Manufacturing Technologies, Gibson, Ian, David W. Rosen, Brent Stucker, andMahyar Khorasani, Springer, 2021.
E- Resources & other digital material
1.https://courses.gen3d.com/courses/enrolled/988400 2.https://markforged.com/resources/blog/design-for-additive-manufacturing-dfam

BASIC MECHANICS OF FLUIDS

Course Code	20CE5601A	Year	III	Semester(s)	II
Course Category	Minor in Civil Engineering	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	3-1-0	Prerequisites	20BS1101- Calculus and Linear Algebra 20BS1201- Differential Equations and Vector Calculus 20BS1104- Applied Physics
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand, analyze** and **apply** various fluid properties to solve the fluid problems and usevarious devices for measuring fluid pressure. (L4)
CO2	**Apply** hydrostatic law to find hydrostatic force on various submerged planes and use of law ofconservation mass to fluid flow. (L3)
CO3	**Apply** the concept of boundary layer theory to determine lift and drag forces on a submergedbody. (L3)
CO4	**Apply** appropriate flow equations and principles to **analyse** pipe flow problems. (L4)
CO5	**Apply** Bernoulli's equation to fluid flow problems and use of different fluid flow measuringdevices. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**INTRODUCTION:** Dimensions and units – Physical properties of fluids specific gravity, viscosity, surface tension, vapour pressure and their influences on fluid motion. Pressure at a point-Pascal's law, Hydrostatic law, Pressure and its Measurement: Atmospheric, gauge and vacuum pressure- measurement of pressure. Pressure gauges, Manometers: differential manometers.	**CO1**

II	**HYDROSTATIC FORCES:** Hydrostatic forces on submerged, horizontal, vertical and inclined surfaces, Total pressure and centre of pressure derivations and problems. **FLUID KINEMATICS-** Description of fluid**,** stream line, path line and streak lines and stream tube. Classification of flows- steady, unsteady, uniform non-uniform, laminar, turbulent, rotational, irrotational flows, Equation of continuity for one, three dimensional flows.	**CO1,CO2**
III	**FLUID DYNAMICS:** Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line for 3-D flow, Momentum equation and its application – forces on pipe bend. Boundary layer – concept, characteristics of boundary layer along a thin flat plate, Separation of boundary layer, Flow around submerged objects- drag and lift**.**	**CO1,CO3**
IV	**LAMINAR FLOW:** Reynold's experiment- Characteristics of laminar and turbulent flows. Flow between fixed parallel plates, Flow through horizontal pipes. **FLOW THROUGH PIPES –** Laws of fluid friction – Darcy's equation, minor losses Pipes in series- pipes in parallel-equivalent pipe, total energy line andhydraulic gradient line**.**	**CO1,CO4**
V	**MEASUREMENT OF FLOW:** Pitot tube, Venturi meter and orifice meter. Classification of orifices, Flow over rectangular, triangular, trapezoidal notch, Broad crested weirs	**CO5**

Learning Resources

Text Books

1. P.N. Modi and S.M. Seth, Fluid Mechanics (18th edition) Standard Book House,2017.
2. A.K. Jain, Fluid Mechanics, Khanna publishers,2010

Reference Books

1. L. Victor, Streeter and E. Benjamin Wylie, Fluid Mechanics, Tata McGrawHill,1985.
2. M. Franck White, Fluid Mechanics, Tata McGraw Hill,2017.
3. K. Subramanya, Theory and Applications of Fluid Mechanics, Tata McGrawHill,2001.
4. A text book of Fluid Mechanics and Hydraulic Machines by R. K. Rajput, S.chand Technical publishers

E- Resources & other digital material

1. Fluid Mechanics virtual labs. http://eerc03-iiith.vlabs.ac.in/
2. https://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/fluid_mechanics/index.htm
3. https://nptel.ac.in/courses/105105119.

IV B.TECH I SEMESTER SYLLABUS

IV B.Tech., I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE4701	Professional Elective-III	3	3	0	0	30	70	100
20EE4702	Professional Elective-IV	3	3	0	0	30	70	100
20EE4703	Professional Elective -V	3	3	0	0	30	70	100
20HS7701	Humanities and Social Sciences Elective	3	3	0	0	30	70	100
	Open Elective -III	3	3	0	0	30	70	100
	Open Elective- IV	3	3	0	0	30	70	100
20SA8752	IOT Applications to Electrical Engineering	2	1	0	2	-	50	50
20EE3781B/C	Industrial/Research Internship	1.5	0	0	0	-	-	-
Total		**23**	**19**	**0**	**2**			

L - Lecture T - Tutorial P – Practical

Professional Elective-III								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4701A	Power System Operation and control	3	3	0	0	30	70	100
20EE4701B	Energy Conservation and Audit	3	3	0	0	30	70	100
20EE4701C	Power Quality	3	3	0	0	30	70	100
20EE4701D	VLSI Design	3	3	0	0	30	70	100
20EE4701E	Operating Systems	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Professional Elective-IV								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4702A	Real Time Control of Power Systems	3	3	0	0	30	70	100
20EE4702B	Electrical Vehicles	3	3	0	0	30	70	100
20EE4702C	Digital Control Systems	3	3	0	0	30	70	100
20EE4702D	Embedded Systems	3	3	0	0	30	70	100
20EE4702E	Database Management Systems	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Professional Elective-V								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20EE4703A	Smart Grid Technologies	3	3	0	0	30	70	100
20EE4703B	AI Techniques in Electrical Engineering	3	3	0	0	30	70	100
20EE4703C	HVDC and FACTS	3	3	0	0	30	70	100
20EE4703D	Switched Mode Power Conversion	3	3	0	0	30	70	100
20EE4703E	Machine Learning	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HUMANITIES AND SOCIAL SCIENCES ELECTIVE COURSES								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20HS7701A	Managerial Economics and Financial Accountancy	3	3	0	0	30	70	100
20HS7701B	Human Resource Management	3	3	0	0	30	70	100
20HS7701C	Entrepreneurship Management	3	3	0	0	30	70	100
20HS7701D	Organizational Behavior	3	3	0	0	30	70	100
20HS7701E	Construction Management	3	3	0	0	30	70	100
20HS7701F	Industrial Engineering Management	3	3	0	0	30	70	100
20HS7701G	Project Management	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Open Elective -III								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2701A	Disaster Management and Preparedness	3	3	0	0	30	70	100
20EC2701B	Embedded and Real time Systems	3	3	0	0	30	70	100
20EC2701C	Research Methodology	3	3	0	0	30	70	100
20EC2701B	E-Waste Management	3	3	0	0	30	70	100
20IT2701A	Fundamentals of Data Science	3	3	0	0	30	70	100
20ME2701A	Operations Research	3	3	0	0	30	70	100
20ME2701B	Management Information Systems	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

Open Elective -IV								
Course Code	**Title**	**Credits**	**L**	**T**	**P**	**Continuous Internal Evaluation**	**End Semester Examination**	**Total Marks**
20CE2702A	Environmental Management & Audit	3	3	0	0	30	70	100
20CS2702A	Data Base Management Systems	3	3	0	0	30	70	100
20EC2702A	Telecommunications	3	3	0	0	30	70	100
20EC2702B	Satellite Communications	3	3	0	0	30	70	100
20IT2702A	Fundamentals of Artificial Intelligence	3	3	0	0	30	70	100
20ME2702A	Mechatronics	3	3	0	0	30	70	100
20ME2702B	Robotics	3	3	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

HONORS -IV								
Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20EE6701A	Advanced Electrical Drives	4	3	1	0	30	70	100
20EE6701B	Grid Integration of Renewable Energy Systems	4	3	1	0	30	70	100
20EE6701C	Special Electrical Machines	4	3	1	0	30	70	100
20EE6701D	Semiconductor Device Modeling	4	3	1	0	30	70	100

L - Lecture T - Tutorial P – Practical

MINOR COURSES

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks	Minor in
20CS5701	Cloud Computing	4	4	0	0	30	70	100	CSE
20IT5701	Cloud Computing	4	4	0	0	30	70	100	IT
20EC5701	Communication Systems	4	3	1	0	30	70	100	ECE
20EC5702	IOT Networks	4	3	1	0	30	70	100	IoT
20ME5701	Alternate Fuels and Emission control in Automotive	4	3	1	0	30	70	100	Automobile Engineering
20ME5702	INDUSTRY 4.0 and IIoT	4	3	1	0	30	70	100	Digital Manufacturing
20CE5701A	Basic Surveying	4	3	1	0	30	70	100	Civil

L - Lecture T - Tutorial P – Practical

POWER SYSTEM OPERATION AND CONTROL

Course Code	20EE4701A	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-III	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	PSA
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of economic load dispatch, hydrothermal scheduling, load frequency control, power factor improvement and voltage control (L2).
CO2	**Demonstrate** the different types of hydrothermal scheduling, economic operation of power systems and load frequency control. (L3)
CO3	**Illustrate** the concepts of power factor improvement and voltage control in power systems. (L3)
CO4	**Analyze** the optimal operation of hydro and thermal power plants**,** single area and two area systems. (L4)
CO5	**Analyze** the most economical power factor for constant kW& kVA loads, and various voltage control devices. (L4)
CO6	**Learn** various power system operation concepts and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					2							3	2
CO3	2							2				2	3	2
CO4		3				1							3	2
CO5		2						1				1	3	2
CO6	3	3							3	3			3	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Economic Operation of Power Systems:** Economic dispatch in Thermal Power Station, - Heat rate Curve - Cost Curve - Incremental fuel Cost and Incremental Production costs, Input-output characteristics, Optimum operation of thermal units without and with transmission losses Numerical problems - Loss Coefficients, General transmission line loss formula (Descriptive treatment only).	**CO 1** **CO 2** **CO 4** **CO 6**

II	**Hydrothermal Scheduling:** Optimal scheduling of hydrothermal system, hydroelectric power plant models, types of scheduling problems, Mathematical formulation and solution Technique of hydrothermal scheduling problem using gradient method.	**CO 1** **CO 2** **CO 4** **CO 6**
III	**Single area load frequency control:** Necessity of keeping frequency constant, concept of control area, Block diagram representation of an isolated power system, Steady state analysis , Dynamic response , Proportional plus Integral control of single area and its block diagram representation.	**CO 1** **CO 2** **CO 4** **CO 6**
I V	**Two area load frequency control**: Development of block diagram of a two area system and its Static and dynamic responses, Tie-line bias control, comparison of load frequency control and Economic dispatch control.	**CO 1** **CO 2** **CO 4** **CO 6**
V	**Power factor and Voltage Control:** Causes of low p.f, methods of improving p.f, static capacitor, synchronous condensers and phase advancers, most economical p.f. for constant kW load and constant kVA type loads. Importance of voltage control, shunt capacitors, series capacitors and their location in the power system.	**CO 1** **CO 3** **CO 5** **CO 6**

Learning Resources
Text Books
1. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", Tata McGraw Hill Publishing Company Ltd, 4th edition, 2011. 2. AbhijitChakrabarti, SunitaHalder, "Power System Analysis: Operation and Control", Prentice Hall of India3rd edition, 2010.
Reference Books
1. O.I.Elgerd, "Electric Energy systems Theory", Tata McGraw-hill Publishing Company Ltd., 2nd edition,2004. 2. Allen J.Wood and bruceF.Wollenberg, "Power generation, operation and control", 2nd edition. 3. John Grainger and William Stevenson, "Power System Analysis", Tata McGraw Hill, 2017. 4. HadiSaadat, "Power System Analysis", McGraw Hill, 2004.
Web Links 1. https://nptel.ac.in/courses/108102047

ENERGY CONSERVATION AND AUDIT

Course Code	20EE4701B	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective III	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of energy conservation and audit. **(L2)**
CO2	**Apply** the knowledge of energy scenario. **(L3)**
CO3	**Analyze** the theory of energy management and audit. **(L4)**
CO4	**Apply** the concepts of energy efficiency in electrical and industrial Systems. **(L3)**
CO5	**Examine** the different energy efficient technologies in electrical system.**(L4)**
CO6	**Show** the ability to apply the various energy conservation and audit concepts and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													3	3
CO2	2						2						3	3
CO3		2				2							3	3
CO4	3												3	3
CO5		3											3	3
CO6									3	3		3	3	3

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Energy Scenario** Renewable and non-renewable energy, Indian energy scenario, integrated energy policy, energy intensity on purchasing power parity, Energy sector reforms, energy and environment, energy security, energy conservation and its importance, Energy Conservation Act-2001 and its features.	**CO1** **CO2** **CO6**
II	**Energy Management & Audit** Definition, energy audit, need, types of energy audit and approach, understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies,	**CO1** **CO3** **CO6**

	optimizing the input energy requirements, fuel & energy substitution, energy audit instruments	
III	**Energy Efficiency in Electrical Systems** Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement benefits, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.	**CO1** **CO4** **CO6**
IV	**Energy Efficiency in Industrial Systems** Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.	**CO1** **CO4** **CO6**
V	**Energy Efficient Technologies in Electrical Systems** Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.	**CO1** **CO5** **CO6**

Learning Resources

Text Books

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

Reference Books

1. W.R. Murphy &G. Mckey Butterworths, ”Energy Management”, New Age International Publishers, 2007
2. Amit kumar Tyagi, Hand book on Energy Audit and Management, TERI (Tata Energy Research Institute).
3. Rakosh Das Begamudre, Energy conversion systems, New Age International Publishers 10th Edition,2000

Web Links

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

POWER QUALITY

Course Code	20EE4701C	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-III	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Electrical Power Generation, Transmission & Distribution
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Outline** definitions of common power quality phenomena. (L2)
CO2	**Identify** different **PQ** phenomena causes and effects (L3)
CO3	**Apply** mitigation techniques to solve power quality problems (L3**)**
CO4	**Analyze** the measured data for PQ monitoring (L4)
CO5	**Investigate** various power quality problems and submit a report

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Power Quality-an Overview:** Power Quality definition, the power quality evaluation procedure, and General classes of power quality problems: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variations.	**CO1 CO2 CO4 CO5**
II	**Voltage sags and Interruptions:** Sources of sags and Interruptions, Estimating Voltage sag performance-Area of vulnerability, equipment sensitivity to voltage sags, transmission system sag performance evaluation, and utility distribution system sag performance Evaluation	**CO1 CO2 CO4 CO5**

III	**Fundamental Principles of Protection:** Fundamental principles of protection, solutions at the end user level, Ferro-resonant transformers, magnetic synthesizers, standby UPS, hybrid UPS and superconducting magnetic energy storage (SMES) devices	**CO1 CO3 CO4 CO5**
IV	**Fundamentals of Harmonics:** Harmonic distortion, voltage versus current distortion, harmonics versus transients, power system quantities under non-sinusoidal conditions, harmonic indexes, harmonic sources from commercial loads, harmonic sources from industrial loads. Devices for controlling harmonics	**CO1 CO2 CO3 CO4 CO5**
V	**Distributed Generation and Power Quality Monitoring:** Resurgence of DG, DG Technologies, Interface to the Utility System, Power Quality issues, operating conflicts. Monitoring Consideration Power quality measurement Equipment	**CO1 CO2 CO4 CO5**

Learning Resources
Text Books
1. R.C.Dugan, MF.Mc.Granaghan, S.Santoso and HW. Beaty, “Electrical Power Systems Quality”, McGraw Hill, Third edition, 2004. 2. Sankaran. C, “Power Quality”, CRC Press, 1st Edition, 2017.
Reference Books
1. M.H.J.Bollen, “Understanding Power Quality Problems- Voltage sag and Interruptions”, IEEE Press, 2001.
e-Resources
1. https://nptel.ac.in/courses/108107157

VLSI DESIGN

Course Code	20EE4701D	**Year**	IV	**Semester**	I
Course Category	Professional Elective-III	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	D&AC
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand MOS transistor fabrication, design and testing processes. (L2)
CO2	Choose an appropriate knowledge on the Properties and testing processes of MOS Technologies. (L3)
CO3	Develop the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit. (L3).
CO4	Illustrate the Electrical Properties, testing processes of MOS and BiCMOS Circuits. (L4).
CO5	Analyze the different design process to build a circuit. (L4)
CO6	Ability to do various applications in VLSI circuits and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3							1					2	1
CO3	3		1		1								2	1
CO4		3					1					1	2	1
CO5		3				1							2	1
CO6									3	3	1			

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	Introduction to MOS Technology: Integrated Circuit (IC) Era, Metal-Oxide semiconductor (MOS) and related VLSI technology, basic MOS transistors, NMOS & CMOS fabrication, comparison of NMOS, CMOS, BICMOS, technologies. Electrical Properties of MOS circuits: Drain current vs Drain Source voltage relationships, MOS transistor threshold voltage, figure of merit-ω_0 ,Transconductance-g_m, g_{ds}, pass transistor, NMOS inverter, CMOS inverter	CO1,CO2 CO4 & CO6
II	**VLSI Circuit Design Processes:** MOS Layers, Stick Diagrams, Design Rules and Layout- Lambda(λ)-based design rules, contacts and Transistors Layout Diagrams, 2µm micron-based design rules.	CO1,CO3, CO5&CO6

III	**Gate level Design:** CMOS Logic gates and other complex gates, Some architectural issues, Switch Logic, Gate Logic**,** Time Delays, Driving large Capacitive Loads, Wiring Capacitances, Choice of layers.	CO1,CO3 CO5 &CO6
IV	**VLSI Design styles:** VLSI Design Flow, Implementation approach in VLSI design -Full-custom, Semicustom, Gate-arrays, FPGAs and CPLDs architecture, Standard Cell.	CO1,CO3, CO5&CO6
V	**CMOS Testing:** CMOS Testing, Need for Testing, Test Principles, Design Strategies for Test, Chip Level and Board Level Test Techniques.	CO1,CO2 CO4 & CO6

Learning Resources

Text Books:

1. Douglas A, Pucknell, Kamran Eshraghian "Essentials of VLSI circuits and systems", PHI,1st Edition ,2005
2. Neil H. E Weste, David Harris, "CMOS VLSI Design – A Circuits and Systems Perspective", Pearson ,3rd Edition, 2009.

Reference Books:

1. John .P. Uyemura,"CMOS logic circuit Design" - Springer, 2007.
2. Wayne Wolf "Modern VLSI Design System-on-Chip Design", Pearson Education, 3rd Edition, 1997.
3. K. Lal Kishore "VLSI Design",IK international publishing house.,2013

E-Resources:

1. https://nptel.ac.in/courses/108/107/108107129/
2. http://swarm.cs.pub.ro/~mbarbulescu/SMPA/CMOS-VLSI-design.pdf

OPERATING SYSTEMS

Course Code	20EE4701E	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-III	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Data structures, Computer Organization and Architecture
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the structure and functionalities of operating systems (L2)
CO2	Apply different algorithms of CPU scheduling, Page replacement and diskscheduling (L3)
CO3	Apply various concepts to solve problems related to process synchronization and deadlocks. (L3)
CO4	Analyze and interpret the functionalities of operating system. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Overview: Introduction**: What Operating Systems Do, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations **Operating System Structures:** Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls.	**CO1, CO2, CO3**
II	**Process Management:** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication. **Threads:** Overview, Multi-core Programming, Multithreading Models.	**CO1,**

	Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms (First-Come, First-Served Scheduling, Shortest-Job-First Scheduling, Priority Scheduling, Round-Robin Scheduling.)	**CO2, CO4**
III	**Process Synchronization:** Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors. **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	**CO1, CO3, CO4**
I V	**Memory Management:** **Main Memory:** Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table **Virtual Memory:** Background, Demand Paging, Copy-on-Write, Page Replacement, Basic Page Replacement, FIFO Page Replacement, Optimal Page Replacement, LRU Page Replacement, LRU-Approximation Page Replacement, Allocation of Frames, Thrashing.	**CO1, CO2, CO4**
V	**Storage Management:** **File–System Interface:** File Concept, Access Methods, Directoryand Disk Structure. **File–System Implementation:** File-System Structure, File- System Implementation, Directory Implementation, Allocation Methods. **Mass-Storage Structure**: Overview of Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, FCFS Scheduling, SSTF Scheduling, SCAN Scheduling, C-SCAN Scheduling, LOOK Scheduling, Selection of a Disk-Scheduling Algorithm.	**CO1, CO2, CO4**

Learning Resources
Text Books
4. Abraham Silberchatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, Wiley India, Ninth Edition, 2016,.
Reference Books
1. William Stallings , Operating Systems - Internal and Design Principles, Pearson, Ninth Edition, 2018. 2. Harvey M.Deitel, Paul J Deitel and David R.Choffnes, Operating Systems -, Pearson, Third Edition,2019. 3. D.M. Dhamdhere, Operating Systems - A Concept based Approach-, McGraw Hill, Second Edition, 2010,.
Web Links 1. https://onlinecourses.nptel.ac.in/noc19_cs50/ 2. http://www.youtube.com/watch?v=MaA0vFKtew&list=PL88oxI15Wi4Kw1aEY2bC5l_4pouojjtd4

REAL TIME CONTROL OF POWER SYSTEMS

Course Code	20EE4702A	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-IV	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	PSA
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the various concepts and applications in real time control of power systems. (L2)
CO2	**Apply** the knowledge of power systems in real time computer control. (L3)
CO3	**Develop** voltage stability analysis and application of ANN, PMU techniques in real time control of power systems. (L3)
CO4	**Analyze** the various real time functions in power systems. (L4)
CO5	**Learn** various real time functions of power system and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**State Estimation:** Introduction, need of state estimation, block diagram of state estimation, static state estimations - theory of Least Square Estimation and Weighted Least Square Estimation methods for linear and nonlinear measurements, applications of state estimation.	**CO 1** **CO 2** **CO 4** **CO 6**
II	**Bad Data Processing:** Bad data observability, pseudo measurements, treatment of bad data, bad data detection using chi-square test, bad data identification and suppression of bad data.	**CO 1** **CO 2** **CO 4** **CO 6**
III	**Computer Control of Power Systems:** Need for real time and computer control of power systems, operating states of a power system, Energy Control Centers, functions of ECC, hierarchical level of Energy Control Centers.	**CO 1** **CO 2** **CO 4**

	Supervisory control and Data Acquisition system - functions, functional block diagram, software and hardware components, applications of SCADA.	**CO 6**
IV	**Voltage Stability:** Concept of voltage stability, voltage instability, voltage collapse and voltage security, factors affecting voltage stability, measures to improve voltage stability, relation between voltage stability to rotor angle stability, voltage stability analysis using 'P-V'curves and 'Q-V' curves.	**CO 1** **CO 3** **CO 4** **CO 6**
V	**Application of ANN in Power System:** Basic concepts and definitions, algorithms for state estimation, short term load forecasting. Concept of PMU-Block diagram of PMU-Applications of PMU in power systems.	**CO 1** **CO 3** **CO 4** **CO 6**

Learning Resources

Text Books

1. Abhijit Chakrabarti, Sunita Halder, "Power System Analysis: Operation and Control", PHI publications, 2008.
2. Carson.W.Taylor, "Power systems voltage stability", McGraw-Hill, 1994.

Reference Books

1. John Grainger and William Stevenson, "Power System Analysis", Tata McGraw Hill, 2017.
2. Hadi Saadat, "Power System Analysis", McGraw Hill, 2004.
3. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", Tata McGraw Hill Publishing Company Ltd, 4th edition, 2011.

Web Links

1. https://nptel.ac.in/courses/108106022

ELECTRICAL VEHICLES

Course Code	20EE4702B	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-IV	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basic Electrical and Electronics Engineering
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Define** the concepts of electric vehicle, hybrid vehicle, fuel cell vehicle and energy storage. (L1)
CO2	**Classify** performance of electric vehicle, hybrid vehicle, fuel cell vehicle and energy storage. (L4)
CO3	**Develop** the basic schemes of electric vehicle, hybrid vehicle, fuel cell vehicle and battery technology of Electric vehicles. (L3)
CO4	**Identify** various drive system and technologies used in the vehicles. (L3)
CO5	**Submit a report** in electric and hybrid vehicle, propulsion system, energy storage systems, energy management for Electric vehicle applications**.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Introduction to Electric Vehicles:** History of Electric and Hybrid Vehicles, Environmental Impact. **Vehicle Fundamentals:** Vehicle resistance, Dynamic Equation, Vehicle Performance, Braking Performance.	**CO1, CO3, CO5**
II	**Configuration and Performance of Electric Vehicles:** Configurations of Electric Vehicles, Performance of Electric Vehicles, Traction Motor Characteristics, Tractive Effort, Concept and Architectures of Hybrid Electric Drive Trains.	**CO2, CO3, CO4, CO5**

III	**Hybrid Electric Vehicles:** Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains.	**CO2, CO3, CO4, CO5**
IV	**Fuel Cell Vehicles:** Operating Principles of Fuel Cells, Electrode Potential and Current–Voltage Curve, Fuel and Oxidant Consumption, Fuel Cell System Characteristics, Fuel Cell Technologies, Fuel Supply.	**CO2, CO3, CO4, CO5**
V	**Energy Storage:** Electrochemical Batteries: Electrochemical Reactions, Thermodynamic Voltage, Specific Energy, Specific Power, Energy Efficiency, Battery Technologies. Ultra capacitors: Features of Ultra capacitors, Basic Principles of Ultra capacitors, Performance of Ultra capacitors, Ultra capacitor Technologies, Ultrahigh-Speed Flywheels, Hybridization of Energy Storages.	**CO1, CO2, CO3, CO4, CO5**

Learning Resources
Text Books
1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electrical and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004. 2. Iqbal Hussein, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press, 2003.
Reference Books
1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
e- Resources & other digital material
1. https://www.sciencedirect.com/topics/social-sciences/hybrid-electric-vehicle

DIGITAL CONTROL SYSTEMS

Course Code	20EE4702C	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-IV	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Signals and Systems & Control Systems
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the fundamentals of digital control systems, sampling theorem (L2)
CO2	**Apply** the basic knowledge of Z-transforms and assess the state of the digital control systems (L3)
CO3	**Apply** various stability tools to check the performance and design of state feedback control systems (L3)
CO4	**Analyze** various state space modeling techniques in digital control systems (L4)
CO5	**Examine** the stability of discrete-time control systems and state feedback controllers via pole placement in z-plane (L4)
CO6	**Ability** to do various problems in Digital control systems and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3												2	1
CO3	3		3	2									2	1
CO4		3											2	1
CO5		3		2									2	1
CO6									3	2		3	2	1

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**Discrete Representation of Continuous Systems:** Basics of Digital Control Systems, Discrete representation of continuous systems, advantages and disadvantages, examples, Impulse sampling and data hold – transfer function of Zero order hold, sampling theorem	CO1, CO2 CO6

II	**The Z-transform:** Z transforms of some elementary functions, important **theorems** of the Z-transform, inverse Z-transform using partial fraction expansion method (simple poles and atleast one zero case), z-transform method for solving difference equations, the pulse transfer function.	CO1, CO2 CO4 & CO6
III	**State space analysis:** Concept of the state space method, State space representations of discrete time systems, solving discrete time state space equations-Homogeneous case (z-transform approach), Controllability, Observability (Kalman's Test), principle of duality	CO1, CO2 CO4 &CO6
IV	**Stability analysis**: Mapping between the s-plane and the z-plane-primary, complementary strips and constant attenuation lines mapping, Stability Analysis of closed loop systems in the Z-plane, the Jury stability test, Stability analysis using bilinear transformation,	CO1, CO3, CO5& CO6
V	**State Feedback Controllers & Observers:** Design via pole placement, necessary and sufficient condition (Ackerman's formula), State observers – necessary and sufficient condition for state observation, full order state observer (Ackerman's formula)	CO1, CO3, CO5& CO6

Learning Resources

Text Books

1. K.OGATA ,Discrete-time Control Systems, prentice hall international, 2nd edition, 2015.
2. B.C.KUO , Digital Control Systems, Oxford University Press, 2nd edition, 2007.

Reference Books

1. M.Gopal ,Digital Control Engineering, New Age International, 2nd edition,2014.
2. V.L.GEORGE, C.P.KURIAN, Digital Control systems, Cengage Learning, 2nd edition,1998.

Web Links

1. https://nptel.ac.in/courses/108103008

EMBEDDED SYSTEMS

Course Code	20EE4702D	**Year**	IV	**Semester**	I
Course Category	Professional Elective -IV	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	MP&MC
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Discuss** the methodologies of embedded systems (L2)
CO2	**Assess** the basic knowledge on building blocks, development Tools for the application in embedded systems. (L3)
CO3	**Examine** the basics of real time operating system, processor scheduling algorithms, different phases and modeling of embedded system. (L3)
CO4	**Identify** the buses and software tools required to build embedded systems. (L4)
CO5	**Determine** the operating system, scheduling algorithms, different phases involved in developing the embedded system applications. (L4)
CO6	**Ability** to do various applications in embedded systems and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3		1										2	1
CO3	3					1		1					2	1
CO4		3		1	1		1					1	2	1
CO5		3					1						2	1
CO6									3	3	1			

Syllabus

Unit No.	Contents	Mapped CO
I	Introduction to Embedded Systems: Embedded systems vs general computing systems, history of embedded systems, classification of embedded systems, major application of embedded systems, purpose of embedded systems, elements of an embedded systems, core of the embedded systems, memory.	CO1 CO2 CO4 CO6
II	Communication Buses in Embedded Systems: On board communication interfaces: I2C, SPI bus,1 Wire bus, parallel interface, External Communication interfaces:RS232, RS485, USB, IEEE 1394 firewire bus, Bluetooth, Wi-Fi, Zigbee, GPRS, GSM.	CO1 CO2 CO4 CO6

III	**Embedded system Development Tools:** Software Development environment-IDE,Types of files generated on cross-compilation, Disssembler/Decompiler, simulators, emulators, debugger, target hardware debugging, hardware-software co-design	CO1 CO2 CO4 CO6
IV	**Introduction to Real-Time Operating Systems:** A brief history of operating systems, defining an RTOS, the scheduler, introduction to task, task states and scheduling, round-robin scheduling algorithm, co-operative scheduling algorithm, pre-emptive scheduling algorithm, Introduction to semaphores.	CO1 CO3 CO5 CO6
V	**Embedded system application development:** Objectives, different phases and modeling of the embedded product development life cycle (EDLC), case studies on smart card, adaptive cruise control in a car, mobile phone software for key inputs.	CO1 CO3 CO5 CO6

Learning Resources
Text Books:
1. Shibu.K.V, "Introduction to Embedded Systems", Tata McGraw Hill, 2nd Edition,2017 2. Rajkamal, 'Embedded System-Architecture, Programming, Design', TMH 3rd Edition, 2017.
Reference Books:
1. Peckol, "Embedded system Design", JohnWiley&Sons,2nd Edition, 2019. 2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 1st Edition, 2013.
E-Resources:
1. https://nptel.ac.in/courses/106105159 2. https://nptel.ac.in/courses/108102045

DATABASE MANAGEMENT SYSTEMS

Course Code	20EE4702E	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-IV	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic concepts of database management systems (L2)
CO2	Apply SQL commands to find solutions for a given application (L3)
CO3	Apply ER Modeling to design a database application (L3)
CO4	Apply normalization techniques to improve database design. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Databases:** Characteristics of the Database Approach, Advantages of using the DBMS Approach, A Brief History of Database Applications. **Overview of Database Languages and Architectures:** Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Database System environment, Centralized and Client-Server Architecture for DBMS.	**CO1**
II	**Relational Model:** The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas. **SQL:** Data Definition, Constraints, Basic Queries and Updates, Views(Virtual Tables)in SQL	**CO2**
III	**Conceptual Data Modeling:** High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types.	**CO3**

	ER-Diagrams: Refining the ER Design, ER Diagrams, Naming Conventions andDesign Issues	
IV	**Database Design Theory**: Functional Dependencies, Normal forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form.	**CO4**
V	**Transaction Processing**: Introduction, Transaction and System Concepts, Desirable Properties of Transactions. **Introduction to Protocols for Concurrency Control in Databases:** Two-Phase Locking Techniques for Concurrency Control - Types of Locks and System Lock Tables.	**CO1**

Learning Resources
Text Books
1. Database Systems Models, Languages, Design and Application Programming, Ramez Elmasri, Shamkant B.Navathe, 6th Edition, Pearson.
References
1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, 3rd Edition, TMH. 2. Data base System Concepts, Abraham Silberschatz, Henry F Korth, S.Sudarshan, 5th Edition, McGraw Hill.
e-Resources and other Digital Material
1. https://nptel.ac.in/courses/106/105/106105175/ 2. https://onlinecourses.nptel.ac.in/noc21_cs04/ 3. https://nptel.ac.in/courses/106/106/106106093/

SMART GRID TECHNOLOGIES

Course Code	20EE4703A	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-V	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	EPGT&D and PSA
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of smart grid technologies. (L2)
CO2	**Apply** the smart grid techniques and smart metering infrastructure to meet the needs of utility(L3)
CO3	**Apply** load flow and contingency methods for smart grid. (L3**)**
CO4	**Apply** the concepts of computational tools for smart grid (L3)
CO5	**Examine** the interoperability and cyber security of smart grid (L4)
CO6	**Create** a frame work for knowledgeable power engineers to operate the grid more effectively and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					3						3	3	3
CO3	3				1							1	3	3
CO4	2		2		1	2						1	3	3
CO5		3		2				2				2	3	3
CO6	3				3				3	3		3	3	3

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Smart Grid:** Smart grid definition, benefits, comparison of traditional grid and smart grid, stakeholders in smart grid development, functions of smart grid components, computation intelligence, comparison between micro grid and smart grid	**CO1 CO2 CO6**
II	**Communication and Measurement:** Introduction, wide area monitoring system, comparison of conventional and smart metering, benefits of smart meters, functional block diagram of a	**CO1 CO2 CO6**

	smart meter architecture, advanced metering infrastructure, GIS technology, MAS technology.	
III	**Performance Analysis Tools For Smart Grid Design:** Challenges to load flow in smart grid , load flow state, contingency studies for the smart grid, steady state contingency analysis, performance indices, sensitivity based approaches.	**CO1 CO3 CO6**
IV	**Computational Tools for Smart Grid:** Introduction to computational tools, decision support tools, optimization techniques, heuristic optimization, evolutionary computational techniques, hybridizing optimization techniques and applications to the smart grid.	**CO1 CO4 CO6**
V	**Interoperability and Cyber Security:** Introduction to interoperability, benefits and challenges of interoperability, model for interoperability in the smart grid environment, smart grid network interoperability, interoperability and control of the power grid, smart grid cyber security, cyber security risks, cyber security concerns associated with AMI, mitigation approach to cyber security risks.	**CO1 CO5 CO6**

Learning Resources
Text Books
1. James Mamoh, "Smart Grid – Fundamentals of design and analysis", John Wiley & sons, inc..Publication First Edition 2012. 2. Janaka Ekanakye, "Smart Grid Technology and Application", John Wiley & sons, inc Publication, First Edition 2012.
Reference Books
1. Jennie C.Stephens," Smart grid - Evolution",Cambridge University Press, First Edition 2015. 2. Andries P. Engelbrecht , "Computational Intelligence - An Introduction", John Wiley & Sons, Ltd, First Edition 2002. 3. Devendra K. Chaturvedi ,"Soft Computing- Techniques and its Applications in Electrical Engineering", Springer 2008.
e-Resources
1. https://nptel.ac.in/courses/108107113

AI TECHNIQUES IN ELECTRICAL ENGINEERING

Course Code	20EE4703B	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-V	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Power System Analysis
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of artificial intelligence techniques. (L2)
CO2	**Categorize** feed forward and feedback neural networks (L4)
CO3	**Analyze** and appreciate the concepts of fuzzy set over classical set theory. (L4)
CO4	**Examine** the concept of genetic algorithm(L4)
CO5	**Apply** ANN, fuzzy logic control and GA to electrical engineering problems (L3)
CO6	**Learn** the computational and mathematical theory, and application of fundamental AI algorithms for electrical engineering problems and **submit the report**.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	2	2	1	2	2						2	2	3	1
CO3	2	2	1	1	1						1	1	3	1
CO4		2	3	2	2						2	2	3	1
CO5	2	2	2	2	1	1	1	1			1	1	3	1
CO6		3	3						3	3		3	3	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Artificial Neural Networks:** Introduction, Biological Neuron and organization of the brain, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Types of Neuron Activation Functions, ANN Architectures, Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzmann learning – Supervised learning – Unsupervised learning – Reinforcement learning.	**CO1, CO2, CO5, CO6**
II	**ANN Paradigms**: Perceptron - Limitations of the Perceptron Model, Back propagation	**CO1, CO2, CO5,**

	Algorithm with example problem – Radial Basis Function Network - Hopfield Network.	**CO6**
III	**Fuzzy Logic:** Introduction to classical sets - properties, Operations and relations, Introduction to Fuzzy sets - Fuzzy versus crisp, Membership function, Basic Fuzzy set operations, Properties of Fuzzy sets, Fuzzy cartesian Product, Defuzzification methods.	**CO1, CO3, CO5, CO6**
IV	**Genetic Algorithms:** Introduction, Fitness Function, Reproduction operators, Genetic operators – Crossover – Single–site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover – Crossover Rate – Inversion & Deletion, Mutation operator –Mutation – Mutation Rate, Generational cycle, convergence of Genetic Algorithm.	**CO1 CO4, CO5, CO6**
V	**Applications of AI Techniques:** Load flow studies, Economic load dispatch, Load frequency control – Single area system and two area system, Small Signal Stability, speed control of DC and AC Motors.	**CO1, CO5, CO6**

Learning Resources
Text Books
1. Rajasekharan and Pai, Neural Networks, Fuzzy logic, Genetic Algorithm - Synthesis and Applications, PHI second edition, 2017 2. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Soft computing techniques", Wiley Publications third edition 2018
Reference Books
1. Jacek M Zurada, Introduction to Artificial Neural Systems Jaico Publishing House, First edition, 1994. 2. K. Deb, Optimization for Engineering Design – Algorithms and Examples, Prentice Hall of India, New Delhi, second edition, 2012. 3. F. Karray and C. De Silva, "Soft Computing and Intelligent Systems Design, Theory, Tools and Applications", Prentice Hall, first edition 2009.
e-Resources
1. https://nptel.ac.in/courses/106105173

HVDC AND FACTS

Course Code	20EE4703C	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective -V	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	EPGT&D and PE
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the importance of FACTS controllers and HVDC in transmission system. **(L2)**
CO2	**Interpret** the concept of AC and DC transmission systems. **(L3)**
CO3	**Identify** the objectives of series and shunt compensation of power systems **(L3)**
CO4	**Analyse** the performance of various compensations by using FACTS controllers. **(L4)**
CO5	**Analyze** converter configurations used in HVDC transmission and evaluate the performance metrics. **(L4)**
CO6	**Ability** to understand the concepts of FACTS controllers, HVDC transmission and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	2						1	1					2	2
CO3	3					1						2	2	2
CO4		2									2		2	2
CO5		3										1	2	2
CO6	3	3							3	3			2	2

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**FACTS Fundamentals:** Introduction to FACTS, Flow of Power in an AC System, Limitations on Loading Capability, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Basic Types of FACTS Controllers, Basic Definitions of FACTS Controllers, Checklist of Possible Benefits from FACTS Technology.	CO1 CO2 CO6
II	**Shunt Compensation:** Objectives of shunt compensation, methods of controllable VAR generation –Thyristor controlled Reactor (TCR), Thyristor Switched	CO1 CO3 CO4

	Capacitor (TSC). Switching Converter Type Var Generators, Basic Operating Principles.	CO6
III	**Series Compensation:** Objectives of series compensation, Concept of Series Capacitive Compensation, Basic operation of Thyristor Switched Series Capacitors (TCSC), Basic operating principle of Static synchronous Series Compensator (SSSC). **Combined Compensators:** Unified power flow controller (UPFC) – Introduction, operating principle. Interline power flow controller (IPFC) – Introduction, operating principle	CO1 CO3 CO4 CO6
IV	**HVDC Transmission:** Introduction, Advantages of HVDC Systems over AC systems. Types of DC links, Layout of HVDC Converter station and various equipments.	CO1 CO2 CO5 CO6
V	**HVDC Converter Operation**: Choice of converter configurations, Analysis of Graetz converter with (u<60) and without overlap, Equivalent circuit representation of rectifier and inverter configurations, Basic operating principle of 12-pulseconverter.	CO1 CO5 CO6

Learning Resources
Text Books
1. Hingorani ,L.Gyugyi, ‘Concepts and Technology of Flexible AC Transmission System’, IEEE Press New York,1st Edition, 2000. 2. Padiyar, K.R., ‘HVDC transmission systems’, Wiley Eastern Ltd., 2nd Edition, 2010.
Reference Books
1. Jos Arrillaga, ‘High voltage Direct Current Transmission’ IET Power and Energy Series 29,2nd Edition,1998 2. Padiyar K.R., ‘FACTS controllers for Transmission and Distribution systems’ New Age International Publishers, 1st Edition, 2007. 3. Song, Y.H. and Allan T. Johns, ‘Flexible AC Transmission Systems (FACTS)’, Institution of Electrical Engineers Press, London,1st Edition, 1999. 4. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho ‘FACTS –Modeling and simulation in Power Networks’ John Wiley & Sons, 1st Edition, 2002.
e-resources: 1. https://nptel.ac.in/courses/108107114 2. https://nptel.ac.in/courses/108104013

SWITCHED MODE POWER CONVERSION

Course Code	20EE4703D	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-V	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Power Electronics
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** Switch Mode Power Conversion and classify the DC to DC Converters. **(L2)**
CO2	**Differentiate** the various Power semiconductor switches. **(L3)**
CO3	**Illustrate** Isolated Power Conversion **(L3)**
CO4	**Analyze** the performance of the Magnetic Components **(L4)**
CO5	**Analyze** the switching regulator control, soft-switched dc-dc power converters **(L4)**
CO6	**Ability** to design the various Switch mode power Converter and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													1	2
CO2	3										3		1	2
CO3	3			3									1	2
CO4		2	2				3						1	2
CO5		2	2	3							3		1	2
CO6									3	3			1	2

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	Introduction To Switch Mode Power Converters About Switch Mode Power Conversion, SMPS requirements. Cuk converters - and their principles of operation; continuous and discontinuous modes of operation.	CO2, CO3 CO6
II	Thyristor Commutation Techniques Review of Recent developments in power devices for switch mode power supplies. Selection of devices, Commutation: Load Commutation, Resonant Pulse Commutation, Complementary Commutation, Impulse Commutation, External Pulse Commutation.	CO2, CO3 CO6
III	Transformer-Isolated Converters Single-switch and multi-switch transformer-isolated DC-DC converters. Flyback and forward converters; transformer isolated half-bridge, full-	CO3, CO4

	bridge converters. Push-pull converters. Voltage fed and current-fed converters.	CO6
IV	Magnetic Component Design Magnetic core materials and performance; basic inductor and transformer design; practical magnetic design; design aspects to be considered for designing transformers for specific applications – flyback, push-pull converters.	CO3, CO4, CO6
V	Switching Regulator Control, Soft-Switched Dc-Dc Power Converters Small-signal models for switching regulators. Performance analysis and design of closed-loop system under different control methods, and operating modes. Measurement of small signal transfer functions. Soft-Switched DC-DC Power Converters -Motivation. Hard-switching vs soft-switching.	CO3 CO5, CO6

Learning Resources

Text Books

1. N Mohan, T M Undeland and W P Robbins, "Power Electronics: Converters, Applications and Design", Wiley , 3rd Edition, 2007
2. Abraham Pressman, Keith Billings, Taylor Morey, "Switching Power Supply Design", McGraw-Hill.3rd Edition, 2009

Reference Books

1. K. Kit Sum, Switch Mode Power Conversion: Basic Theory and Design 1st Edition, Kindle Edition,2017

Web Links

1. https://nptel.ac.in/courses/108108036

MACHINE LEARNING

Course Code	20EE4703E	**Year**	IV	**Semester(s)**	I
Course Category	Professional Elective-V	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic concepts of machine learning. (L2)
CO2	Apply learning techniques on appropriate problems. (L3)
CO3	Apply Evaluation, hypothesis tests and compare learning techniques for various problems. (L3)
CO4	Apply Reinforcement learning to address the real time problems in different areas. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction**: What is Machine learning, Designing a Learning System, Perspectives and Issues in Machine Learning, Applications of Machine learning.	**CO1**
II	**Supervised Learning**: Decision Trees, Bayes Theorem, Naive Bayes Classifier, Measuring Classifier Accuracy, Estimating Hypothesis Accuracy.	**CO1, CO2, CO3**
III	**Instance Based Learning** – Support vector machine, Ensemble Methods, k-Nearest Neighbor Learning, Expectation Maximization Algorithm, Case Based Reasoning.	**CO1, CO2, CO3**
IV	**Un Supervised Learning:** Partition methods of Clustering, Hierarchical methods, Density based clustering, Scalable Clustering Algorithms, Cluster Evaluation measures. **Association analysis**: Apriori algorithm, efficiently finding frequent item	**CO1, CO2, CO3**

	sets with FP-growth.	
V	**Reinforcement learning**: The learning Task, Elements of Reinforcement learning, Q-Learning, Model based Learning, Temporal Difference learning.	**CO1, CO4**

Learning Resources
Text Books
1. Ethem Alpaydin, Introduction to Machine Learning, Prentice Hall of India, Second Edition, 2010. 2. Anuradha Srinivasaraghavan, and Vincy Joseph, Machine Learning, WILEY, Kindle Edition, 2020.
Reference Books
1. Tom M. Mitchell, Machine Learning McGraw Hill Education, International Edition 1997,. 2. ", Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning, MIT Press,2016. 3. Kevin P Murphy & Francis Bach, Machine Learning a Probabilistic Perspective, MIT Press, First Edition, 2012. 4. Tan, Vipin Kumar, Michael Steinbach, Introduction to Data Mining, Pearson, Nineth Edition, 2013.
e-Resources and other Digital Material
1. https://www.coursera.org/learn/machine-learning 2. https://nptel.ac.in/courses/106/106/106106139/

MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTANCY

Course Code	20HS7701A	Year	IV	Semester	I
Course Category	Humanities and Social Science Elective	Branch	Common to all	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

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

	Statement	Skill	BTL	Units
CO1	Understand basics of managerial economics, demand forecasting, cost analysis, industrial organization, financial accounting and capital and capital budgeting.	Understand	L2	1,2,3,4,5
CO2	Apply the managerial economics, e-commerce, demand forecasting and cost analysis techniques in economics related problems.	Apply	L3	1,2
CO3	Summarize different types of industrial organization	Apply	L3	3
CO4	Analyze the financial accounting and depreciation related problems.	Analyze	L4	4,5

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					2		2			3		3	
CO2	3					2		2			3		3	
CO3	3					2		2			3		3	
CO4	3					2		2			3		3	

Syllabus		
UNIT	**Contents**	**Mapped CO**
I	**INTRODUCTION TO MANAGERIAL ECONOMICS:** Introduction, characteristics, scope & definition of Managerial Economics, its relation with other subjects, Basic economic tools in Managerial Economics. Demand Analysis: Meaning- Demand distinctions- Demand determinants- Law of Demand and its exceptions. **ELASTICITY OF DEMAND & DEMAND FORECASTING**: Definition -Types of Elasticity of demand - Measurement of price elasticity of demand and it's significance: Total outlay method, Point method and Arc method. Demand Forecasting: Meaning - Factors governing demand forecasting - Methods of demand forecasting.	**CO1** **CO2**
II	**THEORY OF PRODUCTION AND COST ANALYSIS- INTRODUCTION TO MARKETS-PRICING POLICIES & E-COMMERCE:** Production Function- Isoquants and Isocosts, Law of variable proportions- Law of returns to scale- Least Cost Combination	**CO1** **CO2**

	of Inputs, Cobb-Douglas Production function-Economies of Scale **COST ANALYSIS**: Cost concepts, Determination of Break Even Point (BEP) with simple problems, Managerial Significance and limitations of BEP. Market structures: Types of competition, Features of Perfect Competition, Monopoly and Monopolistic Competition. Pricing strategies.	
III	**TYPES OF INDUSTRIAL ORGANIZATION & INTRODUCTION TO BUSINESS CYCLES**: Characteristic features of Industrial organization, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, State/Public Enterprises and their types. Changing business environment in post-liberalization scenario.	**CO1 CO3**
IV	**FINANCIAL MANAGEMENT AND INTRODUCTION TO FINANCIAL ACCOUNTING**: Functions of financial management, simple and compound interest, Methods of evaluating alternatives- Present Worth method. Future worth Method, Annual equivalent method. Introduction to Double-entry system	**CO1 CO4**
V	**DEPRECIATION**: Introduction, common methods of depreciation: straight line method, Declining balance method, sum of year's digits method. **CAPITAL AND CAPITAL BUDGETING:** Meaning of capital budgeting, Need for capital budgeting – Capital budgeting decisions (Examples of capital budgeting) - Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR), IRR and Net Present Value Method (simple problems).	**CO1 CO4**

Learning Resources

Text Books:

1. Engineering economics, R. Panneerselvam,2nd Edition, PHI Learning Pvt. Ltd., 2013 .
2. Managerial Economics and Financial Analysis, by J.V.Prabhakar Rao, Maruthi Publications, 2011.

Reference Books:

1. Managerial Economics and Financial Analysis, by A R Aryasri, TMH 2011.
2. Financial Accounting,SN Maheswari,SK Maheswari, Vikas Publishing House Pvt Ltd., NewDelhi, 4th Edition,2006.
3. Managerial Economics by Suma damodaran, Oxford 2011.
4. Mangerial Economice and Financial Analysis by S.A. Siddiqui & A.S. Siddiqui, New Age International Publishers, 2011.
5. Engineering economy- Theusen & Theusen, 8th edition,1993,Prentice Hall.

E-Resources & other digital Material:

1. www.tectime.com
2. www.exinfm.com
3. www.economywatch.com

HUMAN RESOURCE MANAGEMENT

Course Code	20HS7701B	**Year**	IV	**Semester**	I
Course Category	**Humanities and Social Science Electives**	**Branch**	Common to all	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Skill**	**Level**	**Unit No**
Upon successful completion of the course, the student will be able to				
CO1	Understand the basic concepts, techniques and applications of Human Resource Management.	Understand	L2	1,2,3, 4,5
CO2	Describe job design, job Analysis, job evaluation and different levels of recruitment	Understand	L2	2,3
CO3	Illustrate different Training and development of human resources	Apply	L3	4
CO4	Summarize e-Human Resource Management and Human resource for small scale industries	Apply	L3	5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H:High(3), M: Medium(2), L:Low(1))														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		2			3					3	1	1	3
CO2	1		2			3					3	1	1	3
CO3	1		2			3					3	1	1	3
CO4	1		2			3					3	1	1	3

Syllabus		
UNIT	**Content**	**Mapped CO**
I	**Introduction:** Functions, Policies & Roles, Skills for HR Professionals, HRM Models, Evolution of HRM, Recent developments in HRM, Nature of Strategic HRM, Strategic HRM versus Conventional HRM, Strategic Management Process, Benefits of SHRM, Barriers to Strategic HRM, Typical HR Strategies, Selecting Strategies to Enhance Performance. **Human Resource Planning:** Nature of HRP, Importance of HRP, Factors Affecting HRP, The Planning Process, Human Resource Planning and the Government Requisites for Successful HRP, Barriers to HRP	**CO1**
II	**Analysis of Work, Designing Jobs and Job Evaluation:** Nature of Job analysis, Job Analysis and Competitive Advantage, The Process of Job Analysis, Methods of Collecting Job Data, Job Analysis and Strategic HRM, Potential Problems with Job Analysis. **Requisites for Job Analysis**, Competency-based Job Analysis, Job	**CO1, CO2**

	Design, Significance of Jobs Design, Factors Affecting Job Design, Job Design Approaches, Contemporary Issues in Job Design, Job Evaluation, Job Evaluation Process, Methods of Job Evaluation, Alternative to Job Evaluation.	
III	**Recruiting Talent:** Nature of Recruitment, Purposes and Importance, Factors Governing Recruitment, Recruitment Process, Evaluation and Control, Philosophies of Recruiting, Alternatives to Recruitment. **Selecting Right Talent:** Nature of Selection, Selection as a Source of Competitive Advantage, Organization for Selection, Selection Process, Assessment Centers, Barriers to Effective Selection, Evaluation of Selection Process, Making Selection Effective.	**CO1, CO2**
IV	**Training and Development, Career Management and Talent Management:** Orientation, Orientation Programme, Requisites of an Effective Programme, Evaluation of Orientation Programme, Problems of Orientation, Typical Orientation Programme, **Nature of Training and Development**, Inputs in Training and Development, Training and Development as Source of Competitive Advantage, The Training Process, Impediments to Effective Training. Government Initiative, Management Development, Career Development, Talent Management.	**CO1, CO3**
V	**e-Human Resource Management:** Nature of e-HRM, e-HR Activities, e-Recruitment, e-Selection, e-Performance Management, e-Learning, e-Compensation **Human Resource Management in Small Scale Units:** Introduction to Small Business Unit, Significance of MSM Enterprises, Facilities Problems, People Practices in Small Units, Challenges in Introducing HR Practices, Current Practices, Guidelines for Application of HR Practices.	**CO1, CO4**

Learning Resource
Text books:
1. Human Resource Management, Text & Cases by K. Aswathappa
Reference books
1. Human Resource Management, by S. Khandkar, S. Chand Publications 2. Personnel Management - Text & Cases, By C. B. Mamoria& V. S. P. Rao, Himalaya 3. Human Resource Management by Gary Dessler, Pearson Education

ENTREPRENEURSHIP MANAGEMENT

Course Code	20HS7701C	Year	IV	Semester	I
Course Category	Humanities and Social Science Electives	Branch	Common to all	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

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

	Statement	Skill	BTL	Units
CO1	Understand the basic concepts and factors for starting and successful running of different forms of an enterprise.	Understand	L2	1,2,3,4,5
CO2	Describe characteristics, values and attitudes of an entrepreneur.	Understand	L2	2
CO3	Illustrate different forms of Entrepreneurial structures and Intrapreneurship.	Application	L3	3,4
CO4	Summarize critical Factors for starting a new enterprise and ethics to be followed during running of enterprise.	Application	L3	5

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		2			3			3		3	2		
CO2	1		2			3			3		3	2		
CO3	1		2			3			3		3	2		
CO4	1		2			3		3	3		3	2		

Syllabus		
UNIT	**Content**	**Mapped CO**
I	**Introduction to Entrepreneurship**: Meaning, Nature, origin and development of entrepreneurship in India, Need and Importance, Core elements, Principles, Essentials, Types, Functions, Concept of entrepreneurship management, Motives behind being an entrepreneur, Entrepreneurial Process.	**CO1**
II	**Entrepreneurial Values and Attitudes**: Introduction to entrepreneurial Values and Attitudes, Dominant characteristics of successful entrepreneurs, Internal and external factors for entrepreneurial motivation, Entrepreneurial Skills, Identifying business opportunities. **Role of creativity in Entrepreneurship-** the creative process, the Innovation process, types of innovation, sources of innovation, principles of innovation, Sources of Business Ideas.	**CO1, CO2**

III	**Forms of Entrepreneurial structures**: Sole Proprietorship-meaning, merits and limitations, Partnership-Meaning, Forms, merits and limitations. **Corporations**-Meaning, merits and limitations, Limited Liability partnerships and corporations, Franchising-Meaning, types, merits and limitations.	**CO1, CO3**
IV	**Intrapreneurship**: Meaning, Characteristics, Intrapreneurs Activities, types of Corporate Entrepreneurs, Corporate V/s Intrapreneurial culture, Climate, Fostering Intrapreneurial culture. **Promoting intrapreneurship**- Pinchot's Spontaneous teams and Formal Venture teams, establishing intrapreneurial ventures**.**	**CO1, CO3**
V	**Critical Factors for starting a new enterprise**: Personal, Environmental, Sociological factors, Problems of a new venture-Financial, administrative, marketing, production and other problems **Ethics and Entrepreneurship**: Defining Ethics, Approaches to Managerial ethics, ethics and business decisions, Ethical practices and code of conduct, Ethical considerations in corporate entrepreneurship.	**CO1, CO4**

Learning Resources

Text Books

1. Entrepreneurship development, Moharanas and Dash C.R., RBSA Publishing, Jaipure.
2. Beyond entrepreneurship, Collins and Lazier W, Prentice Hall, New Jersey, 1992.
3. Entrepreneurship, Hisrich Peters Sphephard, Tata McGraw Hill.
4. Fundamentals of entrepreneurship, S.K. Mohanty, Prentice Hall of India.

Reference Books

1. Small scale industries and entrepreneurship, Dr. Vasant Desai, Himalayan Publishing House.
2. Management of small scale industries, Dr. Vasant Desai, Himalayan Publishing House.
3. Management of small scale industries, J.C. Saboo Megha Biyani, Himalayan Publishing House.
4. A Guide to Entrepreneurship, David Oates, Jaico Publishing House, Mumbai, Edn 2009.

E-Resources & other digital Material

1. https://onlinecourses.swayam2.ac.in/cec20_mg19/preview
2. https://onlinecourses.swayam2.ac.in/ntr22_ed08/preview

ORGANIZATIONAL BEHAVIOUR

Course Code	20HS7701D	**Year**	IV	**Semester**	I
Course Category	Humanities and Social Science Electives	**Branch**	Common to all	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

	Statement
CO1	Demonstrate the applicability of the concept of organizational behaviour to understand the behaviour and culture of people in the organization.
CO2	Demonstrate the applicability of analysing the complexities associated with management of individual behaviour in the organization.
CO3	Analyse the complexities associated with Personality Development in the organization and role of leadership.
CO4	Demonstrate how the organizational behaviour can integrate inunderstanding the motivation between the formation of teams and stages of group development.
CO5	Demonstrate how the organizational behaviour can influence in understanding the development and culture of the individuals in the organization.

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	2	-	-	-

Syllabus		
UNIT	**Content**	**Mapped CO**
I	**Introduction to Organizational Behaviour:** Definition of Organizational Behaviour-Nature and Scope of Organizational Behaviour-Opportunities of Organizational Behaviour-Linkage of Organizational Behaviour with other disciplines-Organizational Behaviour Models	**CO1**
II	**Foundations of Individual Behaviour: Perception:** Definition of Perception- Factors of Perception- The Perception Process-**Motivation:** Definition of Motivation-Theories of Motivation: Maslow’s Hierarchy Theory of Needs- Herzberg’s Two-Factor Theory-Mc Gregor’s Theory of Motivation-**Learning:** Definition Learning- Objectives of Learning-Process of Learning- Theories of Learning-Classical conditioning theory- Operant conditioning theory.	**CO2**

III	**Personality Development and Leadership: Personality Development-** Definition of Personality-Objectives of Personality-Dimensions of Personality- Stages of Personality Development-**Leadership**- Definition of Leadership – Objectives of Leadership –Styles of Leadership in Organization	**CO3**
IV	**Formation of Teams and Group Dynamics: Formation of Teams-** Definitionof Team- Objectives of Teams -Types of Teams- Team Building- Creating Effective teams-**Group Dynamics:** Definition of Group- Formal Vs Informal Groups- Stages of Group Development-Johari Window- Transactional Analysis- Conflict -Definition, Conflict Resolution Mechanisms in Groups	**CO4**
V	**Organizational Change and Culture: Organizational Change-**Definition-Change Models- Organizational resistance to change Management of Change Process- Organizational Culture- Definition- Objectives-Distinction between	**CO5**

Learning Resources	
Text Books	1. Fred Luthans, Organizational Behaviour, McGraw Hill, 11th Edition, 2001. 2. Stephen P. Robins, Organisational Behaviour, PHI Learning / PearsonEducation, 11th edition, 2008.
Reference Books	1. Hellrigal, Slocum and Woodman, Organizational Behaviour, Cengage Learning, 11th Edition 2007. 2. Aswathappa K., "Organizational Behaviour-Text, Cases and Games", Himalaya Publishing House, New Delhi, 2008. 3. Schermerhorn, Hunt and Osborn, Organizational Behaviour, John Wiley,9th Edition, 2008. 4. Udai Pareek, Understanding Organizational Behaviour, 2nd Edition, Oxford Higher Education, 2004. 5. Ivancevich, Konopaske &Maheson, Organizational Behaviour & Management,7th edition, Tata McGraw Hill, 2008. 6. Hitt, Michael .A., Organizational Behaviour- A Strategic Approach, Wiley, India,2008.

CONSTRUCTION MANAGEMENT

Course Code	20HS7701E	Year	IV	Semester	I
Course Category	Humanities and Social Science Electives	Branch	Common to all	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Construction materials and Concrete Technology
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

	Statement
CO1	**Knowledge** on different methods of controlling and Work break down structure
CO2	A complete i**dea** on developing time estimates and problems on networkanalysis.
CO3	**Understanding** of cost analysis and resource allocation and scheduling
CO4	An **idea** on construction management, safety and roles of different stake holders
CO5	**Knowledge** on types of organization and related policies and acts

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)

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

Syllabus

UNIT	Content	Mapped CO
I	**Introduction to Construction Management :** Introduction : Origin of PERT and CPM, Planning, Scheduling and controlling, Bar Charts, Milestone charts, weaknesses in Bar charts, PERT and CPM networks and Problems, Comparison, Event, Activity, Rules for drawing networks Numbering the events (Fulkerson's law), Dummy activities, Work Break-down structure.	CO1
II	**CPM-PERT-Network Analysis:** Time estimate-Expected time, Earliest allowable occurrence time, Latest allowable occurrence time, slack and Problems, Problems on Network Analysis, project duration, probability of completion, Start and Finish time estimates, Floats and Problems, Project scheduling, Critical and sub-critical path. Updating – Process of updating; when to update	CO2

III	**CPM Cost Model & Resources allocations, resource scheduling:** Cost Analysis; direct and indirect costs, operation time, Normal and crash times and costs, Problems on cost analysis, Optimizing project cost, crash limit, Free floatlimit, Optimization Resource smoothening. Resource levelling.	**CO3**
IV	**Management:** Scope of Construction Management; Significance of Construction Management, Concept of Scientific Management; Safety in Construction, Qualities of Manager; The roles/functions performed by effective and competent Managers, The Manager: i) as a decision maker; ii) as a motivator; iii) as a communication-link; iv) as a conflict resolver; v) as a well – wisher of co-employees and the employer; etc Role playwith roles of different stakeholders of construction industry.	**CO4**
V	**Organization** – Types of organization; Merits and demerits of different types of organization – Authority –Policy– Labour Problems; Labour Legislation in India; 'Workmen's compensation Act of 1923 and Minimum Wages Act of 1948', and subsequent amendments.	**CO5**

Learning Resources	
Text Books	1. Dr. B. C. Punmia and K. K. Khandelwal, Project Planning andControl with PERT and CPM, 4/e, Laxmi Publications, 2016 2. Kumar Neeraj Jha, Construction Project Management: Theory and Practices, 2/e, Pearson Education, 2015
Reference Books	1. Dr. P. N. Modi, Rajeev Modi, PERT and CPM - Project Evaluation Review Technique and Critical Path Method, 5/e, Standard Book House, 2012. 2. L S Srinath, PERT and CPM Principles and Applications, 3/e, Affiliated East-West Press, 2001. 3. U.K. Shrivastava, Construction Planning and Management, 2/e, Galgotia Publications- New Delhi, 2000. 4. Kerzner H., Project Management- A systems approach to planning, scheduling and controlling, 10/e, John Wiley & Sons, Inc., New Jersey, USA, 2009.
e-Resources& other digital material	1. https://nptel.ac.in/courses/105104161/ 2. http://jntuk-coeerd.in/

INDUSTRIAL ENGINEERING & MANAGEMENT

Course Code	20HS7701F	**Year**	IV	**Semester**	I
Course Category	**Humanities and Social Science Elective**	**Branch**	Common to all	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation**	70	**Total Marks**	100

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

	Statement	Skill	BTL	Units
CO1	Understand the basic concepts of management, organizational structures, leadership, operations management and project management.	Understand	L2	1,2,3,4,5
CO2	Explain the leadership qualities and concept of plant layout.	Understand	L2	2
CO3	Apply different quality control techniques.	Apply	L3	3
CO4	Illustrate various operations management Techniques	Apply	L3	4
CO5	Solve operations management and project management problems	Apply	L3	5

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)

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

Syllabus

UNIT	Contents	Mapped CO
I	**INTRODUCTION**: Definition of Industrial Engineering, Applications, Role of Industrial Engineer, Quantitative tools of IE, Functions of Management, Taylor’s Scientific Management, Fayol’s Principles of Management, Douglas Mc-Gregor’s Theory X and Theory Y, Hertzberg’s Two Factor Theory of Motivation, Maslow’s Hierarchy of Human Needs. **ORGANISATIONAL STRUCTURES**: Basic concepts related to Organization – Depart mentation and Decentralization, Flat and Tall organizations, Organizational chart, Line organization, Line and staff organization, functional organization	**CO1**
II	**LEADERSHIP**: Introduction, Definition, Types of leadership based on authority- their area of applicability and suitability, advantages and limitations, Traits approach to leadership **PLANT LOCATION**: Definition, factors affecting the plant location,	**CO1, CO2**

	comparison of rural and urban sites. Plant Layout – definition, objectives, types of production, types of plant layout – various data analyzing forms-travel chart.	
III	**INSPECTION AND QUALITY CONTROL**: Types of inspections, Statistical Quality Control techniques, variables and attributes, assignable and non-assignable causes. **Control Charts:** variable control charts- X -bar and R charts, Attribute control charts- P-charts and C-charts. **Acceptance sampling**- Single Sampling, Double sampling, Multiple Sampling, OC curves.	**CO1, CO3**
IV	**WORK STUDY**: Definition, objectives, method study - definition, objectives, steps involved- various types of associated charts-out line process charts, flow process charts, two handed process charts and SIMO charts. **TIME STUDY**: definition, time study, steps involved-equipment, different methods of performance rating- allowances, standard time calculation.	**CO1, CO4**
V	**PROJECT MANAGEMENT**: Network modeling, Probabilistic model-various types of activity times estimation, programme evaluation review techniques (PERT), probability of completing the project, **Deterministic model-** critical path method (CPM), critical path calculation, crashing of simple of networks.	**CO1, CO5**

Learning Resources

Text Books:

1. S.Bhaskar, "Management Science", Anuradha Publications
2. O.P. Khanna, "Industrial Engineering and Management", DhanpatRai
3. T. R. Banga, S. C. Sharma, N. K. Agarwal, "Industrial Engineering and Management Science" Khanna Publishers.

Reference Books:

1. PannerSelvam, Production and Operations Management, PHI, 2004.
2. Ralph M Barnes, Motion and Time Studies, John Wiley and Sons, 2004.
3. Chase, Jacobs, Aquilano, Operations Management, TMH 10th Edition, 2003.
4. L.S.Srinath, PERT / CPM, affiliate East-West Press, New Delhi, 2000.
5. Phillip Kotler, Marketing Management, Pearson, 2004. 6. S. Bhaskar, "Management Science" Anuradha Publications.

PROJECT MANAGEMENT

Course Code	20HS7701G	Year	IV	Semester	I
Course Category	**Humanities and Social Science Electives**	**Branch**	Common to all	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

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

	Statement	Skill	BTL	Units
CO1	Understand the concepts of project management.	Understand	**L2**	1,2,3,4,5
CO2	Explain procedure for analyzing the project risk, market risk and firm risk.	Understand	**L2**	2
CO3	Apply social-cost benefit analysis on a project.	Apply	**L3**	3
CO4	Analyze a project by applying various network techniques for planning, scheduling and controlling of different activities of a project.	Analyze	**L4**	4
CO5	Analyze various aspects to be considered for technical and financial analysis of the Project and the Environmental appraisal	Analyze	**L4**	5

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1							2		3	2	2	1
CO2	2	1							2		3	2	2	1
CO3	2	1							2		3	2	2	1
CO4	2	1							2		3	2	2	1
CO5	2	1							2		3	2	2	1

Syllabus		
UNIT	**Contents**	**Mapped CO**
I	**MEANING, NATURE AND IMPORTANCE OF PROJECT:** Introduction, Concept of project and project management, Characteristics of project, Project Family tree, Classification of Project, Project selection process, **Project life cycle**, Project report, Project appraisal, Tools and techniques for project management, Project manager’s roles and responsibilities	**CO1**
II	**ANALYSIS OF PROJECT RISK, MARKET RISK AND FIRM RISK:** Introduction, Analysis of project risks- Projects with quantified benefits and not quantifiable benefits, **Market risk**- Security market risk, Interest rate risk, Purchasing Power Risk, Firm risk- Business risk, financial risk.	**CO1** **CO2**
III	**COST-BENEFIT ANALYSIS:** Introduction, need for social cost benefit analysis, Procedure of social cost	**CO1** **CO3**

	benefit analysis, Main feature of social cost benefit analysis, **COST-BENEFIT ANALYSIS APPROACHS:** UNIDO approach, Little-Mirrless approach, SCBA in India, Public investment decision making in India, Limitation of SCBA.	
IV	**NETWORK TECHNIQUES FOR PROJECTMANAGEMENT:** Introduction, Network modelling, Probabilistic model-various types of activity times estimation, Programme evaluation review techniques (PERT), probability of completing the project, **Deterministic model**- critical path method (CPM), critical path calculation, crashing of simple of networks	**CO1** **CO4**
V	**TECHNICAL AND FINANCIAL ANALYSIS OF PROJECT:** Introduction, Technical Analysis-Materials and inputs, Production, Choice of technology, Product Mix, Plant capacity, Location and site, Structures and civil works, Project charts and layouts, financial analysis -Significance of financial analysis, Utility of financial and accounting statements, **ENVIRONMENTAL APPRAISAL OF PROJECTS:** Introduction, Types and Environmental Dimensions of a Project, Stresses on Environment, Environmental Impact Assessment Methodologies	**CO1** **CO5**

Learning Resource
Text books:
1. Prasanna Chandra, Projects Planning, Implementation and Control, Tata McGraw Hill Publishing Company Limited, New Delhi, 1995.
Reference books
1. Project Management Institute (PMI), A Guide to the Project Management of Knowledge Newton Square, PA, 1996 2. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons, New York, 1995. 3. L.S. Srinath, PERT & CPM Principles & Applications, 3rd edition, East west Press,2001.
e- Resources & other digital material
1. https://nptel.ac.in/courses/105/106/105106149/
2. https://nptel.ac.in/courses/110/104/110104073/

DISASTER MANAGEMENT AND PREPAREDNESS

Course Code	20CE2701A	**Year**	IV	**Semester(s)**	I
Course Category	Open Elective-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	20MC1301 - Environmental Science
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	**Demonstrate** basic terminology and **classify** types of disasters	L3
CO2	**Outline** the impacts of disaster	L2
CO3	**Familiarize** Disaster management activities and phases	L2
CO4	**Explain** the Components of disaster relief, disaster management policies	L3
CO5	**Develop** the responsibilities towards society after disaster	L3

Contribution of Course Outcomes towards achievement of Program Outcomes

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

1- Low **2-Medium** **3-High**

Course Content

UNIT-1	**INTRODUCTION & DISASTERS CLASSIFICATION** Concepts and definitions: disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation. Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, forest fires.); manmade disasters (industrial pollution, nuclear radiation, chemical spills, terrorist strikes); hazard and vulnerability profile of India.	**CO1**
UNIT-2	**DISASTER IMPACTS** Disaster impacts (environmental, physical, social, ecological, economical, political); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters	**CO2**
UNIT-3	**DISASTER MITIGATION AND PREPAREDNESS** Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Role of remote sensing and GIS in disaster management.	**CO3**
UNIT-4	**POST DISASTER RESPONSE** Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, disease control, security,	**CO4**

	communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local institutions, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector.	
UNIT-5	**DISASTERS - ENVIRONMENT AND DEVELOPMENT** Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.	**CO5**

Learning Resources

Text Books	1. R. B. Singh, Disaster Management, Rawat Publications, 2000 2. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall. 3. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
Reference Books	1. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003 2. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC
E-Resources & other digital material	1. http://ndma.gov.in/ (Home page of National Disaster Management Authority) 2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).

RESEARCH METHODOLOGY

Course Code	20EC2701C	**Year**	IV	**Semester**	I
Course Category	Open Elective-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand basic concepts and its methodologies (L2)
CO2	Demonstrate the knowledge of research processes (L3)
CO3	Apply research articles in their academic projects (L3)
CO4	Analyze various types of testing tools used in research (L4)
CO5	Design a research paper (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

CO/PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2
CO-1	2							2		2		2		
CO-2	3							3		3		3		
CO-3	2							2		2		2		2
CO-4		3			3	3		3		3		3	3	3
Average* (Rounded to nearest integer)		2						2		2		2		

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction**: Meaning of Research, Objectives of Research,Types of Research, Research Approaches. **Research Ethics:** Objectives, codes, policies, conventions of publications, ethics for editors, reviewers and publishers, IPR. **Research Problem**: What is a Research Problem? , Selectingthe Problem, Necessity of Defining a problem.	CO1, CO2

	Research Design –Features of Good Design, Important Concepts related to Research Design, Basic Principles of Experimental Designs.	
II	**Sampling Design** –Sample Design, Sampling and Non- Sampling errors, Goodness of Measurement scales, Sources of error in measurement. **Data Collection Methods** – Collection of Primary Data – Collection of Secondary data. **Data Preparation**: Data Preparation Process, Some problems in Preparation Process, Missing Values and Outliers, Types of Analysis, Statistics in Research.	CO1-CO3
III	**Descriptive Statistics**: Measures of Central Tendency, Measures of Dispersion, Measures of Skewness, Kurtosis, Measures of Relationship, Association in case of Attributes, Other Measures	CO1, CO4
IV	**Sampling and Statistical Inference**: Parametric vs Statistic, Sampling and Non-Sampling errors, Sampling Distribution, Degrees of Freedom, Standard Error. **Testing of Hypothesis**: What is a Hypothesis, Basic Concepts Concerning Testing of Hypothesis, Testing the Hypothesis, Test Statistic and Critical Region, Critical Value and Decision Value, Procedure for Hypothesis Testing.	CO1, CO4
V	**Interpretation and Report Writing**: Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation Significance of Report Writing, Different Steps in Writing Report, Layout of a Research Paper, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	CO1, CO5

Learning Resources
Text Books:
1. C.R.Kothari, Research Methodology: Methods and Techniques, 2^{nd} Ed., New Age International Publishers,2014. 2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, An introduction to Research Methodology, RBSA Publishers, U.K., 2002
References:
1. Day, R.A., How to Write and Publish a Scientific Paper, Cambridge University Press,1992 2. Anthony, M., Graziano, A.M. and Raulin, M.L., Research Methods: A Process of Inquiry, Allyn and Bacon, 2009
e- Resources & other digital material
1. https://www.youtube.com/watch?v=8iFfzYVuCuM 2. https://onlinecourses.nptel.ac.in/noc22_ge08 3. https://www.youtube.com/watch?v=GSeeyJVD0JU

EMBEDDED & REAL TIME SYSTEMS

Course Code	20EC2701B	**Year**	IV	**Semester**	I
Course Category	Open Elective-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Apply** design methodologies for embedded systems. (L3)
CO2	**Build** embedded systems with specifications and technological choice. (L3)
CO3	**Develop** fundamental systems such as sensors, actuators, converters, processors, intra-and inter-communication networks and interfaces. (L3)
CO4	**Utilize** modern hardware/software tools for building prototypes of embedded systems. (L3)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

CO/PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2
CO-1	2									2			2	2
CO-2	2									2			2	2
CO-3	3									3			3	3
CO-4	2									2			2	2
Average* (Rounded to nearest integer)	**2**	**2**								**2**			**2**	**2**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** History of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Core of the Embedded System, Sensors and Actuators, Communication Interface, Embedded Firmware.	CO1

II	**Hardware Software Co-Design And Programme Modeling:** Characteristics of an Embedded System, Quality Attributes of Embedded Systems, Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Hardware Software Trade-offs.	CO2
III	**Devices in Embedded Systems:** Types of supporting devices for an embedded system – various forms of ROM, RAM devices, interrupt sources, Interrupt Service Mechanism, serial port devices, parallel port devices, timers and counting devices.	CO3
IV	**Communication Buses for Device Networks:** Interfacing Features in Device Ports, Wireless Devices, Networked Embedded Systems, Serial Bus Communication Protocols, Parallel Bus Device Protocols- Parallel Communication Network Using ISA, PCI, PCI-X and Advanced Buses.	CO3
V	**Design of Real Time Systems:** processors in complex embedded systems, design process in embedded system, optimizing design metrics, Case study for adaptive cruise control system in car.	CO4

Learning Resources
Text Books:
1. Embedded Systems Architecture, Programming and Design- Raj Kamal, Second Edition, McGrawHill Education. 2. Introduction to Embedded System- Shibu KV, Mc-Graw Hill Edition.
References:
1. Peckol, "Embedded system Design",JohnWiley&Sons,2010 2. Lyla B Das," Embedded Systems-An Integrated Approach",Pearson,2013 3. Embedded/Real-Time Systems, Dr. K.V.K.K. Prasad, dream Tech press
e- Resources & other digital material
1. Microsoft PowerPoint - pcp_embedded_system_intro (iitb.ac.in) 2. NPTEL :: Electrical Engineering - Embedded Systems

E-WASTE MANAGEMENT

Course Code	20EC2701B	**Year**	IV	**Semester**	I
Course Category	Open Elective-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Know about the environmental impacts of e-waste.
CO2	Apply various concept learned under e-waste management hierarchy.
CO3	Distinguished the role of various national and internal act and laws applicable for e-waste management and handling.
CO4	Analyze the e – waste management measures proposed under national and global legislations.

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

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

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction.** E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.	CO1
II	**E-waste hazardous on Global trade** Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-	CO1, CO2

	waste in metro cities of India.	
III	**E-waste control measures** Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source.	CO1, CO3
IV	E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs.	CO1, CO4
V	The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive	CO1, CO4

Learning Resources
Text Books
1. E-waste: implications, regulations, and management in India and current global best practices", Johri R., TERI Press, New Delhi
Reference Books
1. Electronic Waste – 1st Edition (Toxicology and Public Health Issues) , Fowler B. 2017Elsevier 2. Electronic Waste Management. Science , Hester R.E., and Harrison R.M. 2009

FUNDAMENTALS OF DATA SCIENCE

Course Code	20IT2701A	**Year**	IV	**Semester**	I
Course Category	Open Elective-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	DATA MINING
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the basic concepts of Data Science (L2)
CO2	**Apply** different modelling methods (L3)
CO3	**Discuss** the concepts of web mining (L2)
CO4	**Analyze** the different modelling methods (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes

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

1- Low **2-Medium** **3-High**

Course Content

UNIT-1	**Introduction to data science:** The Data Science process: Roles in a data science project, stages of a data science project **Managing Data:** Cleaning data, Sampling for modeling and validation	CO1
UNIT-2	**Modelling Methods:** Choosing evaluating models: Problems to machine learning tasks, Evaluating models,	CO1 CO2 CO4
UNIT-3	**Linear and Logistic Regression:** **Using Linear Regression:** Understanding Linear regression ,building a linear regression model, Making Predictions **Using Logistic Regression:** Understanding Logistic Regression, building a Logistic regression model, Making Predictions	CO1 CO2 CO4
UNIT-4	**Unsupervised methods:** **Clustering Analysis:** Preparing Data, K-Means Algorithm **Association Rules:** Overview of Association rules, Mining Associations rules	CO1 CO2 CO4
UNIT-5	**Web Mining** :Web Content mining, Web structure mining, Web usage mining, Text mining, Unstructured Text, Episode rule discovery for text ,Text Clustering	CO1 CO3

Learning Resources	
Text Books	1. Nina Zumel, John Mount: Practical Data Science with R , Dreamtech, 2015 2. Data Mining Techniques 3rd Edition Arun K Pujari 2013
E-Resources & other digital material	http://nptel.ac.in

OPERATIONS RESEARCH

Course code	20ME2701A	Year	IV	Semester	I
Course category	Open Elective-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

CO	Statement: The students will be able to	Skill	Blooms Level	Units
CO1	Understand the basics of linear programming, transportation, queueing , sequencing of jobs, replacement, inventory and simulation problems	**Understand, Communication**	**L2**	**1,2,3,4,5**
CO2	Apply linear programming, transportation and assignment models to solve real life problems	**Apply, Communication**	**L3**	**1,2**
CO3	Apply Sequencing, queueing, Game and Replacement theories to solve problems	**Apply, Communication**	**L3**	**3,4**
CO4	Apply knowledge of inventory control and simulation to solve practical industrial problems	**Apply, Communication**	**L3**	**5**

		Contribution of Course Outcomes towards achievement of Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3								3	2		3	2
CO2	3	3								3	2		3	2
CO3	3	3								3	2		3	2
CO4	3	3								3	2		3	2

Syllabus	
Unit No	**Contents**
I	Introduction to Operations Research: History, definition, operations research models, phases of implementing operations research in practice, applications. **Linear Programming**: Introduction, formulation, graphical solution, simplex method, artificial variable techniques – Big M and two-phase methods, duality principle.
II	**Transportation**: Formulation, initial feasible solution, optimal solution – MODI method, unbalanced transportation problems, degeneracy in transportation problems. **Assignment**: Formulation, optimal solution, Hungarian method, travelling salesman problem.
III	**Queuing theory**: Introduction, Kendall's notation, classification of queuing models, single server and multi-server models, Poisson arrival, exponential service, infinite population **Sequencing**: Introduction, assumptions, processing n-jobs through two machines, n-jobs through three machines, and graphic solution for processing 2 jobs through n machines with different order of sequence.
IV	**Game Theory**: Introduction, game with pure strategies, game with mixed strategies, dominance principle, graphical method for 2xn and mx2 games. **Replacement Theory**: Introduction, replacement of items that deteriorate with time - value of money unchanging and changing, simple probabilistic model for replacement of items that fail completely
V	**Inventory control**: Introduction, inventory costs, Economic Order Quantity (EOQ)Demand

	rate Uniform and replenishment rate infinite, demand rate non uniform replenishment rate infinite, Demand rate uniform, models with and without shortages, inventory model with single price break. **Simulation**: Definition, Types of simulation models, phases of simulation, applications of simulation

Learning Resource
Text books:
1. Operations Research, by S.D.Sharma, Kedarnath & Ramnath publications (15th edition),2013. 2. Introduction to Operations Research, by Taha, Pearson Education,New Delhi, (8th edition), 2008
Reference books
1. Operations Research, (4th edition) by A.M .Natarajan, P. Balasubramani, ATamilarasi, Pearson Education, New Delhi, 2009. 2. Operations Research, (2nd edition) by R.Pannerselvam, 2009,PHI Publications, Noida 3. Operations Research, (2nd edition) by Wagner, 2007, PHI Publications, Noida 4. Operation Research, (4th edition) by J.K.Sharma, 2009, MacMilan publishers, india Ltd. New Delhi.
E-Resources & other digital Material:
1. http://nptel.ac.in/courses/112106134/ 2. http://nptel.ac.in/courses/112106131/

MANAGEMENT INFORMATION SYSTEMS

Course Code	20ME2701B	**Year**	IV	**Semester**	I
Course Category	Open Elective-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

CO	Statement	Skill	Blooms	Units
CO1	Discuss the basic concepts of MIS, Decision making, Applications of MIS, Decision support systems, BPR and E- Commerce.	Understand	L2	1,2,3,4,5
CO2	Interpret the MIS decision making and its applications.	Apply	L3	2,3
CO3	Categorise Decision support systems and Business Process Re-Engineering	Apply	L3	4
CO4	Summarise the Electronic commerce environment and its opportunities.	Apply	L3	5

Syllabus		Course Outcomes
Unit No	**Contents**	
Unit-I	**Introduction to MIS**: Definition of MIS, Role and Impact of MIS, MIS: Support to the management, As tool for Management Process, Basic model of organization, Modifications to the basic model, organization as a system, MIS: organization, Strategic management of business.	**CO1**
Unit-II	**Decision Making:** Concepts, Methods, Tools, Procedures, Organizational decision making, MIS and Decision making concepts, Information: A Quality Product, Classification of information, Value of information, General model of Human as information processor, Types of systems, Handling system complexity, Development of long range plans of the MIS, Development and implementation of MIS, Factors of Success and failure for MIS.	**CO1, CO2**
Unit-III	**Applications:** Applications in Manufacturing Sector, Personnel, financial, production, materials, marketing management, Applications in service sector, creating a Distinctive service, MIS in service industry, Technology of Information systems, Data processing, Transaction processing, Application processing, TQM of Information systems, Programming languages for system coding.	**CO1, CO2**

Unit-IV	**Decision support systems and BPR:** Concept and philosophy, Deterministic systems, Artificial Intelligence systems, Knowledge based expert system, Enterprise Management systems, ERP basic features EMS and MIS, Business Process Re- Engineering, Process model of organization, Value stream model of the organization MIS and BPR.	**CO1, CO3**

Contribution of Course Outcomes towards the achievement of Program Outcomes

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

Learning Resources

Text Books:	1. W.S. Jawadekar, Management Information Systems: A Global Digital Enterprise Perspective, 5th Edition, McGraw Hill Education, 2013. 2. D. Minoli, Web Commerce Technology Hand Book, 1st edition, McGraw Hill Education, 2000.
Reference Books:	1. K.C. Laudon and J. Laudon, Management Information Systems: Managing a Digital firm, 11th Edition, Pearson Education, 2012. 2. D. Gordon and M. Oslon, Management Information Systems: Conceptual Foundations, Structure and Development, 2nd Edition, McGraw Hill Education Pvt Ltd, India, 2001. 3. R.G. Murdic, J.E. Ross and J.R. Clagget, Information Systems for Modern Management, 3rd Edition, PHI, 2008. 4. K.Ravi and A.B. Whinston, Frontiers of Electronic Commerce, 1st edition, Pearson India, 2002.

ENVIRONMENTAL MANAGEMENT & AUDIT

Course Code	20CE2702A	**Year**	IV	**Semester(s)**	I
Course Category	Open Elective-IV	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	20MC1301 - Environmental Science
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	**Illustrate** basic knowledge on solid waste management	L2
CO2	**Demonstrate** the handling of biomedical waste and its disposal	L3
CO3	**Distinguish** the E-waste sources, problems, control measures and E-waste rules	L3
CO4	**Outline** the basic principles of EIA.	L2
CO5	**Understand** the activities in environmental auditing.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes

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

1- Low **2-Medium** **3-High**

Course Content

UNIT-1	**INTRODUCTION TO SOLID WASTE MANAGEMENT** Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics, segregation of solid wastes – source reduction of waste – objectives of waste processing, elements of solid waste management –public role in solid waste management.	**CO1**
UNIT-2	**BIOMEDICAL WASTE MANAGEMENT** Definition-Sources-Classification of biomedical waste – Objectives of Biomedical waste management-segregation-containers for biomedical waste-Labelling Collection-Transport-Disposal methods	**CO2**
UNIT-3	**E-WASTE MANAGEMENT** E-waste: Sources- Types- components; Collection process- Segregation-Disposal methods; Effect on air, water and soil; Health hazards; Role of individual for E-waste management. Current E-waste Management Rules	**CO3**
UNIT-4	**ENVIRONMENTAL IMPACT ASSESSMENT (EIA)** Introduction-Definition-Scope-Objectives of EIA-Basic EIA Principles, Classification of EIA-Life Cycle Assessment-Environmental Policy of India. Baseline Data Acquisition: Environmental Inventory- Rapid EIA.	**CO4**
UNIT-5	**ENVIRONMENTAL AUDIT INTRODUCTION**	**CO5**

<table>
<tr><td></td><td>Environmental audit Significance for Industry-Elements of Environmental audit. Process of environmental audit-Pre audit- Activity -Activities at site-Post audit.</td><td></td></tr>
<tr><th colspan="3">Learning Resources</th></tr>
<tr><td>Text Books</td><td colspan="2">1. Agarwal, K.M., Sikdar, P.K., Deb., S.C (2005) A Text Book of Environment, Macmillan India Limited.
2. Sharma, R.D. (1976), Organisational Management, Light and Life Publishers, New Delhi.
3. Varma and Agarwal, Theory & practice of Management Forward Book Depot, New Delhi</td></tr>
<tr><td>Reference Books</td><td colspan="2">1. Kovntz, H and C. Danvel (1978): Essential of management, second edition, Tata Mc Graw Hill publishing company, New Delhi.
2. Erickson, P.A. (1977) Environmental Impact Assessment – Principles and Erickson, P.A. (1977)</td></tr>
<tr><td>E-Resources & other digital material</td><td colspan="2">http://nptel.ac.in</td></tr>
</table>

DATABASE MANAGEMENT SYSTEMS

Course Code	20CS2702A	**Year**	IV	**Semester**	I
Course Category:	Open Elective	**Branch**	**IT/ME/EEE/ ECE/CE**	**Course Type**	Theory
Credits:	3	**L – T – P**	3-0-0	**Prerequisites:**	Nil
Continuous Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the basic concepts of database management systems	**L2**
CO2	Apply SQL commands to find solutions for a given application	**L3**
CO3	Apply ER Modeling to design a database application	**L3**
CO4	Apply normalization techniques to improve database design.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

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

Unit No.	CONTENTS	Mapped CO
I	**Introduction to Databases:** Characteristics of the Database Approach, Advantages ofusing the DBMS Approach, A Brief History of Database Applications. **Overview of Database Languages and Architectures:** Data Models, Schemas andInstances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Database System environment, Centralized and Client-ServerArchitecture for DBMS.	**CO1**
II	**Relational Model:** The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas. **SQL:** Data Definition, Constraints, Basic Queries and Updates, Views(Virtual Tables)in SQL	**CO2**

III	**Conceptual Data Modeling :** High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types. **ER-Diagrams:** Refining the ER Design, ER Diagrams, Naming Conventions andDesign Issues	**CO3**
IV	**Database Design Theory**: Functional Dependencies, Normal forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form.	**CO4**
V	**Transaction Processing**: Introduction, Transaction and System Concepts, Desirable Properties of Transactions. **Introduction to Protocols for Concurrency Control in Databases:** Two-Phase Locking Techniques for Concurrency Control - Types of Locks and System Lock Tables.	**CO1**

Learning Resources
Text books
1. Database Systems Models, Languages, Design and Application Programming, Ramez Elmasri, Shamkant B.Navathe, 6th Edition, Pearson.
References
1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, 3rd Edition, TMH. 2. Data base System Concepts, Abraham Silberschatz, Henry F Korth, S.Sudarshan, 5th Edition, McGraw Hill.
e-Resources and other Digital Material
1. https://nptel.ac.in/courses/106/105/106105175/ 2. https://onlinecourses.nptel.ac.in/noc21_cs04/ 3. https://nptel.ac.in/courses/106/106/106106093/

TELECOMMUNICATIONS

Course Code	20EC2702A	Year	IV	Semester	I
Course Category	Open Elective-IV	Branch	ECE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	--
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Infer the basic knowledge of telecommunication system, regulations (L2).
CO2	Make use of revolutionary changes in Tele Communication technologies (L3).
CO3	Analyse different components of tele communication system. (L4).
CO4	Appraise the use of various components of telecommunication systems (L4).

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2	3									2				
CO3		2								2			2	2
CO4		2								2			2	2
Average* (Rounded to nearest integer)	3	**2**								**2**			2	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Telecommunication Systems:** Evolution of Tele Communication Systems, Simple telephone communication, Telephones, Telephone System, Facsimile, Internet Telephony, Tele Communication Standards.	CO1 – CO4
II	**Cell Phone Technologies**: Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital Cell Phone Systems, Long Term Evolution and 4G Cellular Systems	CO1 – CO4
III	**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks,WiMAX and Wireless Metropolitan-Area Networks- Infrared wireless- Ultra wideband wireless- Additional wireless applications	CO1 – CO4
IV	**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers.	CO1 – CO4

V	**Satellite Communication:** Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Navigation Satellite Systems.	CO1 – CO4

Learning Resources
Text Books
1. Louis E. Frenzel Jr., Principles of Electronic Communication Systems, 4/e, Mc Graw Hill Publications, McGraw-Hill Education, 2016. 2. Telecommunication Switching Systems and Networks, by Thiagarajan Viswanathan, PHI
Reference Books
1. Telecommunication Switching and Networks. By P.Gnanasivam, New Age International 2. Willium C. Y. Lee, “Wireless & Cellular Telecommunications”, McGraw-Hill Companies Inc, Third Edition, 2006.1. 2. Wayne Tomasi, Advanced Electronic Communication Systems, 4/e, Pearson Education, 2013. 3. Dennis Roddy, Electronic Communications, 4/e, Pearson Education, 2003.

SATELLITE COMMUNICATIONS

Course Code	20EC2702B	Year	IV	Semester	I
Course Category	Open Elective-IV	Branch	Common to All	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	--
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Illustrate** the basic concepts of satellite communication and different Frequency allocations for satellite services. (L2)
CO2	**Analyze** the satellite orbits and link design for transmission & reception of signals (L4)
CO3	**Analyze** various satellite subsystems and its functionality. (L4)
CO4	**Choose** appropriate multiple access technique for a given satellite communication application (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

Syllabus

Unit No.	Contents	Mapped CO
I	**Introduction :** Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications.	CO1
II	**Orbital Mechanics And Launchers:** Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.	CO1, CO2
III	**Satellite Subsystems:** Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.	CO1, CO3
IV	**Satellite Link Design:** Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.	CO1, CO2
V	**Multiple Access:** Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA On-board processing, DAMA, Code Division Multiple access (CDMA).	CO4

Learning Resources
Text Books
1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2rd Edition, 2003 2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.SuyderhoudPearson Publications, 2nd Edition, 2003.
Reference Books
1. Satellite Communications : Design Principles - M. Richharia, BS Publications, 2rd Edition, 2003 2. Satellite Communication - D.C Agarwal, Khanna Publications, Mc.Graw Hill, 5th Edition, 2008. 3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004. 4. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996
e- Resources & other digital material
1. https://nptel.ac.in/courses/117/105/117105131/3.https://nptel.ac.in/courses/108/105/108105159/

FUNDAMENTALS OF ARTIFICIAL INTELLEGENCE

Course Code	20IT2702A	**Year**	IV	**Semester**	I
Course Category	**Open Elective-IV**	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		**Blooms TaxonomyLevel**
Upon successful completion of the course, the student will be able to		
CO1	Know the challenges and concepts of AI.	L2
CO2	Solve problems using heuristics search algorithms	L3
CO3	Transform knowledge into rules.	L3
CO4	Demonstrate Symbolic reasoning under uncertainty	L3
CO5	Acquainted with expert systems.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength ofcorrelations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 1 1	PO1 2	PSO1	PSO 2
CO1	3												2	3
CO2		3											3	3
CO3		3											3	3
CO4		3					3						3	3
CO5				3									3	3

Syllabus		
Unit No	Contents	Mapped CO
I	What is AI: The AI Problems, What is an AI Techniques, Criteria for Successes? Problems and problem spaces and Search: Problem as a state space search, Production systems, Problem Characteristics, Production system characteristics.	CO1
II	Heuristic search technique: Generate and test, Hill climbing, Best First search, Problem reduction, Constraint satisfaction.	CO1, CO2
III	Knowledge Representation issues: Representations and mappings. Representing knowledge using rules: Procedural knowledge Vs Declarative knowledge, Forward Vs Backward reasoning, matching.	CO3
IV	Symbolic reasoning under uncertainty: Introduction to Non monotonic reasoning, Implementation in DFS and BFS. Weak, strong slot and filler structures: Semantic nets, Frames, Conceptual dependency, Scripts	CO4
V	Planning: Goal stack planning, Hierarchical planning Expert Systems: Expert system shells, Knowledge acquisition.	CO5

Learning Recourses
Text Books
1. Artificial Intelligence, 2nd Edition, E.RichandK. Knight (TMH).
References
1. Artificial Intelligence and Expert Systems–Patterson PHI 2. Expert Systems Principles and Programming-Fourth Edn, Giarrantana/Riley,Thomson 3. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition–PearsonEducation.
e-Resources & other digital material
http://www.jntuk-coeerd.in/ http://nptel.ac.in/video.php?subjectId=106105079 http://nptel.iitk.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Artificial%20intelligence/New_index1.html

MECHATRONICS

Course Code	20ME2702A	Year	IV	Semester	I
Course Category:	Open Elective-IV	Branch	EEE	Course Type	Theory
Credits:	3	L – T – P	3 – 0 – 0	Prerequisites:	Basic electrical and electronics engineering
Continuous Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

CO:	Statement: Upon successful completion of the course, the student will be able to	Skill	Blooms Level	Units
CO1	Explain the concepts related to elements of Mechatronic systems.	Understand, Communication	L2	1,2,3, 4,5
CO2	Summarize the construction and working of sensors used in building mechatronicsystems.	Apply, Communication	L3	1
CO3	Illustrate various types of actuation systems and their components.	Apply, Communication	L3	2
CO4	Develop mathematical models using building blocks and make use of these models to find the dynamic response.	Apply, Communication	L3	3
CO5	Summarize the construction and working of closed loop controllers, Micro processor and Micro controllers.	Apply, Communication	L3	4
CO6	Illustrate the features and applications of digital logic, PLC and of Fuzzy logic.	Apply, Communication	L3	5

Course Articulation Matrix:

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3									2		2	3	1
CO2	3									2		2	3	1
CO3	3		3							2		2	3	1
CO4	3	3			2					2		2	3	1
CO5	3				2					2		2	3	1
CO6	3				2					2		2	3	1

	Course Content	Mapped CO s
UNIT-1	**INTRODUCTION:** Definition of Mechatronics, evolution of mechatronics, systems, measurement systems, control systems, mechatronic design process, traditional design and mechatronic design, applications of mechatronic systems, advantages and disadvantages of mechatronic systems. **SENSORS:** classification of sensors, basic working principles, Velocity	CO1 CO2

	sensors – Proximity and Range sensors, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch. Light sensors – Photodiodes, phototransistors, tactile sensors – PVDF tactile sensor, micro-switch and reed switch, Piezoelectric sensors, vision sensor	
UNIT-2	**PNEUMATIC AND HYDRAULIC ACTUATION SYSTEMS:** Actuation systems, Pneumatic and Hydraulic systems- constructional details of filter, lubricator, regulator, direction control valves, pressure control valves, flow control valves, actuators-linear and rotary. **ELECTRICAL ACTUATION SYSTEMS:** Electrical systems, Mechanical switches, solid state switches, solenoids, DC motors, AC motors, stepper motors. Characteristics of pneumatic, hydraulic, electrical actuators and their limitations.	**CO1** **CO3**
UNIT-3	**BASIC SYSTEM MODELS:** Mathematical models, mechanical system building blocks, electric system building blocks, fluid system building blocks, thermal system building blocks. **DYNAMIC RESPONSES OF SYSTEMS:** Transfer function, Modelling dynamic systems, first order and second order systems.	**CO1** **CO4**
UNIT-4	**CLOSED LOOP CONTROLLERS:** Classification of control systems, feedback, closed loop and open loop systems, continuous and discrete processes, control modes, two step mode, proportional mode, derivative control, integral control, PID controller. **MICROPROCESSOR AND MICRO CONTROLLER:** Introduction, Architecture of a microprocessor (8085), Architecture of a Micro controller, Difference between microprocessor and a micro controller.	**CO1** **CO5**
UNIT-5	**DIGITAL LOGIC:** Digital logic, number systems, logic gates, Boolean algebra, Karnaugh maps, application of logic gates, sequential logic, transducer Signal Conditioning and devices for data conversion. **PROGRAMMABLE LOGIC CONTROLLERS:** Introduction, basic structure, input/output processing, programming, mnemonics, timers, internal relays and counters, shift register, master and jump controls. Data handling, Analog input/output, selection of a PLC. **FUZZY LOGIC APPLICATIONS IN MECHATRONICS**: Fuzzy logic systems, Fuzzy control,Uses of Fuzzy expert systems.	**CO1** **CO6**

Learning Resources

Text Books:	1. Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering, (3rdedition), by W Bolton, Pearson Education Press, 2005. 2. Mechatronics System Design, 5th Indian reprint, 2009, by Devdas shetty, Richard A. kolk,PWS Publishing Company
Reference Books:	1. Mechatronics Source Book, by Newton C Braga, Thomson Publications, Chennai. 2. Mechatronics, by N. Shanmugam, Anuradha Agencies Publishers. 3. Control sensors and actuators, by C.W.Desilva, Prentice Hall. 4. Design with Microprocessors for Mechanical Engineers, by Stiffler, A.K.McGraw- Hill(1992).
E-Resources & other digital Material:	https://onlinecourses.nptel.ac.in/noc22_me54/course

ROBOTICS

Course code	20ME2702B	Year	IV	Semester	I
Course category	Open Elective-IV	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	-
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

CO	Statement: The students will be able to	Skill	Blooms Level	Units
CO1	Understand the basic anatomy of robots, actuators, end effectors, robot sensors, programming and applications.	Understand	L2	1,2,3,4,5
CO2	Understand the working principles of robot actuators, end effectors	Understand	L2	2
CO3	Apply robot programming skills	Apply, Modern Tool Usage	L3	3
CO4	Apply knowledge of robot sensors and their applications in industries	Apply	L3	4,5

	Contribution of Course Outcomes towards achievement of Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3												3	1
CO2	3	3											3	1
CO3	3	3	2		2								3	1
CO4	3		2										3	1

Syllabus	
Unit No	Contents
I	**Introduction:** Automation and robotics – History of robots -Robot anatomy – classification of robots, major components-robot specifications, selection of robots.
II	**Robot actuators**- Pneumatic, Hydraulic actuators, electric & stepper motors **End Effectors**- types of end effectors, grippers and tools, Requirements and challenges of end effectors.
III	**Robot Programming: -** Robot programming languages - programming methods - off and on-line programming - Lead through method - Teach pendent method, simple programs.
IV	**Sensors used in robots:** Sensor devices, Types of sensors - contact, position and displacement sensors, Force and torque sensors - Proximity and range sensors - acoustic sensors –slip sensors, Robot vision systems
V	**Applications of robots:** Application of robots in industry - material handling, processing operations, assembly, and inspection operations.

Learning Resource
Text books:
1. Mikell P. Groover. Industrial Robotics Technology Programming and Applications, McGraw Hill Co., Singapore. 2. Robotic Engineering by Richard D.Klafter, Prentice Hall
Reference books
1. Introduction to Robotics – Saeed B.Niku, Prentice Hall 2. Introduction to Robotics – John J. Craig, Addison Wesley
E-Resources & other digital Material:
1. 1.http://nptel.ac.in/downloads/112101098/

IoT APPLICATIONS IN ELECTRICAL ENGINEERING

Course Code	20SA8752	**Year**	IV	**Semester(s)**	I
Course Category	SOC	**Branch**	EEE	**Course Type**	Skill Oriented
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Nil
Continuous Internal Evaluation:	**-**	**Semester End Evaluation:**	**50**	**Total Marks:**	**50**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Examine the various fundamentals, architectures and technologies of Internet of things. (L3)
CO`2	Illustrate the various communication technologies and sensor technologies used in Internet of things. (L3)
CO3	Demostrate the various device connectivity methods using web and internet on the IoT environment. (L3)
CO4	Apply the knowledge of Internet of Things in the field of electrical engineering. (L3)
CO5	Get the ability to engage in independent study to make an effective presentation and submit a report on various technologies.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**The Internet of Things :** An Overview of Internet of Things (IoT) – Architecture – Technology behind IoT – Sources of the IoT – M2M Communication – Examples of IoT.	**CO 1 CO 5**
II	**Design Principles for Connected Devices**: Introduction –IoT/M2M systems, Layers and Designs Standardization – Communication Technologies – Data Enrichment, Consolidation and Device Management atGateway – Ease of designing and affordability.	**CO 2 CO 5**

III	**Design Principles for the Web Connectivity**: Introduction – Web Communication protocols for Connected Devices - Message Communication protocols for Connected Devices – Web Connectivity for connected devices network.	**CO 3** **CO 5**
IV	**Internet Connectivity Principles**: Internet connectivity, Internet based communication – IP addressing in the IoT – Application Layer Protocols: HTTP, HTTPS.	**CO 3** **CO 5**
V	**Sensor technology**: Actuator, Sensor data communication protocols, Radio Frequency Identification technology, Wireless Sensor Network Technology.	**CO 4** **CO 5**

Exp.No	Contents	Mapped CO
1	Familiarization with Arduino/Raspberry Pi and perform necessary software installation.	CO 1
2	Digital I/O Interface – Multicolour Led, IR Sensor, PIR, Slot Sensor	CO 2
3	To interface temperature Sensor with Arduino and write program to print temperature and humidity readings	CO 2
4	Wireless module interface – Bluetooth and WiFi	CO 3
5	Smart Home Andriod App Development using APP Inventor and Arduino	CO 3
6	Design of digital Voltmeter and Ammeter	CO 4
7	Direction and Speed control of DC motor	CO 4

Learning Resources
Text Books
1. Raj Kamal, Internet of Things: Architecture, Design Principles, McGraw Hill Education(India) Pvt. Limited, 2nd Edition, 2022.
Reference Books
1. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley, First edition, 2013. 2. Arshdeep Bahga, and Vijay Madisetti, Internet of Things : A Hands-on Approach, VPT publishers, 1st edition, 2014
Web Links 1. https://nptel.ac.in/courses/106105166

ADVANCED ELECTRICAL DRIVES

Course Code	20EE6701A	**Year**	IV	**Semester(s)**	I
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Power Electronics
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the stator voltage-controlled induction motor drive. **(L2)**
CO2	**Examine** the operation of stator frequency control and CSI fed induction motor control **(L3)**
CO3	**Analyze** the concept of Linear Transformation **(L4)**
CO4	**Describe** the field-oriented control of induction machine **(L3)**
CO5	**Analyze** the control of synchronous motor drives. **(L4)**
CO6	**Submit a report** on various control of advanced Electric Drives

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													1	2
CO2	3						2				2		1	2
CO3	3			3								2	1	2
CO4		3	3				2				2		1	2
CO5		3		3								2	1	2
CO6									3	3			1	2

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	STATOR VOLTAGE CONTROLLED INDUCTION MOTORS Introduction - Equivalent circuit– Steady state performance equations, Variable voltage constant frequency operation - Conventional method - Variable voltage characteristics –- Control of induction motor by AC voltage controllers - Waveforms - speed torque characteristics - Four quadrant operation – Closed loop speed control - different braking methods.	CO2, CO3 CO6
II	STATOR FREQUENCY CONTROLLED INDUCTION MOTORS Constant variable frequency operation - constant Volt/Hz operation - speed torque characteristics, Analysis -Drive operating regions, variable stator	CO2 CO3 CO4

	current operation and analysis, six step inverter voltage and frequency control - CSI fed IM variable frequency drives - comparison - Closed loop speed control.	CO6
III	LINEAR TRANSFORMATION Introduction, transformation from three phases to two phases and vice verse, transformation from rotating axes to stationary axes, physical concepts of Park's and Clark's transformation.	CO3, CO4, CO6
IV	FIELD ORIENTED CONTROL Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy, Vector control strategy	CO4, CO5 CO6
V	SYNCHRONOUS MOTOR DRIVES Starting and braking of Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – voltage source inverter drive with open loop control – self-controlled and separate controlled synchronous motor.	CO4, CO5, CO6

Learning Resources

Text Books

1. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education 2002.
2. N. Mohan, Power Electronics- Converters, Applications and Design, 3rd Ed., John Wiley & Sons, 2003.

Reference Books

1. Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill, Second Edition, 2010.
2. Gobal K.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, Second Edition ,2009 .
3. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
4. M. Rashid, Power Electronics- Circuits, Devices and Applications, 3rd Ed., Prentice Hall, 2004.

Web Links

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

GRID INTEGRATION OF RENEWABLE ENERGY SYSTEMS

Course Code	20EE6701B	**Year**	IV	**Semester(s)**	I
Course Category	Honors	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the issues related to the integration of distributed renewable generation into the network.(L2)
CO2	**Apply** knowledge about various conversion technologies for grid stabilization (L3)
CO3	**Analyze** various integration techniques for RE sources.(L4)
CO4	**Examine** power system operation with various integration methods (L3**)**
CO5	**Ability** to apply suitable integration technique and submit a report

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Renewable Sources of Energy, Renewable Energy Versus Alternative Energy, Planning and Development of Integrated Energy, Renewable Energy Economics, Integration of Renewable Energy Sources, Energy Recovery Time, Sustainability, Modern Electronic Controls of Power Systems.	**CO1 CO2 CO3 CO5**
II	**Interconnection Technologies :** Principles of Power Injection, Converting Technologies, Power Converters for Power Injection into the Grid, Power Flow, Interconnection Technologies: Synchronous Interconnection, Induction Interconnection, Inverter Interconnection.	**CO1 CO2 CO3 CO4 CO5**
III	**Interconnection Considerations**: Voltage Regulation, Integration with Area EPS, Response to Voltage Disturbance, Response to Frequency Disturbance, Loss of Synchronism, Feeder Reclosing Coordination, Unintentional Islanding Protection.	**CO1 CO3 CO4 CO5**

IV	**Integration of Alternative Energy sources :** IEEE 1547, National Electrical Code, UL Standards, Interconnection Examples for Alternative Energy Sources: Synchronous Generator for Peak Demand Reduction, Small Grid-Connected Photovoltaic System. Grid Integration of PV systems.	**CO1 CO2 CO3 CO4 CO5**
V	**Integration of Multiple Renewable Energy Sources:** DC-Link Integration, AC-Link Integration, HFAC-Link Integration, Islanding and Interconnection Control, DG Control and Power Injection, DG System operating as Part of Utility Power System.	**CO1 CO2 CO3 CO4 CO5**

Learning Resources
Text Books
1. Felix A. Farret and M. Godoy Simoes,"Integration of Alternative sources of Energy", IEEE Press – Wiley-Interscience publication, 2006. 2. Majid Jamil, M. Rizwan, D.P.Kothari ,"Grid integration of solar photovoltaic systems", , CRC Press (Taylor & Francis group), 1st Edition,2017.
Reference Books
1. Marco H. Balderas ,"Renewable Energy Grid Integration", Nova Science Publishers, New York, 2009 2. Ali Keyhani Mohammad Marwali and MinDai,"Integration and Control of Renewable Energy in Electric Power System"John Wiley publishing company,2010 3. S. Chowdhury, S.P. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", IET Power Electronics Series, 2012 4. G.Masters,"Renewable and Efficient Electric Power Systems",IEEE-Wiley Publishers, 2013
e-Resources
https://www.irena.org/publications/2022/Apr/Grid-codes-for-renewable-powered-systems

SPECIAL ELECTRICAL MACHINES

Course Code	20EE6701C	**Year**	IV	**Semester**	I
Course Category	Honors	**Branch**	E.E.E	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Electrical Machines – I &II
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of special machine operation.
CO2	**Examine** the performance characteristics of stepper and switched reluctance motor. (L3)
CO3	**Analyze** the concepts of control, torque of stepper and switched reluctance machines. (L4)
CO4	**Develop** the performance characteristics of permanent magnet, BLDC and linear induction motors. (L3)
CO5	**Outlines** the concepts of control, torque of permanent magnet, BLDC and linear induction motors. (L4)
CO6	**Submit** a report on permanent magnet, Stepper motor, switched reluctance motor BLDC motor and linear induction motor.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3					1		1				1	2	1
CO3		3		3									2	1
CO4	3					1		1				1	2	1
CO5		3		3									2	1
CO6									3	3				

Syllabus

Unit No.	**Contents**	**Mapped CO**
I	**Stepper Motors** Principle of operation of Stepper Motor, Constructional details, Classification of stepper motors, Different configuration for switching the phase windings, Control circuits for stepper motors, Open loop and closed loop control of two-phase hybrid stepping motor.	CO1 CO2 CO3 CO6
II	**Switched Reluctance Motors** 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	CO1 CO2 CO3 CO6

III	**Permanent magnet materials and PMDC motors :** Introduction-classification of permanent magnet materials used in electrical machines, minor hysteresis loop and recoil line-Stator frames of conventional dc machines, Development of electronically commutated dc motor from conventional dc motor, Permanent-magnet materials and characteristics, B-H loop and demagnetization characteristics, high temperature effects reversible losses-Irreversible losses, Mechanical properties, handling and magnetization Application of permanent magnets in motors-power density, operating temperature range-severity of operation duty **Permanent Magnet Synchronous Motor (PMSM**): Construction, Principle of Operation, EMF Equation, Torque Equation, Phasor Diagram, Circle Diagram, Comparison of Conventional and PMSM, Control of PMSM, Applications	CO1 CO4 CO5 CO6
IV	**Permanent Magnet Brushless DC Motor** Principle of operation of BLDC motor, Types of constructions, Surface mounted and interior type permanent magnet DC 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.	CO1 CO4 CO5 CO6
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.	CO1 CO4 CO5 CO6

Learning Resources

Text Books

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

Reference Books

1. AE Clayton and NN Hancock, “The Performance and Design of Direct Current Machines”, CBS Publishers, 3rd edition, 2004.
2. M.G. Say, “Performance and Design of A.C. Machines”, ELBS and Pitman & Sons, 4th edition, 2013.

e- Resources & other digital material

https://nptel.ac.in/courses/108102156
https://nptel.ac.in/courses/108/102/108102146/

SEMICONDUCTOR DEVICE MODELING

Course Code	20EE6701D	**Year**	IV	**Semester(s)**	I
Course Category	Honors	**Branch**	**EEE**	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Electronic Devices & Amplifier Circuits
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	**70**	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** Basic terminologies Semiconductor Device Modeling (L2)
CO2	**Illustrate the** Large signal model and small signal of the BJT (L3)
CO3	**Construct** the Large scale and small signal model of JFET and MOSFET (L3)
CO4	**Analyze** the effect of temperature of the BJT,FET and MOSFET (L4)
CO5	**Assessing** the modeling parameters of BJT and MOS devices (L4)
CO6	**Submit** a report on BJT,FET and MOS device modeling.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	3	3		2									2	1
CO3	3				2								2	1
CO4		3	3	2									2	1
CO5			3		3								2	1
CO6									3	3			2	1

SYLLABUS

Unit No.	Contents	Mapped CO
I	PN-Junction Diode and Schottky Diode DC Current-Voltage Characteristics-Static Model-Large signal Model-Small Signal Model-Temperature and Area Effects on the Diode Model	CO2, CO3, CO6
II	Bipolar Junction Transistor (BJT) Transistor Conventions and Symbols- Ebers-Moll Static Model-Large Signal Model-Small Signal Model-Gummel Poon Static Model-Large SignalModel-Small Signal Model-Temperature and Area Effects on the BJT Model.	CO2, CO3, CO6

III	Junction Field-Effect Transistor(JFET) Static Model-Large Scale Model-Small Scale Model- Temperature and Area Effects on the JFET Model.	CO3, CO4, CO6
IV	The MOS Transistor Structure and Operating Regions of the MOS Transistor-Equations for Level 1 Model-Level 2 Model-Level 3 Model-Effects of Series resistance-small signal model- The effects of Temperature	CO4, CO5, CO6
V	BJT and MOS Parameter Measurements BJT-input and model Parameters-Parameter measurements- MOS parameter measurements- Calculation of Parameters of the Level 1Model, Level 2 Model and Level 3 Model	CO4, CO5, CO6

Learning Resources
Text Books
1. Paolo Antognetti, Giuseppe Massobrio, Semiconductor Device Modeling with SPICE, McGraw-Hill , 1993 2. Nandita dasgupta, amitava dasgupta, “semiconductor devices modelling and technology,PHI,2004
Reference Books
1. Giuseppe Massabrio , Paolo Antognetti , “Semiconductor Device Modeling with Spice”,second edition, Tata McGraw-Hill, 2010 2. Christopher M. Snowden, Robert E. Miles, Compound Semiconductor Modelling, Springer-Verlag, , Springer London Ltd, 1993
Web Links 1. https://nptel.ac.in/courses/117106033

CLOUD COMPUTING

Course Code	20CS5701	Year	IV	Semester(s)	I
Course Category	Minor in CSE	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	4-0-0	Prerequisites	Computer Networks, Operating Systems
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the basic concepts of virtualization and Cloud Computing. (L2)
CO2	Apply cloud computing framework to build and deploy customized applications. (L3)
CO3	Analyse the given application and choose suitable platform for deploying cloud. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	Introduction to Cloud: Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments. Virtualization: Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V.	CO1
II	Cloud Computing Architecture : Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.	CO1, CO2, CO3

III	Aneka: Cloud Application Platform Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, Foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.	**CO1, CO2, CO3**
IV	Cloud Applications: Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.	**CO1, CO3**
V	Cloud Platforms in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google App Engine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.	**CO1, CO3**

Learning Resources
Text Books
1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, 2013,TMH.
Reference Books
1. Cloud Computing Principles and Paradigms, Rajkumar Buyya , James Broberg, AndrzejGoscinski, Wiley Publishing. 2. Cloud Application Architectures, George Reese , First Edition, O‟Reilly, Media 2009. 3. Cloud Computing – web based Applications that change the way you work and collaborate Online, Micheal Miller,.Pearson Education.
E- Resources & other digital material
1. http://www.slideshare.net/himanshuawasthi2109/cloud-computing-ppt-16240131 2. https://nptel.ac.in/courses/106105167 3. https://www.youtube.com/watch?v=r8Lu_BjxlZc 4. http://video.mit.edu/watch/mitef-nyc-cloud-computing-8347/

CLOUD COMPUTING

Course Code	20IT5751	Year	IV	Semester(s)	I
Course Category	Minor in IT	Branch	EEE	Course Type	Theory
Credits	4	L-T-P	4-0-0	Prerequisites	DCCN
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand Fundamental Concepts and Models of Cloud Computing and CloudEnabling Technologies, Infrastructure Mechanisms. (L2)
CO2	Determine Cloud Infrastructure Mechanisms. (L3)
CO3	Determine different Cloud Maintenance strategies. (L3)
CO4	Analyze Cloud Architectures. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Understanding Cloud Computing**: Cloud origins and influences, basic concepts andterminology, goals and benefits, risks and challenges. **Fundamental Concepts and Models:** Roles and boundaries, cloud characteristics, cloud delivery models, cloud deployment models	CO1
II	**Cloud Enabling Technology:** Datacenter technology, virtualization technology, web technology, multitenant technology, service technology.	CO1
III	**Cloud Infrastructure Mechanisms:** Logical network perimeter, virtual server, cloud storage device, cloud usage monitor, resource replication	CO1, CO2
IV	**Specialized Cloud Mechanisms :**Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per- Use Monitor, Audit Monitor, Fail over System,Hypervisor, Resource Cluster, Multi-Device Broker, State Management Database.	CO3
V	**Fundamental Cloud Architectures:** Workload distribution Architecture, resource pooling architecture, dynamic scalability architecture, elastic bresource capacity architecture, service load balancing architecture, cloud bursting architecture, elastic disk provisioning architecture, redundant storage architecture.	CO1, CO4

Learning Resources
Text Books
1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts ,Technology &Architecture, Prentice Hall,2013.
Reference Books
1. JohnW. Rittinghouse, JamesF. Ransome, Cloud Computing: Implementation, Management andSecurity, CRC Press,2012. 2. AnthonyT.Velte, TobyJVelte Robert Elsenpeter, Cloud Computing a practical approach,McGrawHill,2010. 3. MichaelMiller,CloudComputing:WebbasedApplicationsThatChangetheWay You Work and Collaborate Online, QuePublishing,2008.
E- Resources & other digital material
NPTEL VIDEO LECTURES

COMMUNICATION SYSTEMS

Course Code	20EC5701	**Year**	IV	**Semester(s)**	I
Course Category	Minor in ECE	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand Analog and Digital modulation and demodulation techniques. (L2)
CO2	Analyse Analog to Digital conversion techniques (L4)
CO3	Analyse Analog and Digital modulation Systems (L4)
CO4	Develop a GSM Cellular system for Mobile communications. (L3).

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	Block diagram of communication system, Need for modulation. **Amplitude Modulation:** Time domain and frequencydomain description of AM, single tone modulation, Generationof AM waves: square law Modulator, Switching modulator. **Demodulation of AM waves**: Square law detector, Envelopedetector. DSBSC, SSBSC and VSBSC Modulations.	CO1,CO3
II	**Angle Modulation:** Basic concepts of Phase and Frequency Modulation, Single tone frequency modulation, Narrow band FM, Wide band FM. **Generation of FM waves:** Indirect FM, Direct FM. Foster- Seeley Discriminator, Zero crossing detectors.	CO1,CO3
III	**Pulse Modulation:** Generation & Demodulation of Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Position Modulations. **Waveform Coding Techniques:** Introduction, Pulse codemodulation (PCM), Delta modulation, Adaptive delta modulation, Differential Pulse Code Modulation (DPCM).	CO1,CO2
IV	**Digital Modulation Techniques:** Coherent Phase Shift Keying, Coherent Frequency Shift Keying, Quadrature Phase Shift Keying, Non Coherent Frequency Shift Keying, Differential Phase Shift keying.	CO1, CO3

	Multiplexing: Time Division Multiplexing and Frequency Division Multiplexing.	
V	**Cellular & Mobile Systems:** Introduction to Cellular Mobile System, operation of cellular systems, Hexagonal shaped cells. **Global System for Mobile (GSM):** GSM Services and features, GSM System architecture, GSM radio subsystem, GSM Channel types, GSM Traffic channels, GSM Control channels, Examples of GSM call, Frame structure for GSM.	CO1,CO4

Learning Resources
Text Books
1. S. Haykin- Introduction to Analog and Digital Communication System, John Wiley andSons,3rd Ed., 2009. 2. W.C.Y. Lee – Mobile Cellular Telecommunications, Tata McGraw Hill, 2nd Ed., 1995.
Reference Books
1. Sam Shanmugam - Digital and Analog Communication Systems, John Wiley, 1979. 2. A B Carlson– Communication systems, McGraw-Hill, 4th Ed.,2002 3. H.Taub , D. Schilling – Principles of Communication Systems, TMH, 3rd Ed.,2008 4. Kamilo Feher- Wireless Digital Communications, PHI, 2003.
E- Resources & other digital material
1. http://www.ece.utah.edu/~npatwari/ece5520/lectureAll.pdf 2. http://nptel.iitm.ac.in/syllabus/syllabus.php?subjectId=117105077 3. http://nptel.iitm.ac.in/syllabus/117103016/ 4. http://nptel.iitm.ac.in/video.php?courseId=1036

IOT NETWORKS

Course Code	20EC5702	**Year**	IV	**Semester(s)**	I
Course Category	Minor in IoT	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Internet of Things
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Interpret the impact and challenges posed by IoT networks leading to new architecturalmodels (L2)
CO2	Identify security vulnerabilities in wireless networks, IoT applications and devices. (L3)
CO3	Demonstrate the use of wireless technologies for IoT (L3)
CO4	Distinguish relevant communicationprotocols of IOT (L4)
CO5	Interpret the services request response and publish subscribe of IOT application layer. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**INTRODUCTION:** M2M and IoT, Layered Architectures, System Components, Applications	CO1,CO2
II	**Concepts of IOT Networking:** IOT Networking, Types of Networks, Devices-Actuators and Controllers, Gateways; Security, Wireless Sensor Networks.	CO1,CO2
III	**IOT Protocol Layers:** Physical and Link layers: About physical and link layers, Wireline: Ethernet, ITU-T G.9903, IEEE1901.2, MS/TPl Wireless: IEEE802.11, IEEE802.15.3, IEEE802.15.4, Bluetooth Low Energy, ITU-T G.9959, DECT ULE, and NFC	CO1,CO3
IV	**Network and Transport Layers**: Need for IP IPv6, 6Low PAN: Addresses, Header Format, Routingand Forwarding, Header Compression, Fragmentation, Security Considerations, TCP and 6Low PAN	CO1,CO4

V	**Application Layer:** Architectures, Request/Response: REST Architecture, HTTP, XMPP, CoAP Publish/Subscribe: MQTT,AMQP	CO1,CO5

Learning Resources
Text Books
1. Rolando Herrero-Fundamentals of IoT Communication Technologies, Springer Publisher, Ist Ed., 2022 2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry-IoT Fundamentals: Networking Technologies, Protocols and Use cases for the Internetof Things, CISCO Press, 2017
Reference Books
1. Olivier Hersent, David Boswarthick and Omar Elloumi-The Internet of Things: Key applications and Protocols, Wiley 2. Vijay Madisetti and Arsh deep Bahga-Internet of Things (A Hands on Approach), 1st Ed., VPT, 2014. (ISBN: 978-8173719547) 3. Raj Kamal-Internet of Things: Architecture and Design Principles, 1st Ed., McGraw Hill, Ed., 2017 (ISBN: 978-9352605224)
E- Resources & other digital material
1. https://nptel.ac.in/courses/106/105/106105166/

ALTERNATE FUEL AND EMISSION CONTROLS IN AUTOMOTIVES

Course Code	20ME5701	**Year**	IV	**Semester(s)**	I
Course Category	Minor in Automobile Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	NIL
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the fundamental concepts of Alternative fuels andtheir emission control. (L2)
CO2	Illustrate various pollutants emitting from automotive and theireffects and control techniques. (L3)
CO3	Analyse the pollutant characteristics and methodologies,testing equipment used to measure pollutants. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	**Contents**	**Mapped CO**
I	**Alternate fuels**: Introduction to alternate energy sources, availability, properties of biofuels, methanol, ethanol, vegetable oils, biodiesel. Gaseous fuels: hydrogen, natural gas, compressed natural gas (CNG), liquefied petroleum gas(LPG) ,Hydrogen ,Producer gas, Oxygenated fuels: benzol, diethyl ether (DEE), dimethyl ether (DME)-properties and their performance.	**CO1, CO3**
II	**Pollutants and emissions:** Types of pollutants, HC, CO, CO2, NOx, smoke and soot other emissions: aldehydes, sulphur, Emission standards-Bharat stage, Euro norms, Effect of emissions on environment, human health, transient operation effects on pollution.	**CO1, CO2**
III	**Performance and emission characteristics:** alternate fuels Emission characteristics in SI engines, alcohol – gasoline blends, methanol reformed gas engine. Use of alcohols in CI engines. Properties, production and storage methods of hydrogen, safety precautions, Biogas production and its properties, properties of LPG and CNG. Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines.	**CO1, CO2, CO3**

IV	**Emission control techniques:** Engine design changes, Engine operating parameters, EGR systems, glow plugs, thermal converters, Catalytic converters: classification, honey comb, 2-way, 3-way catalytic converters, Particulate filter, Selective catalytic reduction (SCR) systems, Fumigation, water injection, secondary air injection, enhanced evaporative emission control system (EVAP), PCV system.	**CO1, CO2, CO3**
V	**Methodology and equipment to measure pollutants:** testing equipment- Exhaust gas analyzer, Orsat apparatus, NDIR, FID, Chemiluminescent analyzers, Gas chromatography, smoke meters, measurement of CO2 Test procedures: ECE, FTP Tests. SHED Test -chassis dynamometers, dilution tunnels, Cycle test-I, Cycle test-II.	**CO1, CO3**

Learning Resources
Text Books
1. V. Ganesan, Internal combustion engines,4/e, McGraw Hill, 2015. 2. J. Erjavec, A systems approach to automotive technology, 2/e, Cengage Learning, 2013.
Reference Books
1. J. B. Heywood, Internal Combustion Engines Fundamentals, McGraw Hill, 2017. 2. M.F. Hordeski, Alternative Fuels: The Future of Hydrogen, The Fairmont Press, Inc., 2008. 3. R.K. Rajput, A textbook of Internal Combustion Engines, 2/E, Laxmi Publications (P) Ltd, 2007. 4. Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated,2000. 5. S.S. Thips, Alternative Fuels: Concepts, Technologies and Developments, Jaico PublishingHouse, 2010
E- Resources & other digital material
1..https://nptel.ac.in/courses/112/104/112104122/ 2..https://ocw.mit.edu/courses/materials-science-and-engineering/3-080-economic-environmental-issues-in-materials-selection-fall-2005/

INDUSTRY 4.0 and IIoT

Course Code	20ME5702	**Year**	IV	**Semester(s)**	I
Course Category	Minor in Digital Manufacturing	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Basic Manufacturin gProcesses
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Illustrate how Industry 4.0 will change the current manufacturing technologies and processes by digitizing the value chain. (L2)
CO2	Discuss the drivers and enablers of Industry 4.0. (L2)
CO3	Apply various IIoT-related protocols. (L2)
CO4	Explain simple IIoT Systems using Arduino andRaspberry Pi. (L2)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Industry 4.0:** Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Mass Customization, Smart and Connected Business Perspective, Smart Factories	**CO1**
II	**Industry 4.0:** Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis	**CO1, CO2**
III	**Introduction to IIoT:** Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.	**CO3**
IV	**Elements of IIoT:** Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using	**CO3**

	Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.	
V	**IIoT Application Development**: Solution framework for IoT applications-Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices. Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.	**CO 4**

Learning Resources
Text Books
1. Introduction to Industrial Internet of Things and Industry 4.0, Sudip Misra, Chandana Roy,Anandarup Mukherjee, CRC Press, 2020. 2. A Hands on Approach", Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, UniversityPress, 2009. 3. Introduction to Internet of Things: A practical Approach", Dr. SRN Reddy, Rachit Thukraland Manasi Mishra, ETI Labs,2010
Reference Books
1. Internet of Things: Architecture and Design, Raj Kamal, McGraw Hill., 2005. 2. Getting Started with the Internet of Things, Cuno Pfister, O Reilly Media, 2007
E- Resources & other digital material
1.https://onlinecourses.nptel.ac.in/noc21_cs17/preview

BASIC SURVEYING

Course Code	20CE5701A	Year	IV	Semester(s)	I
Course Category	Minor in Civil Engineering	**Branch**	EEE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	20BS1101-Calculus and Linear Algebra 20BS1104-Applied Physics
Continuous Internal Evaluation:	**30**	**Semester End Evaluation:**	**70**	**Total Marks:**	**100**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Measure** the land area by chaining, compass and plane table. (L3)
CO2	**Measure** the elevation of points using dumpy level and illustrate various methods of contouring. (L3)
CO3	**Measure** the height and distance by theodolite and know about the application of tacheometric surveying (L3)
CO4	**Illustrate** the various methods of curve setting in the field and evaluate areas, volumes (L4)
CO5	**Know** the Principles of triangulation survey and precisely **measure** horizontal/vertical distancesusing advanced instrument. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

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

SYLLABUS

Unit No.	Contents	Mapped CO
I	**Chain Surveying:** Surveying objectives, linear measurements, instruments for surveying, preparation of map and plan, measurement of distance, chain surveying principles, offsets, chain surveying instruments, traverses with a chain, problems on obstacles of chain surveying. **Compass Surveying:** Types of compass, meridians and bearings, local attraction, magnetic	**CO1**

	declination, measurement of directions and angles traversing with a compass, plotting of traverse, adjustment of closing error.	
II	**Plane Table Surveying:** Principle and instruments used in plane table surveying, working operations, methods ofplane table surveying. **Levelling and Contouring:** Instruments for levelling, principle and classification of levelling, bench marks, height(level) computations, longitudinal and cross-sectional levelling, problems on levelling. Contours, characteristics of contours, contours of natural features, methods of contouring.	**CO1,CO2**
III	**Theodolite Surveying:** Theodolite component parts, classification, theodolite observations, principle of theodolitesurvey, traverse computations, practical problems. **Tacheometric Surveying:** Principle of tacheometry, methods of tacheometry, tacheometry as applied to subtensemeasurement, field work for tacheometric surveying, errors.	**CO3**
IV	**Curve Setting:** Types of curves, elements of a curve, setting out a simple curve, settingout a compound curve, reverse curve, transition curves. **Construction Surveys:** Setting out of buildings, computation of areas, earthwork measurements: LS&CS, computation of volumes.	**CO4**
V	**Triangulation Surveying:** Base of the object accessible, base of an inclined object accessible, reduced level of the elevated points with inaccessible bases, instrument axes at different levels, principle of triangulation, purpose and classification of triangulation surveys, layout of triangulation. **Total Station & GIS:** EDM instruments, Total Station, Global Positioning System, GIS	**CO5**

Learning Resources
Text Books
1. B.C. Punmia, A.K. Jain, Arun Jain, Surveying I and II, 16/e, LakshmiPublications, 2017. 2. R. Subramanian, Surveying and Levelling, 2/e, Oxford UniversityPress,2014. 3. D.G Charles, R.W. Paul, Elementary Surveying: An Introduction toGeomatics, 15/e, Prentice Hall,2018
Reference Books
1. S.K. Roy, Fundamentals of Surveying, 2/e, Prentice Hall of India, 2011. 2. T.P. Kanetkar, Surveying and Levelling, Part I and II, 4/e, New CentralBook Agency2012.
E- Resources & other digital material
1. https://nptel.ac.in/courses/105107122/ 2. http://jntuk-coeerd.in/

ANNEXURE

COMMUNITY SERVICE PROJECT

Experimental 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. Aquaculture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables

25. Organic farming
26. Corporation
27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilisation of free electricity to farmers and related issues
40. Gender ration in schooling level-observation.

Complementing the community service project the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programmes are;

Programmes for School Children

1. Reading Skill Programme (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Programme on Socially relevant themes.

Programmes for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Womens' Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water

5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti Plastic Awareness
9. Programmes on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

Programmes for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programmes

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programmes in consonance with the Govt. Departments like–
    i. Agriculture
    ii. Health
    iii. Marketing and Cooperation
    iv. Animal Husbandry
    v. Horticulture
    vi. Fisheries
    vii. Sericulture
    viii. Revenue and Survey
    ix. Natural Disaster Management
    x. Irrigation
    xi. Law &Order
    xii. Excise and Prohibition
    xiii. Mines and Geology
    xiv. Energy

Role of Students:

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the

Governmental agencies.

- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
- And also with the Governmental Departments. If the programme is rolled out, the District Administration could be roped in for the successful deployment of the programme.
- An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. **Preliminary Survey (One Week)**
   - A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
   - Asurveyformbasedonthetypeofhabitationtobepreparedbeforevisitingthehabitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
   - The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

2. **Community Awareness Campaigns (Two Weeks)**
   - Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. **Community Immersion Programme (Four Weeks)**

   Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.

4. **Community Exit Report (One Week)**

   During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks work to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.