PRASAD V POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)

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

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

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(Accredited by NBA)

PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)
AICTE approved, NAAC A^+ Accredited, An ISO 9001:2015 Certified Institution
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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 of Electronics and Communication Engineering

VISION

To evolve as a center of excellence by adopting innovative methods for teaching, learning and research in the diversified fields of Electronics and Communications

MISSION

To empower the students with technical knowledge in Electronics and Communications for pursuing higher education, for becoming entrepreneurs / employees of prominent companies and also motivating them towards research to meet the societal needs

PEOs

- PEO-I: Capable of applying the knowledge of basic sciences and engineering to understand the new concepts of Electronics and Communication Engineering
- PEO-II: Able to demonstrate technical competence for the design and development of innovative electronic and communication systems.
- PEO-III: Able to work in a team for the fulfillment of leadership role in a company / organization
- PEO-IV: Able to demonstrate passion for life-long learning through interdisciplinary research works or projects to cater societal needs

PSOs

- PSO - 1 Demonstrate competency in using computer aided design tools for the design and analysis of complex electronic and communication systems
- PSO - 2 Develop smart systems to meet the societal needs

POs

- 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.

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 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. Electronics and Communication Engineering(ECE)
4. Electrical and Electronics Engineering(EEE)
5. Information Technology(IT)
6. 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)

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

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 Frame work

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,	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 behaviour, 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.
2. 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. A CGPA of 8 has to be maintained in the

subsequent semesters without any backlog in order to keep the Honors registration active.

- SGPA or CGPA in excess of 8.0 has to be maintained in the subsequent semesters in major as well as Honors degree without any backlogs in order to keep the Honors degree registration active.
- Should both the SGPA and CGPA fall below 8.0 at any point after registering for the Honors; the Honors degree registration will cease to be active

3. 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.
4. 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).
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.

12. 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.
13. 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.

1. A student shall be permitted to register for Minors program at the beginning of 4^{th} 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 2^{nd} semester without any history of backlogs. It is expected that the 3^{rd} semester results may be announced after the commencement of the 4^{th} semester. If a student fails to acquire 7.75 CGPA up to 3^{rd} semester or failed in any of the courses, his registration for Minors program shall stand cancelled. A CGPA of 7.75 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.
   - An SGPA or CGPA in excess of 7.75 has to be maintained in the subsequent semesters in major as well as minor without any backlogs in order to keep the minor registration active.
   - Should both the SGPA and CGPA fall below 7.75 at any point after registering for the minor; the minor registration will cease to be active.

2. 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.

3. 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.

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

5. 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.

6. 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.

7. 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.

8. 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).

9. 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.

10. 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.

11. 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.

12. 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.

13. 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.

14. 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 four to 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).

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

ii.

Table: Distribution of Marks (SEE)

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

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

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.

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 121 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	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

	on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, 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.	be handed over to the police and a police case is registered against them.
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

Prasad V. Potluri Siddhartha Institute of Technology, Kanuru
Department of Electronics & Communication Engineering
B.Tech. Course Structure - PVP-20 Regulations

Semester I

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

Semester II

Course Code	Name of the course	L-T-P	Credits	Internal Marks	External Marks	Total Marks
20HS1201	Communicative English II	3-0-0	3	30	70	100
20BS1201	Differential Equations and Vector Calculus	3-0-0	3	30	70	100
20BS1203	Engineering Physics	3-0-0	3	30	70	100
20ES1201	Basic Electrical & Electronics Engineering	3-0-0	3	30	70	100
20HS1251	Communicative English II Lab	0-0-3	1.5	15	35	50
20BS1252	Engineering Physics Lab	0-0-3	1.5	15	35	50
20ES1251	Basic Electrical & Electronics Engineering Lab	0-0-3	1.5	15	35	50
20ES1252	Basic workshop	1-0-4	3	15	35	50
Total		**13-0-13**	**19.5**	**180**	**420**	**600**

Prasad V. Potluri Siddhartha Institute of Technology, Kanuru
Department of Electronics & Communication Engineering
B.Tech. Course Structure - PVP-20 Regulations

Semester III

Course Code	Name of the course	L-T-P	Credits	Internal Marks	External Marks	Total Marks
20BS1302	Numerical Methods and Complex Variables	3-0-0	3	30	70	100
20EC3301	Electronic Devices and Amplifier Circuits	3-0-0	3	30	70	100
20EC3302	Digital Logic Design	3-0-0	3	30	70	100
20EC3303	Signals and Systems	3-0-0	3	30	70	100
20EC3304	Network Theory and Analysis	3-0-0	3	30	70	100
20EC3351	Electronic Devices and Amplifier Circuits Lab	0-0-3	1.5	15	35	50
20EC3352	Digital Logic Design Lab	0-0-3	1.5	15	35	50
20ES1355	Basic Simulation Lab	0-0-3	1.5	15	35	50
20SO8354	Programming with ‘C’	1-0-2	2	0	50	50
20MC1341 A/20MC13 41B	NSS/NCC	0-0-2	Completed/ Not Completed			
Total		**16-0-13**	**21.5**	**195**	**505**	**700**

Semester IV

Course Code	Name of the course	L-T-P	Credits	Internal Marks	External Marks	Total Marks
20BS1402	Electromagnetic Fields & Waves	3-0-0	3	30	70	100
20EC3401	Analog Circuits	3-0-0	3	30	70	100
20EC3402	Communication Theory	3-0-0	3	30	70	100
20EC3403	Microprocessor & Microcontrollers	3-0-0	3	30	70	100
20EC3404	Control Systems Engineering	3-0-0	3	30	70	100
20EC3451	Analog Circuits Lab	0-0-3	1.5	15	35	50
20EC3452	Communication Theory Lab	0-0-3	1.5	15	35	50
20EC3453	Microprocessor & Microcontrollers Lab	0-0-3	1.5	15	35	50
20SO8453	AI Tools Lab	1-0-2	2	0	50	50
20MC1402	Environmental Sciences	3-0-0	0	30	70	100
Total		**19-0-11**	**21.5**	**225**	**575**	**800**
Honors /Minor courses		**3-1-0**	**4**	**30**	**70**	**100**

Courses for Honors

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC6401	Digital Electronics Design with VHDL	3-1-0	4
2	20EC6402	Cognitive Radio	3-1-0	4
3	20EC6403	Solid State Microwave Devices	3-1-0	4
4	20EC6404	Artificial Intelligence	3-1-0	4

Course for Minor in Electronics and Communication Engineering

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5401	Analog Systems	3-1-0	4

Course for Minor in IOT

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5402	Microcontrollers and Interfacing	3-1-0	4

Prasad V. Potluri Siddhartha Institute of Technology, Kanuru

Department of Electronics & Communication Engineering

B.Tech. Course Structure - PVP-20 Regulations

Semester V

Course Code	Name of the course	L-T-P	Credits	Internal Marks	External Marks	Total Marks
20EC3501	Digital Communications	3-0-0	3	30	70	100
20ES1501	Internet of Things	3-0-0	3	30	70	100
20ES1502	Data Structures and Algorithms	3-0-0	3	30	70	100
	Open Elective I	3-0-0	3	30	70	100
20EC4501	Professional Elective-I	3-0-0	3	30	70	100
20EC3551	Digital Communications Lab	0-0-3	1.5	15	35	50
20ES1551	Internet of Things Lab	0-0-3	1.5	15	35	50
20SA8554	JAVA Programming	1-0-2	2	0	50	50
20EC3581A	Summer Internship 4-6 weeks (Mandatory) after second year (to be evaluated during V semester	0-0-0	1.5	0	50	50
20MC1502	Universal Human Values	2-0-0	0	30	70	100
20EC3591	Community Service Project	0-0-0	4	100	0	100
Total		**18-0-8**	**25.5**	**310**	**590**	**900**

Honors /Minor courses	**3-1-0**	**4**	**30**	**70**	**100**

Professional Elective-I

S.No.	Course Code	Name of The Subject
1	20EC4501A	Wireless Communications and Networks
2	20EC4501B	Digital Integrated Circuits & Applications
3	20EC4501C	Transmission lines and Waveguides
4	20EC4501D	Computer Architecture & Organization
5	20EC4501E	Artificial Neural Networks

Open Elective-I

S.No.	Course Code	Name of The Subject
1	20CE2501A	Air Pollution and Control
2	20CS2501A	Programming With C (Except CSE, IT, ECE)
3	20EC2501A	Sensor Technology
4	20EC2501B	Electronic Instrumentation
5	20EE2501A	Electrical Safety
6	20IT2501A	Cyber Laws (Except CSE, IT)
7	20ME2501A	Design Thinking
8	20ME2501B	Logistics and Supply Chain Management

Courses for Honors

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC6501	RF IC Design	3-1-0	4
2	20EC6502	Advanced Digital Modulation and Coding Techniques	3-1-0	4
3	20EC6503	Conformal Antennas	3-1-0	4
4	20EC6504	Speech Signal Processing	3-1-0	4

Course for Minor in Electronics and Communication Engineering

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5501	Digital Design Using Verilog HDL	3-1-0	4

Course for Minor in IOT Track

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5502	Sensors and Actuator Devices for IoT	3-1-0	4

Semester VI

Course Code	Name of the course	L-T-P	Credits	Internal Marks	External Marks	Total Marks
20EC3601	Digital Signal Processing	3-0-0	3	30	70	100
20EC3602	Antennas and Propagation	3-0-0	3	30	70	100
20EC3603	VLSI Design	3-0-0	3	30	70	100
20EC4601	Professional Elective-II	3-0-0	3	30	70	100
	Open Elective- II	3-0-0	3	30	70	100
20EC3651	Digital Signal Processing Lab	0-0-3	1.5	15	35	50
20EC3652	Antenna Design & Analysis Lab	0-0-3	1.5	15	35	50
20EC3653	VLSI Design Lab	0-0-3	1.5	15	35	50
20SS8651	Soft Skills	1-0-2	2	0	50	50
20MC1601	Constitution of India	2-0-0	0	30	70	100
Total		**18-0-11**	**21.5**	**225**	**575**	**800**

Honors /Minor courses	**3-1-0**	**4**	**30**	**70**	**100**

Professional Elective-II

S.No.	Course Code	Name of the Subject
1	20EC4601A	Optical Communications
2	20EC4601B	ARM Microcontroller Systems
3	20EC4601C	Microwave Engineering
4	20EC4601D	Computer Networks
5	20EC4601E	Machine Learning

Open Elective-II

S.No.	Course Code	Name of The Subject
1	20CE2601A	Ecology and Environment
2	20CS2601A	Introduction to Data Structures(Expect ECE & EEE)
3	20EC2601A	MATLAB Programming
4	20EC2601B	TV Engineering
5	20EE2601A	Energy Management
6	20IT2601A	Introduction to Data Mining (Except CSE, IT)
7	20ME2601A	Value Engineering
8	20ME2601B	Human Factors in Engineering

Courses for Honors

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC6601	Pattern recognition	3-1-0	4
2	20EC6602	Information Theory & Coding	3-1-0	4
3	20EC6603	Micro Electro Mechanical Systems	3-1-0	4
4	20EC6604	Detection and Estimation Theory	3-1-0	4

Course for Minor in Electronics and Communication Engineering

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5601	Circuit Analysis	3-1-0	4

Course for Minor in IOT Track

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5602	Industrial and Medical IoT	3-1-0	4

Prasad V. Potluri Siddhartha Institute of Technology, Kanuru
Department of Electronics & Communication Engineering
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Semester VII

Course Code	Name of the course	L-T-P	Credits	Internal Marks	External Marks	Total Marks
20EC4701	Professional Elective-III	3-0-0	3	30	70	100
20EC4702	Professional Elective-IV	3-0-0	3	30	70	100
20EC4703	Professional Elective-V	3-0-0	3	30	70	100
	Open elective-III	3-0-0	3	30	70	100
	Open elective-IV	3-0-0	3	30	70	100
20HS1701	Humanities and Social Science Elective	3-0-0	3	30	70	100
20SA8754	Verilog HDL	1-0-2	2	0	50	50
20EC3781B/C	Industrial/Research Internship 4-6 weeks (Mandatory) after third year (to be evaluated during VII semester	0-0-0	3	0	50	50
Total		**19-0-2**	**23**	**180**	**520**	**700**

Honors /Minor courses	**3-1-0**	**4**	30	70	100

Professional Elective-III

S.No.	Course Code	Name of the Subject
1	20EC4701A	Digital Image Processing
2	20EC4701B	Analog IC Design
3	20EC4701C	Microwave Antennas
4	20EC4701D	Operating Systems
5	20EC4701E	Fuzzy Logic

Professional Elective-IV

S.No	Course Code	Name of the Subject
1	20EC4702A	Cellular and Mobile Communications
2	20EC4702B	ASIC Design
3	20EC4702C	RF Circuit Design
4	20EC4702D	Database Management Systems
5	20EC4702E	DSP Processors

Professional Elective-V

S.No	Course Code	Name of the Subject
1	20EC4703A	Global positioning Systems
2	20EC4703B	Wireless sensor Networks
3	20EC4703C	Radar Engineering
4	20EC4703D	Deep Learning
5	20EC4703E	Embedded and Real Time Systems

Open Elective-III

S.No	Course Code	Name of the Subject
1	20CE2701A	Disaster Management and Preparedness
2	20CS2701A	JAVA Programming (Except CSE, IT, EEE & ECE)
3	20EC2701A	Research Methodology
4	20EC2701B	E-Waste Management
5	20EE2701A	Non-Conventional Energy Resources (Except EEE)
6	20IT2701A	Fundamentals of Data Science (Except CSE, IT)
7	20ME2701A	Operations Research (Except ME)
8	20ME2701B	Management Information Systems

Open Elective-IV

S.No	Course Code	Name of the Subject
1	20CE2702A	Environmental Management and audit
2	20CS2702A	Database Management Systems (Except CSE, IT, ECE, EEE)
3	20EC2702A	Telecommunications
4	20EC2702B	Satellite Communications
5	20EE2702A	Utilization of Electrical power (Except EEE)
6	20IT2702A	Fundamentals of Artificial Intelligence (Except CSE, IT)
7	20ME2702A	Mechatronics(Except ME)
8	20ME2702B	Robotics (Except ME)

Humanities and Social Science Elective

S.No	Course Code	Name of the Subject
1	20HS7701A	Managerial Economics and Financial Analysis
2	20HS7701B	Human Resources Management
3	20HS7701C	Entrepreneurship Management
4	20HS7701D	Organizational Behavior
5	20HS7701E	Construction Management (Only for Civil Engineering)
6	20HS7701F	Industrial Engineering Management
7	20HS7701G	Project Management

Courses for Honors

S.No	Course code	Course Title	L-T-P	Credits
1	20EC6701	Low Power VLSI Design	3-1-0	4
2	20EC6702	Software Defined Radio	3-1-0	4
3	20EC6703	EMI/EMC	3-1-0	4
4	20EC6704	Introduction to Robotics	3-1-0	4

Course for Minor in Electronics and Communication Engineering

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5701	Communication Systems	3-1-0	4

Course for Minor in IOT Track

S.No.	Course code	Course Title	L-T-P	Credits
1	20EC5702	IOT Networks	3-1-0	4

Semester VIII

Course Code	Name of the course	L-T-P	Credits	Internal Marks	External Marks	Total Marks
20EC3861	Project Work, Seminar & Internship in Industry (1Sem)	0-0-0	8	60	140	200
Total		**0-0-0**	**8**	**60**	**140**	**200**

I YEAR SYLLABUS

Communicative English I

Course Code	20HS1101	**Year**	I	**Semester**	I
Course Category	Humanities	**Branch**	ECE	**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														
CO2										3		3		
CO3									3	3		3		
CO4										3		3		
CO5									3	3		3		

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 -	CO1,C

	identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. **Grammar and Vocabulary:** Verbs - Tenses; Subject-verb agreement; Direct And Indirect speech, Reporting verbs for academic purposes. Idiomatic expressions	O3, CO4,CO5
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**	ECE	**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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1													1	
CO2	3								2	2			1	
CO3	3								2	2			1	
CO4		3											1	
CO5		3											1	
CO6	3								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 and spherical polar co-ordinates, volume as triple integral. **Application-** Areas enclosed by plane curves.	CO1,CO3, CO5,CO6

Learning Resources

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2019.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Ed., 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**	ECE	**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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1														
CO2	3						1					1	1	
CO3	3						1					1	1	
CO4	3						1					1	1	
CO5	3						1			2		1	1	

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	CO1,CO2, CO4,CO5

	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.	
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 type semiconductors- PV cell / solar cell- Manufacturing of Photovoltaic Cells using Chemical Vapor Deposition Technique-applications of solar energy	CO1,CO2, CO4,CO5
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-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-CO5

Learning Resources

Text Books

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai& 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, Dhanapath Rai and sons, 2003
2. B.S Murthy and P. Shankar, A Text Book of Nano Science and Nano Technology, 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, Murthy Publications 2014
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India, 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 & Programming with Python

Course Code	20ES1102	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	ECE	**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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2
CO 1	3												2	
CO 2	3												2	
CO 3	3								3	3			2	
CO 4		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	CO1, CO2

	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.	

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** **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.	CO1, CO3
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. Weingart, Dr.Troy, Brown and Dr. Wayne An introduction to programming and algorithmic reasoning using raptor, Create Space (an Amazon.com Company), 2018
2. R. Nageswara Rao Core Python Programming, 2018, Dream Tech press.

Reference Books

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford Uty. Press,2017
2. T R Padmanabhan, Wes McKinney and O.Reilly Python for Data Analysis, 2012

e- Resources & other digital material

1. http://fusecontent.education.vic.gov.au/9f79537a-66fc-4070-a5ce-ze3aa315888a1/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**	ECE	**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	

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. **Conic sections**: Construction of ellipse, parabola and hyperbola (general method only) **Cycloidal curves**: Cycloid, Epicycloid and Hypocycloid **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	CO2

	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)	
4	**Orthographic Views**: Systems of projections, conversion of Isometric view to orthographic view. **Isometric Projections**: Principles of Isometric projection- Isometric scale; **Isometric views**: lines, planes and solids. (Treatment is limited to simple objects only)	CO3
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, 53rd Ed., Charotar Publishers, 2016.
2. K.L. Narayana & P.Kannaiah, Engineering Drawing,3rd Ed., Scitech Publishers,2012

Reference Books

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, 2009
2. Shah and Rana, Engineering Drawing, 2nd Ed., Pearson Education, 2009
3. K.Venugopal, Engineering Drawing and Graphics,6th Ed., New Age Publishers,2011
4. K.C. John, Engineering Graphics, 2nd Ed., PHI, 2013.
5. Basant Agarwal and C.M. Agarwal, Engineering Drawing, Tata McGraw Hill,2008.

e- Resources & other digital material

1. http://www.youtube.com/watch?v=XCWJ Xrk Wco, 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**	ECE	**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		
CO2										3				
CO3										3		3		
CO4									3	3				

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,

8	Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.	CO4
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**	ECE	**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 3rd Ed., Dhanpat Rai Publishing Company, 2007
Reference Books
1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6th Ed., 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 & Programming with Python Lab

Course Code	20ES1152	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	ECE	**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												

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

Learning Resources
Text Books
1. Weingart, An introduction to programming and algorithmic reasoning using raptor 2. Dr. Troy, Brown, Dr. Wayne, 2018, Create Space (an Amazon.com Company) 3. R. Nageswara Rao, Core Python Programming, 2018, Dream Tech. press.
Reference Books
1. Reema Thareja, Python Programming: Using Problem Solving Approach, 2017, Oxford University Press. 2. T R Padmanabhan, Programming with python, 2017, Springer. 3. Wes McKinney and O.Reilly, Python for Data Analysis, 2012
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**	ECE	**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				

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	CO3

	Glycolysis TCA cycle Electron transport chain and Oxidative phosphorylation.	
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. U.Satyanarayana, Biotechnology Alliedand books Pvt. ltd. Kolkata

Reference Books

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

Communicative English II

Course Code	20HS1201	**Year**	I	**Semester**	II
Course Category	Humanities	**Branch**	ECE	**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														
CO2									3	3		3		
CO3									3	3		3		
CO4									3	3		3		
CO5									3	3		3		

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 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	CO1, CO3, CO5
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**	ECE	**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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1													1	
CO2	3								2	2			1	
CO3	3								2	2			1	
CO4		3											1	
CO5		3											1	
CO6	3								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, 44th , 2019. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Ed., John Wiley & Sons, 2006.
Reference Books
1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3rd Ed., 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**	ECE	**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

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.	CO1,CO3 CO4, CO6

	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.	
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 integral and differential form, displacement current, continuity equation and Maxwell's equations (qualitatively).	CO1,CO3 CO5, CO6
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, 8^{th} Ed., 2001.
2. S. O. Pillai, Solid State Physics, New age international publishers, 7^{th} Ed. - 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, 2^{nd} Ed., 2005.
5. Introduction To Electrodynamics, David.J.Griffths, Pearson Education India Learning Private Limited, 4^{th} 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**	ECE	**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	2
CO3		3											2	2
CO4	3												2	2
CO5		3											2	2
CO6				3					2	2			2	2

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 theorem with simple examples (**independent sources only**).	CO1-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-CO3,CO6
3	**Transformers**: Construction, working principle, EMF equation, open and short- circuit tests, voltage regulation definition, losses and efficiency.	CO1-CO3,C

	Three Phase Induction Motors: Construction, working principle of three phase induction motor.	O6
4	**Semiconductor Devices**: P-N Junction diode - Basic operating principle, current-voltage characteristics, half-wave rectifier, full-wave rectifier, rectifiers with filter capacitor, Zener diode as Voltage Regulator.	CO1,CO4-CO6
5	**Operational Amplifiers**: The Ideal Op Amp, The Inverting Configuration-The 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.	CO1,CO4-CO6

Learning Resources

Text Books

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1st Ed., Mc Graw Hill Education (India) Pvt. Ltd., 2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1st Ed., S.Chand Publishing, New Delhi, 2006.
3. Millman Jacob, Halkias C Christos, Electronic Devices and Circuits, 2nd Ed., Tata Mc-Graw Hill 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**	ECE	**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		
CO2									3	3		3		
CO3									3	3		3		
CO4									3	3		3		

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	

Learning Resources
Text Books
1. Prabhavathy Y, M.Lalitha Sridevi, English all Round 2: Communication skills for Undergraduate Learners, Orient Black Swan, 2020
Reference Books
1. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Ed., 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 Physics Lab

Course Code	20BS1252	**Year**	I	**Semester**	II
Course Category	Basic Science	**Branch**	ECE	**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

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.	

9	Determine the Resistivity of Semiconductor by Four Probe Method.	CO4,CO6
10	Determine the Numerical Aperture of a given Optical Fibre and Find its Acceptance Angle.	CO5,CO6

Learning Resources
Text Books
1. Ramarao Sri, 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**	ECE	**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)

	PO 1	P O2	P O3	P O4	PO 5	P O6	P O7	P O8	P O9	PO1 0	PO1 1	PO1 2	PS O1	PS O2
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

Expt. No.	Syllabus	Mapped CO's
	Conduct any ten experiments	
1	Verification of Kirchhoff's Laws KVL and KCL.	CO1,-CO3 , CO6
2	Verification of DC Superposition Theorem.	CO1,-CO3 , CO6
3	Verification of Thevenin's Theorem and Norton's Theorem.	CO1,-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,-CO3 ,CO6
12	Verification of Network Theorems using PSPICE.	CO1,-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 Ed., Mc-Graw Hill Education (India) Private Limited, 2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1st Ed., S.Chand Publishing, New Delhi, 2006.
3. Millman Jacob, Halkias C Christos, Electronic Devices and Circuits, 2nd Ed., Tata Mc-Grawhill 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 Ed., 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 switch to connect tube light. 3. 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 the problem and fix it to get the computer back to working condition. 2. Installation 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.	CO4

Learning Resources
Text Books
1. P.Kannaiah and K.L.Narayana, Work shop Manual, Scitech Publishers. 2. Venkat Reddy, Workshop Manual BS Publications, 6^{th} Ed.

II YEAR SYLLABUS

Semester-I

Numerical Methods and Complex Variables

Course Code	20BS1302	**Year**	II	**Semester**	I
Course Category	Basic Sciences course	**Branch**	ECE	**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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	1													
CO 2	2								2	2				
CO 3	3								2	2				
CO 4		2							3	3				
CO 5		2							3	3				
CO 6	1								2	2				

UNIT No.	Contents	Mapped COs
1	**Solution to Algebraic and Transcendental Equations** Solution of algebraic and transcendental equations: Bisection method, method of false position and Newton-Raphson’s method.	CO1,CO2, CO4,CO6

	Finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formula. (All theorems/properties without proofs)	
2	**Numerical Differentiation and Integration** Numerical Differentiation- Newton's forward and backward difference formulae. Numerical integration- trapezoidal rule, Simpson's $\frac{1}{3}^{\text{rd}}$ and $\frac{3}{8}^{\text{th}}$ rules. Ordinary differential equations: Euler's, modified Euler's, Runge-Kutta method of fourth order for solving first order equations. (All theorems/properties without proofs)	CO1,CO2, CO4,CO6
3	**Functions of a complex variable:** Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions –Milne- Thompson's method. (All theorems/properties without proofs)	CO1,CO3, CO5,CO6
4	**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
5	**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 Recourse (s)
Text Book(s)
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2019. 2. S. Chand - T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M.V.S.S.N. Prasad Engineering Mathematics,Vol – III - 9th Revised Ed., 2012.
Reference Book(s)
1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Ed., 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/ 4. FED Moodle

Electronic Devices and Amplifier Circuits

Course Code	20EC3301	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ECE	**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 BJT & 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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2
CO1	2									1			2	
CO2		3								2			3	
CO3		3								2			3	
CO4	3									2			3	
20EC3301 OVER ALL WEIGHTS	3	3								2			3	

Syllabus

Unit No.	**Contents**	**Mapped CO**
1	**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
2	**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
3	**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
4	**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

5	**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, 6th Ed., Oxford University Press, 2013.
Reference Books
1. BehzadRazavi, Fundamentals of Microelectronics, 2th Ed., Wiley Student Edition, 2013. 2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10th Ed., Pearson Education, 2009. 3. 3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2th Ed., Pearson Education, 2008.
e- Resources & other digital material
1. http://www.faadooengineers.com/threads/4615-Electronic-Devices-and-Circuit-Theory-Boylestad-and-Nashelsky 2. https://docplayer.net/53934331-J-b-gupta-electronic-devices-and-circuits.html

Digital Logic Design

Course Code	20EC3302	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ECE	**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	Illustrate Binary arithmetic operations using Complements (L2).
CO2	Construct Logic gate circuits for given Boolean functions (L3).
CO3	Simplify Boolean functions using Boolean Theorems, K-map & Tabulation Methods (L4).
CO4	Analyze various Combinational and Sequential circuits (L4).
CO5	Design Combinational and Sequential circuits for the given specifications (L6)

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	
CO2	2												1	
CO3		2							2				2	
CO4		3							3				2	
CO5			3						3				2	
Average* (Rounded to nearest integer)	2	3	3						3				2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Binary Codes**: Signed Binary Numbers, Complements, Binary Codes, Error detection and correction code, Binary Logic. **Boolean Algebra**: Basic definitions, Axiomatic definition of Boolean algebra, Basic theorems and properties of Boolean algebra, Boolean functions, Canonical and Standard forms, Digital logic gates.	CO1, - CO3
2	**Simplification of Boolean functions**: The map method, Four-variable map, Five-variable map, Tabulation Method, Product of sums simplification, Don't-care conditions, NAND and NOR implementation.	CO2, CO3

3	**Combinational Logic**: Introduction, Design procedure, Half adder, Full Adder, Binary Adder/Subtractor, Decoders, Encoders, Multiplexers, De-Multiplexer, Code Converters.	CO2, CO4, CO5
4	**Sequential Logic**: Latches, Flip-Flops, Excitation tables of Flip-flops, Conversion from one flip-flop to another, Registers, Shift registers, Ripple counters, Design of Synchronous Counters, Ring counter.	CO2, CO4, CO5
5	**Synchronous Sequential Machines**: Analysis of clocked sequential circuits, Mealy and Moore models, State reduction and assignment, Design procedure, Design and realization of circuits using various Flip-flops.	CO2, CO4, CO5

Learning Resources

Text Books

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 4th Ed., Pearson Education, 2007.

Reference Books

1. Zvi Kohavi, Switching and Finite Automata Theory, 2nd Ed., Tata Mc-Graw-Hill Education, 2008.
2. John F. Wakerly, Digital Design Principles and Practices, 4th Ed., Pearson Education, 2008.
3. Frederick J. Hill and Gerald R. Peterson, Introduction to Switching Theory and Logic Design, 3rd Ed., John Willey and Sons, 1981.
4. Charles Roth, Jr., Larry Kinney, Fundamentals of Logic Design, 7th Ed., Cengage Learning, India, 2013.

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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Signals and Systems

Course Code	20EC3303	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ECE/EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Engineering Mathematics
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** 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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	2								2	2				
CO 2	3								2	2			2	
CO 3	3								2	2			2	
CO 4		3							3	3			2	

Syllabus

Unit No.	**Contents**	**Mapped CO**
1	**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
2	**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
3	**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	CO1, CO3, CO4

	Transform: The Fourier transform for periodic signals. Properties of the Continuous-time Fourier transform, Systems characterized by linear constant-coefficient differential equations.	
4	**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 equations.	CO1, CO3, CO4
5	**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', 2nd Ed., Pearson Education, 1997.
Reference Books
1. Simon Haykin, Barry Van Veen, 'Signals and Systems', 2nd Ed., 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

Network Theory and Analysis

Course Code	20EC3304	**Year**	II	**Semester**	I
Course Category	Program core	**Branch**	ECE	**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	**Relate** facts and ideas of network analysis methods to **respond**/ **find solutions** to simple questions/ problems on different 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)

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

Syllabus

Unit No.	Contents	Mapped CO
1	**Sinusoidal Steady-State Analysis:** Sinusoids, sinusoidal functions and complex functions, instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power, phasors, phasor relationships for R, L and C and steady state analysis of RL, RC and RLC circuits	CO1-CO3
2	**Transient Analysis of circuits**: Transient analysis of first order and second order systems, initial and final conditions in networks, dc transients: source free and forced response of RL, RC and RLC circuit analysis using Laplace transform	CO1-CO3
3	**Network Analysis Methods and Theorems (Application to AC Circuits)**: Ohm’s law, Kirchhoff's laws, series and parallel circuits, source transformations, delta-wye conversion, mesh, super mesh analysis, nodal, super node analysis, Linearity and superposition theorem, Thevenin's and Norton's theorems, maximum power transfer theorem	CO1-CO3

4	**Two Port Networks:** Impedance parameters, admittance Parameters, hybrid parameters and transmission parameters, relationships among parameters	CO1-CO3
5	**Resonance**: Series resonance, parallel resonance, bandwidth, selectivity, quality factor	CO1,CO2, CO4

Learning Resources
Text Books
1. M. E.Van Valkenburg, Network Analysis, 3rd Ed., Pearson Education 2. A. Sudhakar and Shyammohan S. Palli, Circuits and Networks, 5th Ed., McGraw Hill
Reference Books
1. William H. Hayt, Jack E. Kimmerly and Steven M. Durbin, Engineering Circuit Analysis, 8th Ed., Tata Mc-Graw Hill 2. Ravish R.Singh, Network Analysis and Synthesis, 1st Ed., Tata Mc-Graw Hill Education (India) Pvt. Ltd, New Delhi
e-Resources & other digital material
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/

Electronic Devices and Amplifier Circuits Lab

Course Code	**20EC3351**	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ECE	**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 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)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1		3							3				3	
CO2	3								3				3	
CO3		2							2				2	
CO4			2						2				2	
CO5										3				
Over all	3	3	2						3	3			3	

Syllabus

Any Ten Experiments (Hard Ware 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 (gm, ro, rπ, re) 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 (gm, ro, gmb) 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, 6th Ed., Oxford University Press, 2013.

Reference Books

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

e- Resources & other digital material

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

Digital Logic Design Lab

Course Code	20EC3352	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ECE	**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

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3												2	2
CO 2	3												3	2
CO 3		3											2	2
CO 4			2										2	3
CO 5										3				

Course Outcomes

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

CO1	Describe the truth tables of different Combinational & Sequential circuits (L2).
CO2	Construct Logic gate circuits for given Boolean functions (L3).
CO3	Analyse different Combinational & Sequential circuits (L4).
CO4	Design Combinational and Sequential circuits for the given specifications (L6).
CO5	Make an effective report based on experiments (L3).

Syllabus

Expt. No.	Contents	Mapped CO
1	Verification of Truth Tables of Logic gates.	CO1
2	Implementation of Basic gates using Universal Gates.	CO1
3	Implementation of the given Boolean functions using logic gates.	CO2
4	Simplification of the given Boolean functions using K-map and implementation using logic gates.	CO2
5	Realization and verification of Full adder and Full Subtractor using logic gates.	CO1, CO2
6	Implementation of 2x4 Decoder and 4x1 Multiplexer using Logic Gates.	CO1, CO2
7	Implementation of the given function using decoder and logic gates.	CO2, CO3

8	Implementation of the given function using Multiplexer.	CO2, CO3
9	Verification of State Tables of SR, D, JK and T-Flip-Flops.	CO1, CO3
10	Design and Verify the operation of 3-bit Ripple Counters using JK flip-flops.	CO1, CO2, CO4
11	Design and Verify the operation of 3-bit Synchronous Counter using T flip-flops.	CO1, CO2, CO4
12	Design and Verify the operation of a 4-bit Shift Register.	CO3, CO4
13	Mini Project.	CO1- CO4

Learning Resources

Text Books

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 4th Ed., Pearson Education, 2007.

Reference Books

1. ZviKohavi, Switching and Finite Automata Theory, 2nd Ed., Tata McGraw-Hill Education, 2008.
2. John F. Wakerly, Digital Design Principles and Practices, 4th Ed., 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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Basic Simulation Lab

Course Code	20ES1355	**Year**	II	**Semester**	I
Course Category	Engineering Sciences	**Branch**	ECE	**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	Analyse various types of signals and sequences.
CO2	Apply convolution and correlation operations on different signals
CO3	Analyse various circuits in the time and transform domains using transient analysis methods.
CO4	Analyse various networks by applying transformation techniques, mesh analysis, nodal analysis and network theorems
CO5	Determine the characteristics of different two port networks
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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		3											3	
CO2	3												3	
CO3		2											2	
CO4		2											2	
CO5					2								2	
CO6										3			3	
Avg.,	3	3	3		2					3			3	

Syllabus

Any Ten Experiments (Hard Ware or Simulation)

Expt. No.	**Contents**	**Mapped CO**
1	Generation of Various Signals and Sequences such as Unit impulse, Unit step, Square, Triangular, Sinusoidal, Ramp and Sync functions	CO1,CO6
2	Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting and Folding	CO1,CO6
3	Verification of Linearity and Time Invariance properties of a given Continuous / Discrete-time system.	CO1,CO6
4	Convolution of Signals and Sequences.	CO1,CO2,CO6
5	Computation of Unit Sample and Unit Step Response of given LTI System	CO1,CO2,CO6

6	Find the Fourier Transform of a given signal and plot its magnitude and phase spectrum	CO1,CO2,CO6
7	Auto Correlation and Cross Correlation of Signals and Sequences	CO1,CO2,CO6
8	Experimental determination of time constant of series RL & RC circuits	CO1,CO3,CO6
9	Experimental determination of frequency response of RLC circuits	CO1,CO3,CO6
10	Experimental verification of Thevenin's and Norton's theorems	CO4,CO6
11	Experimental verification of Superposition Theorem& Maximum power transfer Theorem	CO1,CO4,CO6
12	Simulation of a given series resonance circuit	CO1,CO5,CO6
13	Determination of parameters for a given two port network	CO5,CO4,CO6

Learning Resources

Text Books

1. Alan V. Oppenheim, Alan S. Wilsky with S.Hamid Nawab, 'Signals and Systems', 2nd Ed., Pearson Education, 1997
2. M. E.Van Valkenburg, Network Analysis, 3rd Ed. , Pearson Education
3. A. Sudhakar and Shyammohan S. Palli, Circuits and Networks, 5th Ed., Mc-Graw Hill

Reference Books

1. Simon Haykin, Barry Van Veen, 'Signals and Systems', 2nd Ed., Wiley Student Edition.
2. Bhagawandas P. Lathi, 'Linear Signals and Systems', Oxford University Press, 2009.
3. Luis Chaparro, Signals and Systems using MATLAB, Kindle Edition
4. William H. Hayt, Jack E. Kimmerly and Steven M. Durbin, Engineering Circuit Analysis, 8th Ed., Tata Mc-Graw Hill
5. Ravish R. Singh , Network Analysis and Synthesis, 1st Ed., Tata Mc-Graw Hill Education(India) Pvt. Ltd, New Delhi

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
6. https://www.tutorialspoint.com/network_theory/network_theory_quick_guide.htm
7. https://nptel.ac.in/courses/108/105/108105159/

Programming with ‘C’

Course Code	20SO8354	**Year**	II	**Semester**	I
Course Category	Skill Oriented Course	**Branch**	ECE	**Course Type**	Lab
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Nil
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	Build algorithm and flowchart for solving problems.(L3)
CO2	Apply Structured Programming/C constructs for solving problems (L3).
CO3	Analyze outputs using given constraints/test cases.(L4)
CO4	Develop an effective report based on various programs implemented and express with an effective oral communication. (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3												3	
CO2	3								3				3	
CO3		3											3	
CO4										3				
Averag e* (Round edto nearest integer)	3	3							3	3			3	

Syllabus		
Expt. No.	**Contents**	**MappedCO**
1	Fundamentals of Computer Hardware, Introduction to Programming Languages, DOS/UNIX Commands	CO2, CO4
2	Draw flowcharts for fundamental algorithms.	CO1, CO4
3	C Programs to demonstrate Variables, Data Types.	CO1-CO4
4	C Programs to demonstrate C-tokens.	CO1-CO4
5	C Programs to demonstrate Decision making and branching (Selection).	CO1-CO4
6	C programs to demonstrate different loops.	CO1-CO4
7	C programs to demonstrate arrays.	CO1-CO4
8	C programs to perform operations on strings with String handling functions and without String handling functions.	CO1-CO4
9	C programs to demonstrate functions.	CO1-CO4
10	C programs on pointers.	CO1-CO4

11	C programs on structures and unions.	CO1-CO4
12	C programs to demonstrate files.	CO1-CO4

Learning Resources

Text Books

1. R.G. Dromey, How to Solve it by Computer, 1st Ed., Pearson Education, 2006.
2. Reema Thareja, Programming in C, Oxford University Press, AICTE Ed., 2018.

Reference Books

1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming ApproachUsing C, 3rd Ed., Cengage Learning, 2007.
2. Pradip Dey, Manas Ghosh, Programming in C, Oxford University Press, AICTE Ed.
3. B. Gottfried, Programming with C, 3rd Ed., Schaum's outlines, Mc-Graw Hill (India), 2017.
4. Jeri R. Hanly, Ellot B. Koffman, Problem Solving and Program Design in C, 5th Ed., Pearson.

e- Resources & other digital material

1. http://cprogramminglanguage.net/
2. https://www.geeksforgeeks.org/c-programming-language/
3. https://nptel.ac.in/courses/106105085/4

Semester IV

Electromagnetic Fields & Waves

Course Code	20BS1402	**Year**	II	**Semester**	II
Course Category	Basic Sciences	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Engineering Physics, Differential Equations and Vector Calculus
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 mathematical concepts related to electromagnetic fields, uniform plane waves and its boundaries. (L2)
CO2	Apply the Electrostatic and Magneto static Fields to various applications(L3)
CO3	Apply Maxwell's equations for static and time-varying fields to solve vector wave equations, power and polarization for waves propagation. (L3).
CO4	Analyze the uniform plane wave characteristics for wave incidence in different mediums(L4)

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	2									2		2		
CO2	3									2		2	3	
CO3	3				3					2		2	3	
CO4	2				2					2		2	2	

Syllabus

Unit No.	**Contents**	**Mapped CO**
1	**Review of coordinate systems; Electrostatics:** Coulomb's Law, Electric Field Intensity, Field due to a line charge, Electric Flux Density, Guass's law, Electric Potential, Potential gradient, energy stored, Laplace's and Poison's equations.	CO1
2	**Magnetostatics:** Steady current, Biot-Savart's law, Static magnetic field due to line current, Magnetic flux Density, Ampere's circuital law, Lorentz force equation, Magnetic Vector Potential, energy stored.	CO1
3	**Time-varying Fields and Maxwell's Equations:** Time varying fields, Faraday's law of electromagnetic induction, Displacement	CO2, CO3

	current, Maxwell's equations in point form and integral form, boundary conditions of electromagnetic fields, Polarization, Magnetization.	
4	**Uniform Plane Wave:** Wave equation, Wave propagation in free space, wave propagation in conductor and dielectrics, Poynting Theorem, skin effect, wave polarization, Direction cosines.	CO4
5	**Plane Waves at Boundaries and in Dispersive Media:** Reflection of uniform plane waves by perfect conductor – normaland oblique incidence, standing wave ratio, Reflection and transmission of uniform plane waves by perfect dielectric – normal and oblique incidence.	CO4

Learning Resources
Text Books
1. Matthew N.O.Sadiku, Principles of Electromagnetics, Oxford University Press 2. William H. Hayt, Engineering Electromagnetics, Tata Mc-Graw Hill Publications
Reference Books
1. R Shevgaonkar, Electromagnetic Waves , Tata Mc-Graw Hill Publications 2. E. C. Jordan, EM Waves and Radiating Systems, PHI, 2^{nd} Ed.,2007
e- Resources & other digital material
1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-spring-2009/ 2. https://nptel.ac.in/courses/117/103/117103065/

Analog Circuits

Course Code	20EC3401	Year	II	Semester	II
Course Category	Program Core	Branch	ECE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	EDAC
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	Explain the basic concepts of various types of Analog Circuits (L2)
CO2	Apply the concepts of feedback to find the characteristics parameters of feedback amplifiers and oscillators (L3)
CO3	Apply the principles of circuit analysis techniques to solve the problems on Op-amps, Timers and data converters (L3)
CO4	Analyze various analog circuits to support generalizations (L4)

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	2									1				2
CO2	3									2				3
CO3	3									2				3
CO4		3								3				3

Syllabus

Unit No.	Contents	Mapped CO
1	Feedback Amplifiers: The general feedback structure, properties of negative feedback, basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining loop gain	CO1, CO2, CO4
2	Oscillators: Basic principles of sinusoidal oscillators, op amp RC oscillator circuits, LC and crystal oscillators. Power amplifiers: Classification of output stages, class A output stage, class B output stage, class AB output stage, Power Transistors	CO1, CO2, CO4
3	Operational Amplifiers: The ideal op amp, the inverting and non-inverting configuration, difference and instrumentation amplifiers, summing, scaling and averaging amplifiers, integrators, differentiators, logarithmic amplifiers, V/I and I/V converters, Comparators and waveform generators	CO1, CO3, CO4

4	IC Timers: Introduction, operating modes of the 555 timer, terminals of the 555 timer, free running mode and applications. Active Filter Design: LPF, HPF, BPF, BEF, all-pass filters.	CO1, CO3, CO4
5	Data Converters: Digital to analog conversion process, voltage output DACs, multiplying DAC, DAC characteristics. Analog to Digital Converters: integrating ADC, successive approximation ADC, Flash converters: Principle of operation, Dual slope ADC, Remote control applications, ADC characteristics.	CO1, CO3, CO4

Learning Resources

Text Books

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

2. D Roy Choudhury, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003

3.Ramakanth A.Gayakwad, Op-Amps and Linear Integrated Circuits, 4th Ed., Pearson Education, 2007

Reference Books

1. Behzad Razavi, Fundamentals of Microelectronics, 2nd Ed., Wiley Student Edition, 2013.

2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6th Ed., Pearson Education, 2008.

3. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Ed., Tata Mc-Graw Hill, 2002.

Web Resources:

1. https://nptel.ac.in/courses/108/108/108108114/

2. https://nptel.ac.in/courses/108/105/108105158/

3. https://www.digimat.in/nptel/courses/video/108108111/L19.html

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Communication Theory

Course Code	20EC3402	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**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	Explain different concepts of analog and pulse modulation techniques (L2).
CO2	Apply various transform techniques for frequency domain analysis of analog baseband and passband signals(L3)
CO3	Develop AM and FM systems suitable for community(L3)
CO4	Analyze the noise performance of analog modulation techniques (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	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	**2**													
CO2	**3**								**2**	**2**		**2**	**3**	
CO3	**3**								**2**	**2**		**2**	**3**	
CO4		**3**							**3**	**3**		**3**	**3**	
Average* (Rounded to nearest integer)	**3**	**3**							**2**	**2**		**2**	**3**	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Amplitude Modulation**-AM, DSB-SC, SSB, VSB - Modulation index, Spectra, Power relations and Bandwidth ,AM Generation – Square law and Switching modulator, Envelope Detection of AM waves, DSBSC Generation – Balanced and Ring Modulator, Coherent detection of DSB-SC Modulated waves: COSTAS Loop, Quadrature carrier multiplexing Generation of SSB waves, Generation of VSB waves, comparison of different AM techniques, Super heterodyne Receiver	CO1-CO4
2	**Angle Modulation** : Basic concepts of Phase and Frequency Modulation, Frequency modulation, Narrow band FM, Wide band FM, Generation of FM waves: Indirect FM, Direct FM, **Demodulation of FM waves:** Balanced Frequency discriminator, Phase locked loop (First Order). FM Radio Broadcasting, FM Stereo Multiplexing	CO1-CO4

3	**Random Processes** : Random variables, Random Process, Stationary Processes, Mean, Correlation and Covariance functions, Ergodic Process, Transmission of a Random Process Through a LTI filter, Power Spectral Density, Gaussian Process,	CO1,CO4
4	**Noise in Analog modulation** : AM Receiver model, , Signal to Noise Ratios for Coherent Reception, Noise in DSB Receiver, Noise in SSB Receivers, Noise in AM receivers using Envelope Detection ,Threshold Effect, FM Receiver model, Noise in FM receiver, FM Threshold effect, Pre-emphasis and De-emphasis in FM.	CO1,CO3, CO4
5	**Digital Representation of Analog Signals** : Low pass sampling , Aliasing, Signal Reconstruction, Uniform & non-uniform quantization, quantization noise , Logarithmic Companding, PAM, PPM, PWM, TDM, FDM.	CO1,CO3

Learning Resources
Text Books
1. Simon Haykin, Communication Systems, 4th Ed., Wiley, 2014. 2. John G. Proakis, Masoud Salehi, Fundamentals of Communication Systems, Pearson, 2nd Ed., 2013
Reference Books
1. H Taub & D. Schilling, Gautam Sahe, Principles of Communication Systems,TMH, 3rd Ed.,2007 2. Sam Shanmugam, Analog and Digital Communication System, John Wiley and Sons,3rd Ed.,2009
e- Resources & other digital material
1. https://freevideolectures.com/course/2590/introduction-to-communication-theory 2.https://nptel.ac.in/courses/108/105/108105159/ 3. https://cosmolearning.org/courses/introduction-to-communication-theory-452/video-lectures 4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-1-introduction/

Microprocessors & Microcontrollers

Course Code	20EC3403	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**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	Demonstrate the impact of instruction set architecture on cost-performance of computer design.(L2)
CO2	Apply a basic concept of digital fundamentals to Microprocessor based personal computer system.(L3)
CO3	Utilize the architectural features and instruction set of 16 bit microcontroller MSP430 for low power applications(L3)
CO4	Identify the functions of various peripherals which are interfaced with MSP430.(L3)
CO5	Function MSP430 using the various instructions for different applications.(L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**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**
1	**Computers, Microprocessors and Microcontrollers**: Introduction, Common Terminologies Associated with Computing Systems, Microprocessors and Microcontrollers, CISC and RISC Systems, Computing Languages, **Memory** - Random Access Memory (RAM), Read-Only Memory (ROM), Cache Memory, Memory Latency, **Computer Architecture**: Harvard and von Neumann , Evolution of Microcontrollers-4 bit to 32 bit	CO1,CO2
2	Architecture and features of 8086, Pin configuration of 8086, Minimum mode and Maximum mode, Timing diagrams, Addressing modes.	CO1,CO2
3	**MSP Microcontroller Introduction and Key Features**: Introduction, Low Power Applications,MSP430 RISC CPU Architecture, Details of 16-Bit RISC CPU, Clock System ,Memory subsystem	CO1,CO3

4	**On Chip Peripherals, Interfacing and Applications of MSP430**: Watchdog Timer, Timers, Real Time Clock, DAC: Digital-to-Analog Conversion, Direct Memory Access (DMA), LCD Controller, Case studies of applications of MSP 430 data Acquisition system	CO1,CO4
5	**Programming the MSP430:** Addressing Modes, Instruction Set of MSP430, Double Operand Core Instructions, Single Operand Core Instructions (Format II), Program Flow control, Emulated Instructions, Movement Instructions, Implementation of Decimal Arithmetic, Shift and Rotate Instructions.	CO1,CO5

Learning Resources
Text Books
1. K. Uma Rao, Andhe Pallavi, "The 8051 and MSP430 Microcontrollers: Architecture, Programming and Applications", Wiley, 2019 2. A.K.Ray and K.M.Bhurchandi , Advanced microprocessor and Peripherals -, Tata Mc Hill, 2000. 3. Deshmukh, Micro Controllers, Tata Mc-Graw Hill Ed., 6th Reprint, 2007.
Reference Books
1. Douglas.V. Hall, Microprocessors & Interfacing, 3rd Ed., Pearson/ PHI. 2007
e- Resources & other digital material
1. http://freevideolectures.com/Course/3018/Microprocessors-and-Microcontrollers

Control Systems Engineering

Course Code	20EC3404	**Year**	II	**Semester**	II
Course Category	Program Core	**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	**Classify** control systems and determine the stability of a system using various models (L2)
CO2	**Apply** standard test signals to a system to determine their characteristics (L3)
CO3	**Make use of** stability concepts to obtain the desired characteristics (L3)
CO4	**Inspect** the characteristics of a linear control system using various time and frequency domain tools (L4)
CO5	**Examine** the system behaviour using various stability analysis techniques (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	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2							2		2			2	
CO2	1							2		2			2	
CO3	3							2		2			2	
CO4		2						3		3			3	
CO5		2						3		3			3	

Syllabus

Unit No.	Contents	Mapped CO
1	**Introduction:** Concepts of control systems. Examples of control systems, classification of control systems, Block diagram algebra, Representation by Signal flow graph. Reduction using Mason's gain formula. Feedback Characteristics, Effects of feedback. Mathematical modelling of systems – Electrical, mechanical translational and rotational systems.	CO1,CO3
2	**Time Domain Analysis:** Standard test signals, Time response of first and second order systems with standard input signals, Time domain specifications, steady state error and error constants. Effects of P, PI, PD and PID Controllers.	CO1,CO2, CO3,CO4
3	**Stability Analysis in S-Domain:** Concept of stability, Routh Hurwitz criterion. Construction of Root locus. Effects of adding poles and zeros to open loop transfer function on the root loci.	CO1, CO3,CO4,CO5
4	**Frequency Response Analysis:** Correlation between time and frequency responses. Determination of frequency domain specifications, Gain margin and Phase margin -Stability Analysis from Bode Plots, Polar plots and Nyquist plots.	CO1, CO3,CO4,CO5

5	**State variable analysis:** State, State variables, State variable representation, State variable form from Transfer function (Diagonal form), transfer function from State variable form, State transition matrix, properties of state transition matrix, Controllability and Observability	CO1, CO5

Learning Resources
Text Books
1. M.Gopal, Control Systems Engineering , 3rd Ed., Wiley Eastern Ltd., TMH ,2008 2. Benjamin C.Kuo, Automatic Control Systems, 7th Ed., Prentice Hall of India, 1997
Reference Books
1. Ogata, Modern Control Engineering , 2nd Ed., Prentice Hall of India., 2011 2. R.C. Sukla, Control Systems, 3rd Ed., Dhanpatrai and Sons,1998 3. Nise, Control Systems Engg..– John wiley , 3rd Ed., 2000
e- Resources & other digital material
1. https://nptel.ac.in/courses/108/106/108106098/ 2. https://freevideolectures.com/course/2337/control-engineering

Analog Circuits Lab

Course Code	20EC3451	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	EDAC
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 feedback amplifiers using FET (L4)
CO2	**Evaluate** the performance of Power Amplifiers using BJT(L5)
CO3	**Design** the various applications using Op-amp (L6)
CO4	**Design** the various applications using IC 555 Timer (L6)
CO5	Make 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		1			3				3				3	
CO2				2	3				3				3	
CO3			3		3				3				3	
CO4			2		3				3				3	
CO5										3				

Any Ten Experiments (Hardware or Simulation)

Syllabus

Expt. No.	**Contents**	**Mapped CO**
1	Calculation of gain, input resistance, output resistance of a feedbackamplifier with and without feedback using FET	CO1,CO5
2	Design and verify an RC phase-shift oscillator for a given frequencyusing Op-Amp	CO3,CO5
3	Design and verify a Wein-bridge Oscillator for a given frequency using Op-Amp	CO3,CO5
4	Design and verify a Colpitt’s Oscillator for a given frequency using Op-Amp	CO3,CO5
5	Evaluate the Conversion efficiency of a Class A power amplifier using BJT	CO2,CO5
6	Evaluate the Conversion efficiency of Class B Push - pull power amplifier using BJT	CO2,CO5
7	Design and Simulate the RC differentiator using Op-Amp	CO3,CO5
8	Design and Simulate the RC integrator using Op-Amp	CO3,CO5
9	Design and verify Adder and Subtractor circuits using Operational Amplifier	CO3,CO5
10	Design and verify an Astable multivibrator using 555 timer	CO4,CO5
11	Design and verify Monostable multivibrator using 741Op-Amp	CO3,CO5

12	Design and verify Monostable multivibrator using 555 timer	CO4,CO5
13	Design and verify an Astable multivibrator using 741 Op-Amp	CO3,CO5
14	Design and verify LPF and HPF using Op-Amp	CO3,CO5
15	Design and verify a 4 bit DAC using OP-Amp	CO3,CO5

Learning Resources

Text Books

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6th Ed., Oxford Uty Press, 2013.

D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003

3. R. Gayakward, Op-Amps and Linear Integrated Circuits, 4th Ed., Pearson Education,2007

Reference Books

1. Behzad Razavi, Fundamentals of Microelectronics, 2nd Ed., Wiley Student Edition, 2013.
2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6th Ed., PearsonEducation, 2008.
3. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Ed.,Tata Mc-Graw Hill, 2002.

Communications Theory Lab

Course Code	20EC3452	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**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	Analyse different Concepts of Analog modulation techniques (L4)
CO2	Analyse different parameters of pulse modulation techniques (L4)
CO3	Simulate & validate various modulation and Demodulation Techniques (L5)
CO4	Simulate & validate various functional modules of a communication system (L5)
CO5	Make 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	
CO2		2											2	
CO3				3	3								3	
CO4				2	2								2	
CO5									2	2				

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Amplitude Modulation and Demodulation	CO1,CO5
2	DSBSC Modulation and Demodulation	CO1,CO5
3	Frequency modulation and Demodulation	CO1,CO5
4	Pre-emphasis and De-emphasis	CO1,CO5
5	Spectral Analysis of AM and FM using Spectrum Analyzer	CO1,CO5
6	SSB Modulation and Demodulation using MATLAB	CO1,CO5
7	TDM and FDM using MATLAB	CO3, CO5
8	PAM Signal Generation and Demodulation using MATLAB	CO2,CO3,CO5
9	PPM Signal Generation and Demodulation using MATLAB	CO2,CO3,CO5

10	AGC Characteristics of Radio Receiver using MATLAB	CO3,CO5
11	Phase Lock Loop and FM Demodulator using MATLAB	CO4,CO5
12	Verification of Sampling Theorem using MATLAB	CO4,CO5

Learning Resources

Text Books

1. Simon Haykin, Introduction to Analog and Digital Communication System, John Wiley and Sons, 3rd Ed., 2009.
2. J. G. Proakis, Masoud Salehi, Fundamentals of Communication Systems, Pearson, 2nd Ed., 2013

Reference Books

1. H Taub & D. Schilling and Gautam Sahe, Principles of Communication Systems, TMH, 3rd Ed., 2007
2. Sam Shanmugam, Analog and Digital Communication System, John Wiley and Sons, 3rd Ed., 2009

Microprocessors & Microcontrollers Lab

Course Code	20EC3453	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**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 for various applications using 8086 Microprocessor (L3)
CO2	Apply appropriate techniques, resources, and Code Composer Studio based IDE for modelling system designs with understanding of limitations. (L3)
CO3	Analyze usage of various resources like GPIO, Timers, Interrupts, ADC, UART, Comparator (L4)
CO4	Make 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1			3										3	
CO2	3												3	
CO3		3											3	
CO4										3			2	
Average * (Rounded to nearest integer)	3	3	3							3			3	3

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	16-bit Signed and unsigned Arithmetic operations, ASCII – arithmetic operations	CO1,CO4
2	Arithmetic operations – Multi byte Addition and Subtraction	CO1,CO4
3	Logical operations, Sum of Squares, Sum of Cubes	CO1,CO4
4	Write ALP to find smallest, largest number, arrange numbers in Ascending order, Descending order in a given series.	CO1,CO4
5	Using string operation and Instruction prefix: Move Block, Reverse string, String comparison	CO1,CO4
6	Introduction to MSP430 launch pad and Programming Environment. (Study Experiment)	CO2, CO4

7	Read input from switch and Automatic control/flash LED (soft-ware delay).	CO2-CO4
8	Read Temperature of MSP430 with the help of ADC.	CO2-CO4
9	PWM Generator	CO2- CO4
10	Enabling serial communication with UART on Lunchbox	CO2- CO4

Learning Resources

Text Books

1. K. Uma Rao, Andhe Pallavi, The 8051 and MSP430 Microcontrollers: Architecture, Programming and Applications, Wiley Publication, 2019
2. A.K.Ray and K.M.Bhurchandi, Advanced microprocessor and Peripherals, Tata Mc-Graw Hill, 2000.
3. Deshmukh, Micro Controllers, Tata Mc-Graw Hill Edition. 6th reprint, 2007

Reference Books

1. Douglas.V. Hall, Microprocessors & Interfacing, 3rd Ed., Pearson/ PHI. 2007

e- Resources & other digital material

1. http://freevideolectures.com/Course/3018/Microprocessors-and-Microcontrollers

AI Tools Lab

Course Code	20SO8453	**Year**	II	**Semester**	II
Course Category	Skill Oriented Course	**Branch**	ECE	**Course Type**	Lab
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Nil
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 various pre-processing techniques and Machine Learning/ Deep Learning methods on different datasets for a given problem.	L3
CO2	Implement various experiments in Jupyter Notebook Environment.	L3
CO3	Develop an effective report based on various learning methods implemented.	L3
CO4	Apply technical knowledge for a given scenario and express with an effective oral communication.	L3
CO5	Analyze the outputs and visualizations generated for different datasets.	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	1	
CO2					2				2			1	1	
CO3										2			2	
CO4	3									1			1	
CO5		3											2	

Syllabus		
Exp. No.	**Contents**	**Mapped CO**
1	Apply Data pre-processing techniques.	CO1-CO5
2	Construct a Machine Learning model using supervised learning method.	CO1-CO5
3	Construct a Machine Learning model using Unsupervised learning method.	CO1-CO5
4	Construct a Machine Learning model using Semi supervised learning method.	CO1-CO5
5	Develop a Deep Learning model using supervised learning method.	CO1-CO5
6	Develop a Deep Learning model using Unsupervised learning method.	CO1-CO5

7	Apply a Convolutional Neural Network for Image Classification.	CO1-CO5
8	Build an AI application.	CO1-CO5

Learning Resources

Text Books

1. Stuart Russell and Norvig, Artificial Intelligence: A Modern Approach, 3rd Ed., 2015, Pearson Education.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, 2012, MIT Press
3. Ian Good fellow, Yoshua Bengio, Aaron Courville, Francis Bach, Deep Learning (Adaptive Computation and Machine Learning series), 2017, MIT Press

e-Resources & other digital material

1. https://github.com/atinesh-s/Coursera-Machine-Learning-Stanford
2. https://github.com/Kulbear/deep-learning-coursera

Environmental Sciences

Course Code	20MC1402	**Year**	II	**Semester**	II
Course Category	Mandatory course	**Branch**	Common to All Branches	**Course Type**	Theory
Credits	0	**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	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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2						2							
CO 2		2					3							
CO 3		3					3							
CO 4		2					3							
CO 5	2						2							

Syllabus

UNIT No.	**Contents**	**Mapped COs**
1	**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	CO1 CO2

	resources: World food problems, Impacts of overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, use of renewable and non-renewable energy sources, case studies.	
2	**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
3	**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
4	**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
5	**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 Recourses
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.

Digital Electronics Design with VHDL

Course Code	20EC6401	**Year**	II	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	DLD
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	use modern development tools to design complex digital circuits(L2)
CO2	Analyze syntax and behavior of the VHDL language (L4)
CO3	Design the combinational and sequential logic circuits using VHDL(L3)
CO4	Simulate and make a synthesis of designs using Field Programmable Gate Array (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2				2					2		2	2	
CO2		2			2					2			2	
CO3	3		3		3					3			3	
CO4	2		2		2					2			2	
Average* (Rounded to nearest integer)	2	2	3		2					2		2	2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction to Hardware Description Languages** (HDL) and HDL based design, VHDL- Variables, Signals and constants, Arrays, VHDL operators	CO1, CO2
2	**Expressions and signal assignments**. Entities, architecture specification. Component instantiation. VHDL description of combinational networks, VHDL models for a multiplexer	CO1, CO3
3	**VHDL functions**, VHDL procedures, Packages and libraries, Compilation, simulation of VHDL code.	CO1, CO3
4	**Modeling flip-flops using** VHDL, Modeling a sequential machine, VHDL model for a counter, Synthesis of Combinational and sequential circuits.	CO1, CO3

5	**Designing with Programmable Logic Devices:** Read-only memories (ROM, EPROM, EEPROM/FLASH), Programmable logic arrays (PLAs), Programmable array logic (PLAs, Designing with FPGAs, Xlinx 4000 series FPGAs, using a one-hot state assignment	CO1, CO4

Learning Resources
Text Books
1. J.Bhaskar- VHDL Primer, Pearson Education Asia, 2001
Reference Books
1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, McGraw-Hill Higher Education.

Cognitive Radio

Course Code	20EC6402	**Year**	II	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**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 design principles on software defined radio and cognitive radio(L2)
CO2	Develop the ability to design and implement algorithms for cognitive radio spectrum sensing and dynamic spectrum access(L3)
CO3	Apply the various routing protocols of cognitive radio in real time wireless applications(L3)
CO4	Apply the knowledge of advanced features of cognitive radio for real world applications(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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2				2									
CO2	3				3	2								3
CO3	2				2									
CO4	3				3	2								
Average* (Rounded to nearest integer)	3				3	2								3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction to software-defined radio and cognitive radio:** Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.	CO1, CO2

2	**Cognitive radio architecture:** Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands	CO1, CO2
3	**Spectrum sensing and dynamic spectrum access:** Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.	CO1, CO3
4	**MAC and network layer design for cognitive radio;** MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.	CO1, CO4
5	**Cognitive Radio Platforms** Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.	CO1, CO5

Learning Resources
Text Books
1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, ―Cognitive Radio Communications and Networks, Academic Press, Elsevier, 2010. 2. Linda E-Doyle CUP , Essentials of Cognitive Radio — 2009
Reference Books
1 Huseyin Arslan (Ed.), ―Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007. 2. Bruce Fette, ―Cognitive Radio Technology, Newnes, 2006. 3. Kwang-Cheng Chen, Ramjee Prasad, ― Cognitive Radio Networks, John Wiley and Sons, 2009.
e- Resources & other digital material
1. https://www.youtube.com/watch?v=z-E5jIoUFbA 2. https://www.youtube.com/watch?v=rWtcfyNpvRM

Solid State Microwave Devices

Course Code	20EC6403	**Year**	II	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Microwave 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	Analyse various solid state diodes (L4)
CO2	Operate Transferred-Electron Devices in various applications(L3)
CO3	Make use of various Microwave Solid State Devices.(L3)
CO4	Analyze the characteristics of Microwave Transistors (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		2								2				
CO2	2									3				3
CO3	3									3				
CO4		2								2				
Average* (Rounded to nearest integer)	2	3								3				3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Varactor Diode:** Introduction, Analysis of graded junction, Equivalent circuit, Manley Rowe power relation, Applications of Varactor diode- Parametric amplifiers, Parametric Up converter, Noise properties of Parametric amplifiers, Varactor diode Multiplier, Advantages and Limitations of Parametric amplifiers.	CO1
2	**Tunnel Diode:** Introduction, Principle of operation, Equivalent circuit, Tunnel diode amplifiers, I-V Characteristics of Tunnel diode, **Transferred-Electron Devices-Gunn Diodes**: current-voltage characteristics, Modes of operation of Gunn diode, Applications of Gunn Diode, LSA Diodes, InP Diodes.	CO1,CO2

3	**PIN Diodes:** Description, the I-layer, Equivalent circuit behaviour under reverse bias and forward bias, Diode impedance, Applications.	CO1,CO3
4	**Avalanche Transit-Time Devices:** Introduction, **Read Diode-** Structure, Operation, Carrier current and external current, Output power and Quality factor, **IMPATT Diode**- Structure, Different doping profile structures, Operation, Small-signal theory , Power output and Efficiency, applications. **TRAPATT**- Structure, Principle of Operation, Power output and Efficiency, **BARITT**- Structure, Principle of Operation, Performance and Applications. .	CO1,CO3
5	**Microwave Transistors:** Introduction, Microwave Transistors-physical structure, Transistor Configurations, principle of operation, V-I characteristics, Equivalent circuit, Amplification phenomena, Power- frequency limitations**, Hetero-junction Bipolar Transistors (HBTs)-** physical structure, Operational Mechanism, Applications	CO3,CO4

Learning Resources
Text Book(s): **1.** Samuel Y. Liao, Microwave Devices and Circuits, 3rd Ed., PHI. 2. M.L. Sisodia, Vijay Lakshmi Gupta Microwaves- Introduction to Circuits, Devices and Antennas, New Age International Publishers, 2001.
Reference Books
1. Annapurna Das, Sisir K Das, Vijay Lakshmi Gupta Microwave Engineering, TMH.

Artificial Intelligence

Course Code	20EC6404	**Year**	II	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Neural networks
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 principles of Artificial Intelligence L2
CO2	Apply different approaches to Intelligent Agents. L3
CO3	Make use of various Search Algorithms to solve real time applications. L3
CO4	Analyse different Search Algorithms and Constraint Satisfaction Problems L4

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**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2									2				
CO2	2				2					2				2
CO3	3				3					3				3
CO4		3			3					3				3
Average* (Rounded to nearest integer)	**2**	**3**			**3**					**3**				**3**

Syllabus		
Unit No.	**Contents**	**Mapped COs**
1	**Artificial Intelligence**: **Introduction** What is AI: - Acting humanly: The Turing Test approach, Thinking humanly: The cognitive modeling approach, Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach. The Foundations of Artificial Intelligence.	CO1, CO2
2	**Intelligent Agents:** Agents and Environments, Good Behavior: The Concept of Rationality, Performance measures, Ratioilality, Omniscience. Learning and autonomy, The Nature of Environments, Specifying the task environment, Properties of task environments, The Structure of Agents, Agent programs, Simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents.	CO1, CO2

3	**Solving Problems by Searching:** Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies.	CO1, CO3,CO4
4	**Informed Search and Exploration:** Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.	CO1, CO3,CO4
5	**Constraint Satisfaction Problems:** Constraint Satisfaction Problems, Backtracking Search for CSPs, Local Search for Constraint Satisfaction Problems, The Structure of Problems.	CO1, CO4

Learning Recourses

Text Book(s)

1. Stuart Russell Peter Norving, Artificial Intelligence A Modern Approch, 2nd Ed, Prentice Hall.
2. Elaine Rich, Kevin Knight, Shivasankar B Nair, Series in Artificial Intelligence, Tata Mc-Graw Hill publishing Company Limited.

References

1. Ela Kumar, Artificial Intelligence, , 3rd Ed., Pearson

E-Resources :

1. www.learnartificialIntelligence.com

Analog Systems

Course Code	20EC5401	**Year**	II	**Semester**	II
Course Category	**Minor**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**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 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)

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				
CO2	2								2	2				
CO3	3								3	3				
CO4		3							3	3				3
Average* (Rounded to nearest integer)	2	3							3	3				3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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

2	**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
3	**Active Filters**: Introduction, classification, Butter worth filters – 1^{st} order, 2^{nd} order LPF, HPF, Band pass, Band reject filters, All pass filters.	CO1,CO3,CO4
4	**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
5	**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, 4^{th} Ed., 2009
2. J.Milliman, C.C Halkias - Electronic Devices and Circuits, Tata Mc-Graw Hill, 2^{nd} 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, 2^{nd} Ed., 2007

e- Resources & other digital material

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**	II
Course Category	**Minor**	**Branch**	ECE	**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)

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	2
CO 3	3					3				3			3	3
CO 4	2					2				2			2	2
Average* (Rounded to nearest integer)	**2**					2				**2**			**2**	**2**

Syllabus

Unit No.	Contents	Mapped CO
1	**8051 Microcontroller** Microcontrollers, Types of Microcontrollers, 8051 Microcontroller Architecture, Microcontroller 8051 Pins, 8051 Ports, Internal and External Memory.	CO1
2	**8051 Instruction Set** Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language programs.	CO2
3	**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

4	**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
5	**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, 2nd Ed., Pearson. 2. Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay-The 8051 Microcontroller and Embedded Systems – using assembly and C, Pearson, 2nd Ed.
References
1. Kenneth J. Ayala- The 8051 Microcontroller, 3rd Ed., Thomson/Cengage Learning.
e-Resources
https://nptel.ac.in/courses/108105102

III YEAR SYLLABUS

Semester –V
Digital Communications

Course Code	20EC3501	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Communication 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	Construct different Baseband Digital Systems (L3)
CO2	Analyze the parameters of digital Passband and Spread Spectrum modulation Techniques (L4)
CO3	Develop various Source Coding techniques (L3)
CO4	Build Coding sequences for different error correcting codes (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2													
CO2	3								2	2		2	3	
CO3	3								2	2		2	3	
CO4		3							3	3		3	3	
Average	3	3							2	2		2	3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Waveform Coding Techniques:** Introduction, Pulse code modulation (PCM), DPCM, Delta modulation(DM), ADM, output Signal to quantization Noise ratio in PCM and DM systems, Line Codes, Intersymbol interference, Correlative coding.	CO1,CO2
2	**Digital Modulation Techniques:** Introduction, Gram Schmidt Orthogonalization procedure, Correlation receiver, Matched filter, Coherent Phase Shift Keying, Quadrature Phase Shift Keying, Differential Phase Shift keying. Coherent and Non Coherent Frequency Shift Keying, M-ary PSK and M-ary FSK.	CO1,CO2
3	**Spread-Spectrum Modulation**: Introduction, Pseudo-Noise Sequences, Direct sequence spread spectrum, Processing Gain,	CO1,CO2

	Jamming margin, Frequency Hopping Spread spectrum, Slow frequency Hopping, Fast Frequency Hopping.	
4	**Information Theory:** Introduction, information, Entropy, Source Coding Theorem, Lossless Data Compression, ,Shannon-Fano coding, Huffman coding, Lempel-Ziv Coding, Discrete memoryless channels, Mutual information, Channel Capacity, Channel Coding Theorem , Information Capacity Theorem	CO2,CO3
5	**Error Control Coding:** Introduction, Linear Block codes, Syndrome and its Properties, Syndrome Decoding, Cyclic Codes, Encoder, Syndrome calculator, Convolutional Codes, Code Tree, Trellis and State diagram, The Viterbi Algorithm.	CO4

Learning Resources
Text Books:
1. Simon Haykin -Digital communications -, John Wiley, 4th Ed. - 2010 2. John G Proakis -Digital Communications –, McGraw Hill , 5th Ed., 1995
Reference Books
1. H Taub & D. Schilling, Gautam Sahe -Principles of Communication Systems, TMH, 3rd Ed.,2007 **2.** Sam Shanmugam -Analog and Digital Communication System-, John Wiley and Sons, 3rd Ed.,2009 3. A B Carlson - Communication systems –, McGraw-Hill, 4th Ed., 2002 4. B Sklar- Digital communications, Pearson Education, 2nd Ed., 2013
e- Resources & other digital material
1.https://www.youtube.com/playlist?list=PLC7D3EAEFA0CC0420&app=desktop 2.https://nptel.ac.in/courses/108/105/108105159/

Internet of Things

Course Code	20ES1501	**Year**	III	**Semester**	I
Course Category	ES	**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	**Summariz**e the genesis and impact of IoT applications, architectures in real world.	L2
CO2	**Apply** diverse methods in deploying smart objects and connecting them to network.	L3
CO3	**Construct** applications using Arduino.	L3
CO4	S**elect** different protocols required for communication in the IoT system.	L3
CO5	**Analyze** and develop a solution for a given application using APIs.	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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2									2		2		2
CO2	3		3		3					3		3	3	
CO3	2		2							2		2		2
CO4	2				2		2			2			2	
CO5		2	2							2		2	2	2
Average * (Rounded to nearest integer)	2	2	2		3					2		2	2	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Genesis of IoT**, IoT and Digitization, IoT Impact-Connected roadways, Smart connected buildings, Convergence of IT and IoT, IoT Challenges, Comparing IoT Architectures - OneM2M IoT Architecture and IoTWF Architecture, A Simplified IoT Architecture	CO1,CO2
2	**Smart Objects**: The Things in IoT- Sensors, Actuators, and Smart Objects, **Sensor Networks**-Advantages and Disadvantages, Communications Criteria-Range, Frequency bands, Power consumption, Topology, IoT Access Technologies- IEEE 802.15.4,IEEE 1901.2a,IEEE 802.11ah (only Standardization and Alliances, Physical Layer, MAC Layer and Topology)	CO1, CO2

3	**Embedded Computing Basics**- Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino- Developing on the Arduino, Some Notes on the Hardware, Openness	CO1, CO3
4	**Communication in the IoT**: Internet Principles, Internet Communications: An Overview- IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses- DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports- An Example: HTTP Ports, Other Common Ports, Application Layer Protocols- HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols.	CO1, CO4
5	**Prototyping Online Components**: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols.	CO1, CO5

Learning Resources

Text Books

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEd., Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

Reference Books

1. Arshdeep Bahga and Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014
2. Srinivasa K G, Internet of Things, CENGAGE Leaning India, 2017

e-Resources & other digital material

1. https://ocw.cs.pub.ro/courses/iot
2. https://education.ni.com/teach/resources/1079/industrial-internet-of-things-laboratory

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Data Structures and Algorithms

Course Code	**20ES1502**	**Year**	III	**Semester**	I
Course Category	ES	**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	Understand the basic concepts of algorithms, time and space complexities, recursion and data structure	L2
CO2	Apply a suitable data structure to solve a given problem	L3
CO3	Apply algorithm design technique to construct one for a given problem	L3
CO4	Analyse the given problem and use a suitable data structure to provide a feasible solution	L4
CO5	Analyse the given problem and use suitable algorithm techniques to provide a feasible solution	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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2				2							2	2	
CO2	2				2								2	
CO3	2		2		2								2	
CO4		3			3								3	
CO5		2			2								2	
Average * (Rounded to nearest integer)	2	3	2		2							2	2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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, Singly Circular linked list, and doubly linked list. Time and space complexity of operations.	CO1,CO2 CO4

2	**Stacks, Queue**: Definition, operations: array implementation of stack and queue, Circular Queue. Time and space complexity of operations.	CO1,CO2 CO4
3	**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. **Graph**: Adjacency matrix and list representation, BFS and DFS traversal. Time and space complexity of operations.	CO1,CO2 CO4
4	**Divide and Conquer**: Binary search, Merge sort, Quick Sort. **Greedy Method:** Fractional knapsack problem, Single Source Shortest path (Dijkstra's). Time and space complexities the problems.	CO1,CO3 CO5
5	**Dynamic Programming**: 0/1 Knapsack problem, All-pairs shortest paths, Travelling salesman problem. Time and space complexities of the problems.	CO1,CO3 CO5

Learning Resources

Textbooks

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Ed., 2002, Pearson.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Ed., 2010, PHI

References

1. T. H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford - Introduction to Algorithms, 3rd Ed., MIT Press, 2012
2. Ellis Horowitz, Sartaj Sahni, S. Rajasekharan - Fundamentals of computer algorithms, 2nd Ed., Universities Press,2008
3. Horowitz, Sahani, Anderson-Freed - Fundamental of Data Structures in C, 2nd Ed., Universities Press,2008
4. Debasis Samantha, Classic Data Structures, 2nd Ed., PHI,2009.
5. Narasimha K - Data Structures and Algorithms Made Easy, Career Monk Publication,2020
6. A. Levitin - Introduction to the Design & Analysis of Algorithms, 3rd Ed., Pearson Education,2011.

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
5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/

Air Pollution & Control

Course Code	20CE2501A	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	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	**Understand** the various types of air pollutants and their effects.	L2
CO2	**Examine** the behavior 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

	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**

1- Low **2-Medium** **3-High**

Syllabus

Unit No	**Contents**	**Mapped CO**
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
2	**Meterology and Plume Dispersion** Properties of atmosphere-heat, pressure, wind forces, moisture and relative humidity influence of meteorological phenomenon on air quality- wind rose diagram, inversions and Plume behavior, Gaussian model for plume dispersion.	CO2
3	**Sampling of Air Pollution**: Stack sampler; Sampling Procedure- Sampling point – size – Isokinetic 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.	CO3

4	**Methods of Controlling Air Pollution** Different means of control of effluent discharges into the atmosphere. Control of Particulate matter by equipment -Settling chamber, inertial separators, fabric filters, wet scrubbers, Electrostatic Precipitators	CO4
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. Rao M.N and Rao, H.N.,Air Pollution and Control Tata Mc-Graw Hill, New Delhi 2007. 2. Suresh, S. K. Environmental Engineering and Management, 2nd Ed., Kartarai & Sons, 2005.
Reference Books
1. Trivedy, R.K, An Introduction to Air pollution, B. S. Publications, 2005. 2. Wark and Warner, Air pollution 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	**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 (L3)
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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2					2	2					2		
CO2	3					3	2						3	
CO3	2				2	2	2						2	
CO4	2				2	2	2						2	
CO5		2					2							2
Average* (Rounded to nearest integer)	**3**	**2**			**2**	**2**	**2**					**2**	**3**	**2**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Sensors Fundamentals and Characteristics** Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics	CO1,CO2
2	**Physical Principles of Sensing** Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect;	CO1,CO2

	Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements	
3	**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
4	**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
5	**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

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Electronic Instrumentation

Course Code	**20EC2501B**	**Year**	III	**Semester**	I
Course Category	Open 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	
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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2					1	2			2				
CO2	2					2	2			2				2
CO3	3					2	2			2				2
CO4		2				2	1			2				2
CO5	2					2	2			2				2
Average * (Rounded to nearest integer)	**2**	**2**				**2**	**2**			**2**				**2**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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, Multimeters for Voltage, Current and resistance measurements.	CO1,CO2
2	**Signal Generator& Wave Analyzers:** Fixed and variable signal generators, AF oscillators, Standard signal generator, AF sine and square wave signal generators, Function Generators, Basic wave analyzers, Frequency selective wave analyzers, Hetero- dyne	CO1,CO3

	wave analyzer, Harmonic Distortion Analyzers, Spectrum Analyzers.	
3	**Oscilloscopes:** Dual trace oscilloscope, Measurement of amplitude, period and frequency, Sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope.	CO1,CO4
4	**Bridges:** Wheatstone Bridge, AC Bridges Measurement of inductance- Maxwell's bridge, Measurement of capacitance - Schearing Bridge. Wien Bridge, Q-meter.	CO1,CO3
5	**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. H.S.Kalsi - Electronic instrumentation, - Tata Mc-Graw Hill, 2nd Ed., 2004. 2. A.D. Helfrick and W.D. Cooper - Modern Electronic Instrumentation and Measurement Techniques – PHI, 5th Ed., 2002.
Reference Books
1. David A. Bell - Electronic Instrumentation & Measurements, PHI, 2nd Ed., 2003. 2. Robert A.Twitter, Electronic Test Instruments, Analog and Digital Measurements - Pearson Education, 2nd Ed., 2004
E-resources
1. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm

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Electrical Safety

Course Code	20EE2501A	**Year**	III	**Semester**	I
Course Category	OE	**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 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 safety 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's**
1	**Introduction To Electrical Safety, Shocks And Their Prevention:** Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. 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-CO4,CO6
2	**Electrical Safety in Residential, Commercial and Agricultural Installations**: Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building –Temporary installations –Agricultural pump installation –Do's and Don'ts for safety in the use of domesticelectrical appliances.	CO1, CO2 CO4, CO6

3	**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
4	**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
5	**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 Ed., 2020 2. John Codick, Electrical safety hand book, Mc-Graw Hill Inc., 3rd Ed., 2006
Reference Books
1. Cooper.W.F, Electrical safety Engineering, Newnes-Butterworth Company, 3rd Ed., 1998. 2. Kothari, D.P and Nagrath, I.J., Power System Engineering, Mc-Graw Hill, 3rd Ed., 2019. 3. Wadhwa, C.L., Electric Power Systems, New Age International, 8th Ed., 2004.

Cyber Laws

Course Code	20IT2501A	**Year**	III	**Semester**	I
Course Category	Open Elective	**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	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)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1						3	3	3					3	3
CO 2						3	3	3					3	3
CO 3						3	3	3					3	3
CO 4						3	3	3					3	3

Syllabus		
Unit No	**Contents**	**Mapped CO**
1	**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-CO4
2	**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-CO4
3	**Traditional Computer Crime: Early Hacker and Theft of Components:** Traditional Problems, Recognizing and Defining	CO1- CO4

	Computer Crime, Phreakers: Yesterday's Hackers, Hacking, Computer as Commodities, Theft of Intellectual Property.	
4	**Identity Theft and Identity Fraud:** Typologies of Internet Theft/Fraud, Prevalence and Victimology, Physical Methods of Identity Theft.	CO1-CO4
5	**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- CO4

Learning Resources
Text books
1. Vivek Sood, Cyber Law Simplified, Tata Mc-Graw 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} Ed.,PHI, 2003. 2. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing, 1^{st} Ed.,New Delhi, 2003. 3. Sharma, S.R., Dimensions of Cyber Crime, Annual Publications Pvt. Ltd., 1^{st} Ed., 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	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Pre-requisites**	-
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		Blooms Level
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														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1			3			2	2		3	3	2	2	2	3
CO 2			3			2	2		3	3	2	2	1	3
CO 3			3			2	2		3	3	3	2	1	3
CO 4			3			2	2		3	3	2	2	1	3

Syllabus		
Unit No	**Contents**	**Mapped CO**
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
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

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
4	**Prototyping and Testing**: 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	CO1, CO3
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. Tim Brown and Harper Collins, Change by Design, 2009,
2. George E Dieter, Engineering design, 4^{th} Revised Ed., Mc-Graw Hill, 2009.

Reference books

1. Idris Mootee, Design Thinking for Strategic Innovation, John Wiley & Sons, 2013
2. Design Thinking-The Guide book–Facilitated by the Royal Civil service Commission, Bhutan
3. Vijay Kumar, Design Methods: A Structured Approach for Driving Innovation in Your Organization, 1^{st} Ed., Wiley, 2012
4. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World, IDEO, 2^{nd} Ed., 2011

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-anempath\capproach-in-design-thinking

Logistics & Supply Chain Management

Course Code	20ME2501B	**Year**	III	**Semester**	I
Course Category	**Open Elective**	**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		Level
Upon successful completion of the course, the student will be able to		
CO1	Identify the importance of Supply Chain Management	L2
CO2	Explain different Inventory control techniques	L1
CO3	Design various Supply Chain Networks suitable for various market conditions	L3
CO4	Discuss supply chain strategies and procurement strategies	L1
CO5	Identify various issues in Supply Chain Management	L2

CO'S /PO'S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
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 No.	**Content**	**Mapped CO**
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	CO2

	opportunities, deterministic models, quantity discounts. periodic and quantity review policies, mathematical modeling under known stock out 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 4benefits, 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 Managing the Supply Chain: Concepts, Strategies and Case Studies, 3rd Ed., Tata Mc-Graw-Hill, 2008.
2. Chopra, S. and Meindl, Supply Chain Management: Strategy, Planning and Operations, 2nd Ed., Pearson Education, 2004.

Reference books

1. Doebler, D.W. and Burt, D.N, Purchasing and Supply Management-Text and Cases, 6th Ed., Mc-Graw- Hill, 1996.
2. Tersine, R.J, Principles of Inventory and Materials Management, 4th , Prentice Hall, 1994.

e- Resources & other digital material

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/

Wireless Communications and Networks

Course Code	20EC4501A	**Year**	III	**Semester**	I
Course Category	Professional Elective-I	**Branch**	ECE	**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** concepts of all Wireless Communication techniques. (L2)
CO2	**Identify** the Multiple Access Techniques for Wireless Communication. (L3)
CO3	**Illustrate** the Development of wireless networks, WLAN &Bluetooth. (L3)
CO4	**Analyze** the Wireless Data Services, Mobile IP and Wireless Access Protocol (L4)
CO5	**Illustrate** the Mobile Data Networks ,Wireless ATM & HiPER LAN .(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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2									2			2	2
CO2	2									2			2	2
CO3	3									3			3	3
CO4		2								2			2	2
CO5	2									2			2	2
Average* (Rounded to nearest integer)	**2**	**2**								**2**			**2**	**2**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Multiple Access Techniques for Wireless Communication:** Introduction, FDMA, TDMA, Spread Spectrum, Multiple access, SDMA, Packet radio, Packet radio protocols, CSMA protocols, Reservation protocols	CO1,CO2
2	**Introduction to Wireless Networking**: Introduction, Difference between wireless and fixed telephone networks, Development of wireless networks, Traffic routing in wireless networks.	CO1,CO3
3	**Wireless Data Services**: Common channel signalling, ISDN, BISDN, SS7, SS7 user part, signalling traffic in SS7.	CO1,CO4

	Mobile IP and Wireless Access Protocol: Mobile IP Operation of mobile IP, Co-located address, Registration, Tunnelling, WAP Architecture, overview, WML scripts, WAP service, WAP session protocol, Wireless datagram protocol.	
4	**Wireless LAN Technology:** Infrared LANs, Spread spectrum LANs, Narrow band microwave LANs, IEEE 802 protocol Architecture and services, 802.11 medium access control, 802.11 physical layer. **Bluetooth**: Overview, Radio specification, Base band specification, Links manager specification, Logical link control and adaptation protocol. Introduction to WLL Technology.	CO1,CO3
5	**Mobile Data Networks**: Introduction, Data oriented CDPD Network, GPRS and higher data rates, Short messaging service in GSM, Mobile application protocol. **Wireless ATM & HiPER LAN**: Introduction, Wireless ATM, HIPERLAN, Adhoc Networking and WPAN	CO1,CO5

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Learning Resources
Text Books
1. William Stallings- Wireless Communication and Networking –PHI, 2003. 2. Theodore, S. Rappaport, Wireless Communications, Principles, Practice –PHI, 2nd Ed., 2002.
Reference Books
1. Thiagarajan Viswanathan - Telecommunication switching systems and networks – PHI 2. Kamilo Feher - Wireless Digital Communications – PHI, 1999. 3. Kaveh Pah Laven and P. Krishna Murthy - Principles of Wireless Networks, Pearson Education, 2002

Digital Integrated Circuits and Applications

Course Code	20EC4501B	**Year**	III	**Semester**	I
Course Category	Professional Elective	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	DLD
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 of Verilog HDL and logic families(L2)
CO2	**Build** different levels of Modelling in Verilog HDL and logic gates using different logic families (L3)
CO3	**Develop** Verilog HDL code for various digital ICs of combinational logic (L3)
CO4	**Develop** Verilog HDL code for various digital ICs of sequential logic (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2
CO1		2			2								2	
CO2	3				3								3	
CO3	2				2								2	
CO4	2				2								2	
Average* (Rounded to nearest integer)	**2**	**2**			**2**								**2**	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction to Verilog** Need for HDL, Historical development of Verilog, Module: Design module, Test bench, Importance of Verilog in VLSI, Verilog data types and operators	CO-1, CO-2
2	**Different levels of Modelling** Gate level modelling: Gate types, Gate delays. Data flow modelling: Continuous assignments, delays. Behavioral Modelling :initial statement, always statement, procedural assignments, conditional statements, multi way branching, loops	CO-1, CO-2
3	**Logic Families** Introduction to logic families, CMOS logic, TTL families, CMOS/TTL interfacing, low voltage CMOS	CO-1, CO-2

	logic and interfacing, Comparison of logic families, Familiarity with standard 74XX series-ICs and 40 XX series-ICs.	
4	**Verilog models of the Combinational Logic ICs.** Decoders, encoders, three state devices, multiplexers and demultiplexers, Code Converters, comparators, adders & subtractors, ALUs, Combinational multipliers	CO-1- CO-3
5	**Verilog models of the Sequential Logic ICs.** Latches, flip-flops, counters and shift registers, impediments to synchronous design.	CO-1,CO-2, CO-4

Learning Resources

Text Books

1. Samir Palnitkar - Verilog HDL – A Guide to Digital Design and Synthesis, 2nd Ed., Pearson Publishers, 2003
2. John F. Wakerly - Digital Design Principles & Practices – PHI/ Pearson Education Asia, 3rd Ed., 2005

Reference Books

1. J. Bhasker - Verilog Primer –, Pearson Education/ PHI, 3rd Ed., 2003
2. Alan B. Marcovitz - Introduction to Logic Design –TMH, 2nd Ed., 2003

E Resources:

1. https://www.youtube.com/watch?v=FWE0-FOoE4s&list=PLUtfVcb-iqn-EkuBs3arreilxa2UKIChl
2. https://www.youtube.com/watch?v=ow_gCaxPnmc

Transmission Lines and Waveguides

Course Code	20EC4501C	Year	III	Semester	I
Course Category	Program Elective	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	
CO1	Interpret various parameters of transmission lines, waveguides and resonators. (L2)
CO2	Solve various parameters like load reflection coefficient, Standing Wave Ratio, Line impedance and Cut-off frequency for transmission lines, waveguides and resonators (L3)
CO3	Apply smith chart for line parameters and impedance calculations. (L3)
CO4	Analyze the field components and characteristics of a transmission lines, waveguides and resonators. (L4)
CO5	Submit a report on transmission lines ,waveguides and resonators (L5)

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2					1								
CO2	3					2							3	
CO3	3				3	2							3	
CO4		3				2							3	
CO5									3	3				
Average* (Rounded to nearest integer)	**3**	**3**			**3**	**2**			**3**	**3**			**3**	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Basics of Transmission Lines:** Concept and definition, Different kinds of transmission lines, Applications, Equivalent circuit, Primary constants- R, L, C and G, Secondary constants –	CO1 , CO2,CO5

	Propagation constant and Characteristic Impedance, General transmission line equations. Attenuation and phase constant. Wavelength, phase velocity and group velocity. The lossless transmission line, The infinite long transmission line, The distortion less transmission line and condition for distortionlessness and minimum attenuation.	
2	**Finite Transmission Lines**: The load reflection coefficient, Standing Wave Ratio, Line impedance, Generalized reflection coefficient, The lossless terminated transmission line, The lossless matched transmission line, The lossless shorted transmission line, The lossless open transmission line.	CO1 , CO2,CO5
3	**UHF Lines:** UHF lines as circuit elements: λ/4, λ/2, λ/8 lines, Smith Chart: Construction of smith chart, Smith chart as impedance chart, smith chart as admittance chart, Problems using smith chart. Impedance matching, Quarter wave transmission line, Single stub and introduction to double stub matching.	CO1,CO3, CO4,CO5
4	**Waveguides**: Introduction, Rectangular Waveguides-Transverse Electric (TE) and Transverse Magnetic (TM) mode analysis – Field expressions, Characteristic equation, Cut-off frequency, Phase velocity, Group velocity, Attenuation and Phase constants, Wavelength and Impedance. Dominant and degenerate modes	CO1,CO2, CO4, CO5
5	**Cavities:** Rectangular Cavity Resonators-Dominant modes and Resonant Frequencies, Q factor, Types of coupling and Coupling coefficients. **Planar transmission lines:** Introduction, Strip Lines, Micro strip Lines- characteristic impedance, Losses and Quality factor. Parallel Strip Lines- distributed parameters, characteristic impedance and attenuation losses.	CO1, CO2,CO4 , CO5

Learning Resources

Text Books

1. Nathan Ida, Engineering Electromagnetics, Springer International, 2nd Ed., 2008.
2. Samuel Y. Liao, Microwave Devices and Circuits –Pearson Education, 3rd Ed., 2003.

Reference Books

1. E.C. Jordan and K.G. Balmain Electromagnetic Waves and Radiating Systems, PHI, 2nd Ed., 2009
2. Annapurna Das, Sisir K Das, Microwave Engineering, 2nd Ed., 2006, Tata Mc-Graw Hill

e- Resources & other digital material

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm
2. http://nptel.iitm.ac.in/video.php?subjectId=117101056 3.
3. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Transmission%20Lines%20and%20EM%20Waves/TOC.htm
4. http://www.mike-willis.com/Tutorial/PF2.htm

Computer Architecture & Organization

Course Code	20EC4501D	**Year**	III	**Semester**	I
Course Category	PE-I	**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	
After 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 computer 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)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3					2	2							
CO2	2					2	2			1			2	1
CO3	2					2	2			1			2	1
CO4		2				2	2			1			2	1

Syllabus		
Unit No.	**Contents**	**Mapped Cos**
1	**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
2	**Basic Computer Organization**: Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input- Output and Interrupt.	CO1,CO2
3	**Central Processing Unit**: General registers Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control	CO1,CO3
4	**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
5	**Input-Output Organization**: Peripheral Devices, Input-output Interface, Asynchronous Data Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor. Pipeline and	CO1,CO4

	Parallel Processing: Parallel processing, Pipelining, Arithmetic pipeline, Instruction pipeline	

Learning Resources
Text Books
1. Morris M. Mano - Computer System Architecture, 3rd Ed., 1992, Pearson. 2. William Stallings - Computer Organization and Architecture, 8th Ed., 2010, PHI.
Reference Books
1. Carl Hamachar, Vranesic - Computer Organization, 2002, Mc-Graw Hill.
e- Resources and other Digital Material
1. https://nptel.ac.in/courses/106/106/106106092/

Artificial Neural Networks

Course Code	20EC4501E	**Year**	III	**Semester**	I
Course Category	PE-I	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Engineering Mathematics, signals and systems
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 principles of Neural Networks L2
CO2	Identify different types of models of artificial neural networks L3.
CO3	Analyse the feed-forward neural networks. L4
CO4	Analyse the feedback neural networks. L4
CO5	Compare different applications of artificial neural networks. L4

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

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2									2		2		
CO2	2				2					2				
CO3		2								2			2	
CO4		3								3			3	
CO5		2				2	2		2	2				2
Average * (Rounded to nearest integer)	**2**	**2**			**2**	**2**	**2**		**2**	**2**		**2**	**3**	**2**

Syllabus		
Unit No.	**Contents**	**Mapped COs**
1	**Basics of Artificial Neural Networks**: Characteristics of Neural Networks, Historical Development of Neural Network Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws.	CO1, CO4
2	**Activation and Synaptic Dynamics**: Introduction, Activation Dynamics Models, Synaptic Dynamics Models, Learning Methods.	CO1, CO2

3	**Feed forward Neural Network**: Introduction, Analysis of Pattern Association Networks, Analysis of Pattern Classification Networks,	CO1, CO3
4	**Feedback Neural Networks**: Introduction, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks.	CO1, CO4
5	**Applications of ANN**: Introduction, Direct Applications	CO1, CO5

Learning Recourses

Text Book(s)

1. B. Yegnanarayana - Artificial neural network PHI Publication.2005
2. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms

Reference Books

1. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005
2. Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press, 1995

e- Resources and other Digital Material

1. https://ocw.mit.edu/courses/9-641j-introduction-to-neural-networks-spring-2005/
2. https://nptel.ac.in/courses/117105084

Digital Communications Lab

Course Code	**20EC3551**	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	ECE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Communication Theory 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	**Demonstrate** the performance of Analog to Digital Conversion techniques. (L4)
CO2	**Analyze** different Digital Modulation & Demodulation schemes (L4)
CO3	**Evaluate** various Source & Channel Coding Techniques (L5)
CO4	**Design** Multiplexing & Demultiplexing scheme (L4)
CO5	**Make** 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1		2			2				3				2	
CO2		2			2				3				2	
CO3				2	2				3				2	
CO4		3			3				3				3	
CO5									3	2				
Average* (Rounded to nearest integer)		**2**		**2**	**2**				**3**	**2**			**2**	

Have to perform a minimum of 10 Experiments in the given concepts using Hardware or MATLAB programming.

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Generation and Reconstruction of Analog to Digital conversion. (PCM, DPCM & DELTA MODULATION)	CO1
2	Implementation of Digital Modulation & Demodulations. (BPSK,DPSK& BFSK)	CO2
3	Implementation of Source Coding Techniques. (HUFFMAN CODING, SHANNON FANO CODING & LZ CODING)	CO3
4	Implementation of Channel Coding Techniques. (LINEAR BLOCK CODES, CYCLIC CODES & CONVOLUTION CODES)	CO4
5	Implementation of Spread Spectrum concepts. (DSSS & FHSS)	CO4

NOTE: OCTAVE/MATLAB/LABVIEW software tools may be used for conducting the experiments

- ❖ A Minimum of TEN experiments covering all the above topics need to be conducted

Learning Resources
Text Books
1. Simon Haykin - Digital communications - John Wiley, 4^{th} Ed. 2. John G Proakis - Digital Communications – McGraw Hill , 5^{th} Ed., 1995
Reference Books
1. Sam Shanmugam - Analog and Digital Communication System-John Wiley and Sons,3^{rd} Ed.,2009
e- Resources & other digital material
1.https://www.youtube.com/playlist?list=PLC7D3EAEFA0CC0420&app=desktop 2.https://nptel.ac.in/courses/108/105/108105159/

Internet of Things Lab

Course Code	20ES1551	**Year**	III	**Semester**	I
Course Category	Engineering Sciences	**Branch**	ECE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming for Problem Solving
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** appropriate techniques, resources and IDE for modeling system designs with understanding of limitations.	**L3**
CO2	**Develop** various sensor interfacing using programming language	**L3**
CO3	**Evaluate** wireless control of remote devices	**L5**
CO4	**Develop** mobile application which can interact with sensors and actuators	**L6**
CO5	**Make** 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3								2				3	3
CO2	**3**								2				3	3
CO3				3					2				1	1
CO4			2						2				2	2
CO5										3				
Average* (Rounded to nearest integer)	**3**		**2**	**3**					**2**	**3**			**2**	**2**

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Introduction to Arduino and necessary software installation. Interface and control LED.	CO1, CO5
2	Digital I/O Interface.	CO1, CO2, CO5
3	Analog I/O Interface.	CO1, CO2, CO5
4	Fabrication and direction control of wheeled robot using Arduino.	CO1, CO2, CO5

5	Serial Communication - Device Control.	CO1, CO2, CO5
6	Wireless Module Interface.	CO1,CO3, CO5
7	Basic Android App Development using MIT App Inventor.	CO1,CO4, CO5
8	Smart Home Android App Development using App Inventor and Arduino.	CO1,CO4, CO5

- A minimum of 10 experiments to be done covering all the above topics

Learning Resources
Text Books
1. Sylvia Libow Martinez, Gary S Stager, Invent To Learn: Making, Tinkering, Engineering in the Classroom, Constructing Modern Knowledge Press, 2016.
References
1. Michael Margolis, Arduino Cookbook, Oreilly, 2011.
e-Resources & other digital material
1. https://ocw.cs.pub.ro/courses/iot **2.** https://education.ni.com/teach/resources/1079/industrial-internet-of-things-laboratory

Java Programming

Course Code	20SA8554	**Year**	III	**Semester**	I
Course Category	SOC	**Branch**	ECE	**Course Type**	Lab
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Programming With 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 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: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						
CO3	3				3			3	3	3				
CO4	3				3			3						
CO5		3			3		3	3						
Average* (Rounded to nearest integer)	**3**	**3**			**3**		**3**	**3**	**3**	**3**		**3**		**3**

Syllabus		
Expt No.	**Contents**	**Mapped CO**
1	Implement Java Programs by using Conditional Statements, Switch and loops with suitable examples.	CO1-CO5
2	Develop Java Programs Using 1D Arrays and 2D arrays.	CO1-CO5
3	Use String, String Buffer and String Tokenizer classes to develop Java programs.	CO1-CO5
4	Implement the concept of static variables, static methods and static block.	CO1-CO5
5	Implement the concept of instantiation of objects using Classes.	CO1-CO5
6	Implement reusability concept through inheritance.	CO1-CO5
7	Implement concept of Polymorphism using method overloading and overriding.	CO1-CO5

8	Develop Java programs using Abstract Class to achieve Partial abstraction.	CO1-CO5
9	Use interfaces to develop Java programs with complete Abstraction.	CO1-CO5
10	Create a package and access members from the package to Avoid naming conflicts.	CO1-CO5
11	Implement Exception handling to build robust programs.	CO1-CO5
12	Develop Java programs using Multithreading for process Synchronization.	CO1-CO5
13	Implement various data structures using Collection Framework.	CO1-CO5

Learning Resources

Text Books

1. Herbert Schildt, Java - The Complete Reference, 9th Ed., 2014, Mc-Graw-Hill.
2. Y. Daniel Liang - Introduction to Java Programming 10th Ed. 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?cours =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/

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
1- Low 2-Medium 3-High

	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
Avg.						2		2						2

Syllabus

Unit No.	Contents	Mapped PO
1	**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- the basic 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,	CO1

	Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	
2	**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 in detail, Programs to ensure Sanyam and Health.	CO2
3	**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
4	**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
5	**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	CO5

	engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.	

Learning Resources

Text Books

1. R R Gaur, R Sangal, G P Bagaria - Human Values and Professional Ethics by, Excel Books, New Delhi, 2010.
2. A Nagaraj, Jeevan Vidya Prakashan, Amarkantak - Jeevan Vidya: Ek Parichaya, 1999.

Reference Books

1. A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
2. Mohandas Karamchand Gandhi - The Story of My Experiments with Truth

e- Resources & other digital material

1. https://www.youtube.com/channel/UCQxWr5QBeZUnwxSwxXEkQw

RF IC Design

Course Code	20EC6501	**Year**	III	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Electronic devices and 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 passive components at RF frequencies and required circuit theory(L2)
CO2	Design high frequency amplifiers and low noise amplifiers(L3)
CO3	Compare different types of mixers(L4)
CO4	Analyze oscillators and synthesizers at RF frequencies(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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2				2					2			2	
CO2	2		2		2					2			2	
CO3		2			2					2			2	
CO4		3			3					3			3	
Average* (Rounded to nearest integer)	2	3	2		2					2			2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Characteristics of passive IC components at RF frequencies** – interconnects, resistors, capacitors, inductors and transformers – Transmission lines Classical two-port noise theory, noise models for active and passive components, Noise figure, Nonlinearity , cascaded stages, Sensitivity and dynamic range	CO1
2	**High frequency amplifier design** – zeros as bandwidth enhancers, shunt-series amplifier, fTdoublers, Low noise amplifier design – LNA topologies, impedance matching, power constrained noise optimization, linearity and large signal performance	CO1, CO2

3	**Mixers** – fundamentals of mixers, multiplier-based mixers, sub sampling mixers, diode-ring mixers.	CO1, CO3
4	**Oscillators**– Feedback View of Oscillators, Colpitts oscillator, Hartley oscillator, describing functions, tuned oscillators, negative resistance oscillators.	CO1, CO4
5	**Synthesizers**: Basic Integer-N Synthesizer, synthesis with static moduli, combination synthesizers, phases noise considerations.	CO1, CO4

Learning Resources

Text Books

1. Thomas H. Lee, Cambridge, The Design of CMOS Radio-Frequency Integrated Circuits, UK: Cambridge University Press, 2004
2. Phillip E. Allen and Douglas R. Holberg- CMOS Analog Circuit Design Oxford University Press -3rd Ed., -2011

Reference Books

1. Behzad Razavi, RF Microelectronics, Prentice Hall, 1998.
2. Ludwig, RF Circuit Design, 2nd Ed., Pearson

E-Resources

1. https://nptel.ac.in/courses/117102012

Advanced Digital Modulation and Coding Techniques

Course Code	20EC6502	**Year**	III	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Digital Communications
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 different digital modulation schemes - L2
CO2	Apply the knowledge in designing turbo codes-L3
CO3	Design encoders and decoders for Space-Time Codes –L4
CO4	Understand the significance of LDPC and POLAR codes in various applications-L2

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												3	
CO2	3								2			2	3	
CO3		3								2		2	3	
CO4	3								2	2		3	3	
Average* (Rounded to nearest integer)	3	3							2	2		2	3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Passband Digital Modulation schemes** Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying	CO1
2	**Turbo Codes** Product codes, Iterative decoding of product codes, Concatenated convolutional codes- Parallel concatenation, The UMTS Turbo code, Serial concatenation, Parallel concatenation, Turbo decoding	CO2
3	**Low Density Parity Check codes** Definition, properties, LDPC codes in 5G, proto-graph, base matrix, expansion, Encoding LDPC codes in 5G , SISO decoders for repetition, SPC codes, log-likelihood ratio Decoding LDPC codes: message passing, iterations	CO4
4	**Space-Time Codes** Introduction, Digital modulation schemes, Diversity, Orthogonal space- Time Block codes, Alamouti’s schemes, Extension to more than Two Transmit Antennas, Simulation Results, Spatial	CO3

	Multiplexing: General Concept, Iterative APP Pre-processing and Per-layer Decoding.	
5	**Polar codes** Generator matrix, binary tree representation, frozen bits and information bits Encoding polar codes, Successive cancellation decoder for polar codes	CO4

Learning Resources
Text Books
1.Wozencraft J. M. and Jacobs I. M., Principles of Communication Engineering', John Wiley, 1965 2. Shu Lin, Daniel J.Costello, Error Control Coding- Fundamentals and Applications, Prentice Hall, Inc 2014
Reference Books
1. John G. Proakis, Digital Communications, 5th Ed., TMH, 2008. 2. Salvatore Gravano, Introduction to Error Control Codes- Oxford
e- Resources & other digital material
2. https://nptel.ac.in/courses/108/105/108105159/

Conformal Antennas

Course Code	20EC6503	**Year**	III	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Antennas & Propagation
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 fundamental parameters of Conformal antennas in wireless communication.L2
CO2	Analyse the Characteristics & Shapes of conformal antennas. L4
CO3	Examine the single surface and double surface conformal antennas and its radiation patterns. L4
CO4	Utilize various feeding methods to improve performance the wireless communication system 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	2													
CO2		3				2								3
CO3		2				2								
CO4	2													2
Average* (Rounded to nearest integer)	2	3				2								3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction:** The definition of a conformal antenna, why conformal antennas, history, metal radomes, sonar arrays**.**	CO1, CO2
2	**The Shapes of Conformal Antennas:** Introduction, 360° Coverage, 360° Coverage Using Planar Surfaces, 360° Coverage Using Curved Surface, Hemispherical Coverage, Hemispherical Coverage Using Planar Surfaces Half Sphere Cone Ellipsoid Paraboloid & Comparing Shapes.	CO1, CO2
3	**Geodesics on Curved Surfaces** Introduction, Definition of a Surface and Related Parameters, The	CO1, CO3

	Geodesic Equation, Solving the Geodesic Equation and the Existence of Geodesics, Singly Curved Surfaces, Doubly Curved Surfaces-The Cone, Rotationally Symmetric Doubly Curved Surfaces, and Properties of Geodesics on Doubly Curved Surfaces Geodesic Splitting.	
4	**Conformal Array Characteristics** Introduction, Mechanical Considerations - Array Shapes, Element Distribution on a Curved Surface, Multifacet Solutions, Tile Architecture, & Static and Dynamic Stress. Radiation Patterns - Introduction, Grating Lobes, Scan-Invariant Pattern, & Phase-Scanned Pattern.	CO1, CO2, CO3
5	**Beam Forming** Introduction, A Note on Orthogonal Beams, Analog Feed Systems - Vector Transfer Matrix Systems, Switch Matrix Systems, Butler Matrix Feed Systems, RF Lens Feed Systems - The R-2R Lens Feed, The R-kR Lens, Feed Mode-Controlled Lenses, The Luneburg Lens, The Geodesic Lens, The Dome Antenna, & Digital Beam Forming.	CO1, CO4

Learning Resources

Text Books

1. Lars Josefsson, Patrik Persson, Conformal Array Antenna Theory, A Wiley-Inter science Publication4th Ed., 2021.

Reference Books

1. R C Hansen - Conformal Antenna Array Design Handbook
2. Constantine A. Balanis–Antenna Theory and Applications, John Wiley & Sons, 4th Ed., 2021

Speech Signal Processing

Course Code	20EC6504	**Year**	III	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**Course Type**	THEORY
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Digital Signal Processing, Random Process
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 speech recognition principles, methods, models and implementation (L2)
CO2	Apply speech recognition principles &methods to characterize the speech signal and to recognize the speech (L3)
CO3	Apply the Pattern Comparison Techniques and Hidden Markov Models to recognise the speech (L3)
CO4	Analyse the speech recognition methods, pattern comparison techniques and Hidden Markov Models (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	3							1	2	2				
CO2	2							1	2	2				
CO3	3							1	2	2				
CO4		3						1	2	2				
Average* (Rounded to nearest integer)	3	3						1	2	2				

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**The Speech Signal:** Fundamentals of Speech recognition, the process of speech production and perception in human beings, the speech production process, representing speech in time and frequency domains, speech sounds and features.	CO1, CO2
2	**Signal Processing and Analysis methods for Speech Recognition:** Spectral analysis models, The Bank-of-filters front-end processor, Linear predictive coding model for Speech recognition, Vector quantization.	CO1,CO2, CO4

3	**Pattern Comparison Techniques:** Introduction, Speech detection, Distortion measures- Mathematical considerations, Distortion measures- Perceptual considerations, Spectral distortion measures.	CO1, CO3, CO4
4	**Theory and Implementation of Hidden Markov Models:** Introduction, Discrete time Markov processes, Extensions to Hidden Markov models, Three basic problems for HMMs, Types of HMMs, Continuous observation densities in HMMs, comparison of HMMs, Implementation issues for HMMs, HMM system for isolated word recognition.	CO1, CO3, CO4
5	**Large Vocabulary continuous speech recognition:** Introduction, Sub word speech units, sub word unit models based on HMMs, Training of sub word units, Language models for Large vocabulary speech recognition, Statistical language modelling, Perplexity of the language model, Overall recognition system based on sub word units.	CO1,CO3, CO4

Learning Resources
Text Books
1. Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson Education, 2007.
Reference Books
1. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, Fundamentals of Speech Recognition, Pearson Education, 2009. 2. Claudio Becchetti and Lucio Prina Ricotti, Speech Recognition, John Wiley and Sons, 1999. 3. Frederick Jelinek, Statistical Methods of Speech Recognition, MIT Press, Cambridge, MA; London, England, 1997. 4. Daniel Jurafsky and James H Martin, Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 1st Ed., 2000.
e- Resources & other digital material
1. https://nptel.ac.in/courses/117105145 2. https://ocw.mit.edu/courses/6-345-automatic-speech-recognition-spring-2003/ 3. https://www.classcentral.com/course/youtube-digital-speech-processing-47859

Digital Design Using Verilog HDL

Course Code	20 EC5501	**Year**	III	**Semester**	I
Course Category	**Minor**	**Branch**	ECE	**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	Analyze and Verify the functionality of digital circuits/systems using test benches (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2									2				
CO2	2									2				
CO3	2								2	2		2		2
CO4		3							2	2		2		2
Average* (Rounded to nearest integer)	2	3							2	2		2		2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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
2	**Gate-Level Modelling:** Modelling using basic Verilog gate Primitives, Description of and/or and buf/not type gates, rise, fall	CO1, CO3

	and turn-off delays, min, max, and typical delays, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in Gate-level Modelling.	
3	**Dataflow Modelling:** Continuous assignments, Delay specification, expressions, operators, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in dataflow model.	CO1, CO3
4	**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 & Counters in Behavioral model.	CO1, CO3
5	**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
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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Sensors and Actuator Devices for IOT

Course Code	20EC5502	**Year**	III	**Semester**	I
Course Category	**Minor**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	IOT
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
Avg.	3	3								2				2

Syllabus

Unit No.	**Contents**	**Mapped CO**
1	**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
2	**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
3	**Radiation Sensors**: Introduction – Basic Characteristics – Types of Photo sensistors /Photo detectors– X-ray and Nuclear Radiation Sensors – Fiber Optic Sensors.	CO1-CO3
4	**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

5	**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- 2nd Ed., PHI, 2013. 2. Robert H. Bishop, The Mechatronics Handbook, 2nd Ed., 3. Robert H. Bishop, Mechatronic Systems, Sensors and Actuators, fundamentals and modelling, CRC Press
e- Resources & other digital material
1. https://nptel.ac.in/content/syllabus_pdf/108108147.pdf

III YEAR

II SEMESTER

Digital Signal Processing

Course Code	20EC3601	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**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	Interpret discrete-time signals and systems using Z-transform & DFT (L2).
CO2	Analyse frequency response and impulse response of discrete-time LTI systems (L4).
CO3	Build Digital Systems in Direct, Cascade and Parallel form structures (L3).
CO4	Design IIR and FIR digital filters for the given specifications (L5).
CO5	Apply FFT & Multirate signal processing concepts to various DSP applications (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	3								3	2		1	2	1
CO2		3							3	2		1	2	1
CO3	3								2	3		1	2	1
CO4			3						2	2		1	2	1
CO5	3								2	3		1	2	1
Average* (Rounded to nearest integer)	3	3	3						2	2		1	2	1

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Transform Analysis of Discrete time LTI Systems**: Analysis of Discrete-time Linear Time-Invariant Systems, Convolution, Stability, Causality, Frequency response of LTI systems, System functions of LTI systems characterized by linear constant coefficient difference equations: Stability, Causality, Impulse response and Step response for rational system functions.	CO1, CO2
2	**The Discrete Fourier Transform (DFT)**: Introduction to Discrete Fourier Transform, Computation of DFT, Properties of DFT, Circular convolution, Linear convolution using DFT, Introduction, Radix-2 Decimation-in-time FFT algorithm, Radix-	CO1, CO5

	2 Decimation-in-frequency FFT algorithm, Inverse DFT using FFT algorithms.	
3	**Design of IIR Digital Filters**: Design of analog prototypes from digital filter specifications using Butterworth and Chebyshev approximations, Design of IIR filters from analog filters: Butterworth filter and Chebyshev filter design using Impulse Invariance Method, Bilinear Transformation Method.	CO1, CO2, CO4
4	**Design of FIR Digital Filters**: Linear discrete time systems with generalized linear phase, Design of linear phase FIR filters using Window functions, Frequency Sampling technique. **Realization of Discrete time systems:** Realization of IIR and FIR systems-Direct, Cascade & Parallel realizations.	CO1- CO4
5	**Multirate Digital Signal Processing:** Introduction, Decimation and Interpolation by integer factor, Sampling rate conversion by Rational number, Multistage approach to sampling rate Conversion, Applications of Multirate Signal processing.	CO1, CO5

Learning Resources
Text Books
1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Ed., Pearson Education, 2007. 2. Lonnie C Ludeman - Fundamentals of Digital Signal Processing-John Wiley & Sons, 2003
Reference Books
1 A.V. Oppenheim, R. W. Schafer, Discrete-Time Signal Processing, 3rd Ed., Prentice Hall of India, 2009. 2.Sanjit K Mitra - Digital Signal Processing “A – Computer Based Approach” - Tata Mc Graw Hill 2nd Ed., 2003
e- Resources & other digital material
1. http://www.nptel.iitm.ac.in/ 2. http://www.ee.umanitoba.ca/~moussavi/dsp815/LectureNotes/index.html 3. http://www.ece.cmu.edu/~ee791 4. http://cobweb.ecn.purdue.edu/~ipollak/ee438/FALL04/notes/notes.html

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Antennas and Propagation

Course Code	20EC3602	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Electro Magnetic Fields & Waves
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 fundamental parameters of antennas and wave propagation in the construction of a wireless communication link. L2
CO2	Analyse various wire antennas, antenna arrays and establish their mathematical relations. L4
CO3	Develop antennas for different frequency ranges and analyse their radiation properties L3
CO4	Analyse the wave propagation through different layers of atmosphere 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2								1	1		1	1	1
CO2		3							2	2		2	2	2
CO3	2								2	2		2	2	2
CO4		1							1	2		1	1	1
Average* (Rounded to nearest integer)	2	2							2	2		2	2	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Antenna Fundamentals:** Introduction, Types of Antennas, radiation mechanism – single wire, two- wire, dipoles, current distribution on a thin wire antenna, antenna parameters - radiation pattern, radiation power density, radiation intensity, beam width, directivity, antenna efficiency, gain, realized gain, beam efficiency, bandwidth, Polarization, input impedance antenna radiation efficiency, antenna vector effective length, equivalent areas and Friis transmission equation.	CO1, CO2
2	**Linear Wire Antennas:** Retarded potentials, radiation from small electric dipole, quarter wave monopole and half wave dipole –	CO2, CO3

	current distribution, evaluation of field components, power radiated, radiation resistance, antenna theorems. Loop antennas: field components, comparison of far fields of small loop and short dipole. Helical antenna- monofilar, axial mode and normal mode operations,	
3	**Antenna Arrays:** Introduction, 2-element arrays – different cases, principle of pattern multiplication, N-element uniform linear arrays – broadside, end fire arrays, EFA with increased directivity, concept of scanning arrays, directivity relations, Binomial arrays.	CO2, CO3
4	**Broadband & Microwave Antennas:** **Broadband Antennas**: Introduction, folded dipole, Yagi-Uda antenna, reflector antennas- plane reflector, corner reflector, parabolic reflector, feed methods for parabolic reflectors, F/D ratio, aperture blocking. **Microstrip Antennas** –Introduction, Features, Advantages and Limitations, Rectangular Microstrip Antenna – Geometry, Feeding Methods, Characteristics of Microstrip Antennas. Circular Microstrip Antenna – Geometry& Design Parameters	CO2, CO3
5	**Wave Propagation:** Ground wave propagation–characteristics, parameters, wave tilt, flat and spherical earth considerations. Sky wave propagation – structural details of ionosphere, refraction and reflection, ray path, critical frequency, MUF, LUF, OF, skip distance, virtual height, Ionospheric abnormalities, Space wave propagation – mechanism, LOS and radio horizon. Tropospheric wave propagation – radius of curvature of path, effective earth's radius.	CO1, CO4

Learning Resources

Text Books

1. Constantine A. Balanis - Antenna Theory and Applications – John Wiley & Sons, 4 th Ed., 2021
2. J.D Kraus, R.J Marhefka & Ahmad S Khan - Antennas and Wave Propagation – TMH, 4th Ed., 2010.

Reference Books

1. E.C. Jordan and K.G. Balmain - Electromagnetic Waves and Radiating Systems – PHI,2nd Ed., 2009.
2. K.D. Prasad, Satya Prakashan - Antennas and Wave Propagation, Tech India Publications, New Delhi, 2001
3. E.V.D. Glazier and H.R.L. Lamont, Transmission and propagation, Vol.5 Standard Publishers Distributors- New Delhi

e- Resources & other digital material

1. http://www.antenna-theory.com/
2. http://www.antenna-theory.com/basics/main.html
3. https://nptel.ac.in/courses/108/105/108105114/#

VLSI Design

Course Code	20EC3603	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Digital 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 fundamentals of different types of MOS Circuits, PLD's and Verilog modules (L2)
CO2	Apply various programmable logic devices to implement Boolean functions (L3)
CO3	Analyze VLSI fabrication processes and CMOS Logic (L4)
CO4	Compare different scaling methods of MOS logical circuits (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2				2					2			2	
CO2	2				2					2			2	
CO3		3			3					3			3	
CO4		2			2					2			2	
Average * (Rounded to nearest integer)	2	3			2					2			2	

Syllabus

Unit No.	**Contents**	**Mapped CO**
1	**Computer-Aided Design:** Hardware Description Languages, Verilog Description of Combinational Circuits, Verilog Modules, Verilog Assignments, Procedural Assignments, Modelling Flip-Flops Using Always Block, Delays in Verilog, Compilation, Simulation, and Synthesis of Verilog Code, Verilog Data Types and Operators, Simple Synthesis Examples, Verilog Models for Multiplexers, Modeling Registers, Counters and Behavioral and Structural Verilog, Testing a Verilog Model.	CO1
2	**Programmable Logic Devices: Complex** Programmable Logic Devices (CPLDs), Field-Programmable Gate Arrays (FPGAs), Implementing Functions in FPGAs.	CO2 ,CO1

3	**IC Design Technology:** Integrated Circuit (IC) Era, Metal-Oxide-semiconductor (MOS) and related VLSI technology, basic MOS transistors, enhancement mode transistor action, NMOS fabrication, CMOS fabrication, comparison of NMOS, CMOS, BICMOS, GaAs technologies.	CO3,CO1
4	**Electrical Properties of MOS circuits:** Drain current vs Drain-Source voltage relationships, MOS transistor threshold voltage, pass transistor, NMOS inverter, CMOS inverter. **MOS Circuit Design Process:** MOS Layers, Stick Diagrams, Design Rules and Layout, 2μm micron based design rules, Layout Diagrams.	CO1,CO3
5	**Scaling of MOS Circuits:** Scaling Models and Scaling factors, Scaling factors for device parameters, Limits of scaling, Switch Logic and Gate Logic.	CO1,CO4

Learning Resources:

Text Books

1. Charles H. Roth, Lizy Kurian John, Byeong Kil Lee, Digital Systems Design using Verilog, 1st Ed., Cengage Learning, 2016.
2. Douglas A, Pucknell, Kamran Eshraghian, Essentials of VLSI Circuits and Systems,1st Ed., Prentice Hall, 2012

References

1. Kang, Leblibici, CMOS Digital Integrated Circuits, 3rd Ed., Tata McGraw Hill, 2001.
2. Jan M. Rabaey, Digital Integrated Circuits, 2nd Ed. , Pearson Education, 2002.
3. Jackson, Hodges, Analysis and Design of Digital Integrated Circuits, 3rd Ed., Tata McGraw Hill,2010
4. Gary S May, Simon M Sze, Fundamentals of Semiconductor Fabrication, 1st Ed. Wiley, 2004.

e-Resources:

1. https://nptel.ac.in/courses/108/107/108107129/
2. https://www.cin.ufpe.br/~mel/pub/prototipac%E3o/referencias/CMOS_design/CMOS-VLSI-design.pdf

Optical Communications

Course Code	**20EC4601A**	**Year**	III	**Semester**	II
Course Category	Professional Elective-II	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Engineering Physics, Communication 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	Illustrate the basic components of Fiber Optic Communication system and its applications (L2).
CO2	Analyze different types of Optical Sources, Optical Amplifiers and Optical Detectors. (L4).
CO3	Apply the concepts of Wavelength Division Multiplexing (L3)
CO4	Analyse the modulation characteristics and causes for signal degradation in fiber communication link (L4).
CO5	Analyze analog and Digital System Design (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		2		2
CO2		2								2				2
CO3	2									2				2
CO4		3								3				3
CO5		2								2				2
Average * (Rounded to nearest integer)	2	2								2				2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction to Fiber Optic Communications-** Block Diagram, Advantages **Optic Fiber Waveguides:** Ray theory, Step – Index Fiber, Graded – Index Fiber, Attenuation, Pulse Distortion and Information Rate in Optic Fibers.	CO1,CO4

2	**Light Sources and Detectors:** Light-Emitting Diodes-Surface Emitting LEDs, Edge Emitting LEDs, Operating Characteristics, Laser Principles, Laser Diodes, Laser-Diode Operating Characteristics, Distributed – Feedback Laser Diode, Optical Amplifiers, Principles of Photo detection, Photomultiplier, Semiconductor Photodiode, PIN Photodiode, Avalanche Photodiode	CO1,CO2
3	**Couplers and Connectors:** Principles, Fiber end Preparation, Splices, Connectors, Source Coupling, Distribution Networks, Directional Couplers, Star Couplers, Switches, Fiber Optical Isolator, Wavelength - Division Multiplexing.	CO1,CO3
4	**Modulation, Noise and Detection:** Light-Emitting-Diode Modulation and Circuits, Laser-Diode Modulation and Circuits, Analog-Modulation Formats, Digital-Modulation Formats, Optic Heterodyne Receivers, Thermal and Shot Noise, Signal-to-Noise Ratio, Modal Noise, Amplifier Noise, Laser Noise.	CO1,CO4
5	**System Design and Fiber Optical Applications:** Analog System Design, Digital System Design, Applications of Fiber Optics, Fiberless transmission	CO1,CO5

Learning Resources

Text Books

1. Gerd Keiser, Optical Fiber Communication, Mc-Graw Hill. 3rd Ed., 2003
2. Joseph. C. Palais, Fiber Optic Communications, Pearson Education, Asia, 2002.

Reference Books

1. J.M.Senior, Optical Fiber Communication: Principles and Practice, Pearson Ed., 2nd Ed., 2006.
2. S. C. Gupta, Text Book on Optical Fiber Communication and its Applications, PHI, 2005
3. D. K. Mynbaev, Gupta, Scheiner, Fiber Optic Communications, Pearson Education, 2005
4. Howes M.J., Morgan, D.V, Optical Fiber Communication, John Wiely.1992.
5. John Powers, Fiber Optic Systems, Irwin Publications, 1997.

e- Resources & other digital material

1. http://www.ocw.titech.ac.jp/index.php?module=General&action=T0300&JWC=201806903&lang=EN
2. https://www.ll.mit.edu/r-d/communication-systems/optical-communications-technology

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ARM Microcontroller Systems

Course Code	20EC4601B	**Year**	III	**Semester**	II
Course Category	Professional Elective-II	**Branch**	ECE	**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	Interpret the evolution of ARM processors, architectural advances and classification of ARM processors. (L2)
CO2	Demonstrate programming proficiency using the addressing modes and instructions of the arm microcontroller. (L2)
CO3	Develop programs to interface various peripherals with microcontrollers.(L3)
CO4	Analyse real time communication modules using ARM microcontroller (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2												1	
CO2	2												1	2
CO3	2								2	2			2	2
CO4		3							3	3			2	2
Average* (Rounded to nearest integer)	2	3							3	3			2	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**ARM Architecture:** Introduction to Cortex M microcontroller, ARM instruction set architecture, register set, processor operating modes, interrupts and processor reset sequence, pipelined architecture and data path.	CO1, CO2
2	**ARM Assembly language programming:** Addressing modes, Data processing instructions, data transfer instructions, control flow instructions, multiple register transfer instructions, co-processor instructions, break point instructions, memory faults.	CO2, CO3
3	**fundamentals of I/O configuration:** Configuring ARM pins as GPIO’s, clock and bus configuration, mode control configuration, pad	CO2, CO4

	control configuration, data control configuration, configure keil tools for hardware design	
4	**I/O Interfacing:** LED and switch, interfacing seven-segment display, keypad interfacing, interfacing LCD module, methods for Input and output synchronization	CO1, CO3
5	**Serial Communication Interfaces:** UART interface, UART details on TM4C123 microcontroller, I2C interface, SPI & CAN	CO3, CO4

Learning Resources

Text Books

1. Muhammad Tahir and Kashif Javed - ARM Microprocessor Systems – Cortex – M Architecture, Programming, and Interfacing by, CRC Press.
2. Steve Furber - ARM System-on-chip Architecture by, 2nd Ed., Pearson

Reference Books

1. Embedded Systems Fundamentals with ARM Cortex-M based Microcontrollers: A Practical Approach in English, by Dr. Alexander G. Dean, Published by Arm Education Media
2. Cortex -M3 Technical Reference Manual
3. Joseph You- The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors

Web Resources:

1. https://nptel.ac.in/courses/117/106/117106111/
2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview

Microwave Engineering

Course Code	20EC4601C	**Year**	III	**Semester**	II
Course Category	Professional Elective-II	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Transmission Lines & Wave Guides
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 various frequency bands of microwave range and their designations in electromagnetic spectrum and applications of microwaves. [L2]
CO2	Build microwave tubes *for* high-power and high-frequency applications. [L3]
CO3	Identify different types of waveguide passive components and solid state devices for engineering applications.[L3]
CO4	Analyse Microwave Bench for measurement of various microwave parameters.[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		2
CO2	3					3	3					3		3
CO3	3				3	3	3					3		3
CO4		2			2	2	2					2		2
Average * (Rounded to nearest integer)	3				3	3	3					3		3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	Introduction to microwaves, Electromagnetic Spectrum and Microwave bands, Applications of microwaves, Limitations of conventional Tubes at Microwave Frequencies. **Microwave Tubes:** Linear Beam Tubes (O-type): Two Cavity Klystron –Velocity Modulation, Bunching Process, Output Power and Efficiency. Reflex Klystrons – Velocity Modulation, Power Output, Efficiency.	CO1,CO2

2	**Helix Traveling-Wave Tubes (TWTs):** Slow Wave Structures, Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations. Microwave Crossed Field Tubes (M-Type): Introduction, Cross-field Effects, Cylindrical Traveling Wave Magnetron–Hull Cut-off and Hartree Conditions.	CO1,CO2
3	**Microwave Passive Components** –Waveguide sections: Matched terminations, waveguide bends, corners and Twists, Coupling Probes and Loops, Waveguide Attenuators and Phase Shifters. Waveguide Multiport Junctions: E plane Tee, H plane Tee and Magic Tee. Directional Couplers. Ferrites – Composition and Characteristics, Faraday rotation, Ferrite Components – Gyrator, Isolator and Circulator. Scattering Matrix - Significance, Formulation and Properties, S-Matrix of Waveguide Tee Junctions, Directional Coupler, Circulator and Isolator.	CO1,CO3
4	**Microwave Solid State Devices**: Introduction, Classification, Applications. Transferred Electron Devices: Introduction, Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Avalanche Transit-Time Devices- IMPATT, TRAPATT and BARITT diodes.	CO1,CO3
5	**Microwave Measurements**: Description of Microwave Bench – Different components and their features, Precautions, Power measurement, Attenuation measurement, Impedance Measurement, Frequency measurement, VSWR measurement, Measurement of Cavity Q factor.	CO1,CO4

Learning Resources
Text Books
1. R.E. Collin, John Wiley, Foundations for Microwave Engineering, 2nd Ed., 2005 2. Samuel Y Liao, Microwave Devices and Circuits, Pearson Education, 3rd Ed, 2003,
Reference Books
1. Annapurna Das, Sisir K. Das, Microwave Engineering, Tata Mc-Graw Hill, 2nd Ed., 2006, 2. David M.Pozar, Microwave Engineering, John Wiley & Sons Inc., 2nd Ed, 2004 3. M.L. Sisodia and G.S.Raghuvanshi, Microwave Circuits and Passive Devices, Wiley Eastern Ltd., New Age International Publishers Ltd., 1995 4. Peter A. Rizzi, Microwave Engineering Passive Circuits – PHI, 1999
e- Resources & other digital material
1 https://nptel.ac.in/courses/108/103/108103141/ 2.http://www.slideshare.net/sarahkrystelle/lecture-notes-microwaves

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Computer Networks

Course Code	20EC4601D	**Year**	III	**Semester**	II
Course Category	Program Elective II	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Linear, algebra, Statistics and Probability
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 functions and protocols of different layers.	L2
CO2	Apply appropriate Packet switching mechanism/Addressing Formats for a given scenario.	L3
CO3	Select protocols for computer communications.	L3
CO4	Analyze sub netting and routing mechanisms.	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	2									2		2	2	
CO2	3									3			3	
CO3	3									3			3	
CO4		2								2			2	
Average * (Rounded to nearest integer)	3	2								3		2	3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction:** Uses of Computer Networks, OSI, TCP/IP, Examples of **Networks:** Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN. **Physical Layer:** Transmission media copper, twisted pair wireless, switching techniques; ISDN and ATM	CO1, CO2
2	**Data link layer:** Design issues, framing, error detection and correction, CRC, Elementary Protocol-stop and wait, Sliding Window, Data link layer in HDLC **Medium Access sub layer:** ALOHA, Carrier sense multiple access. IEEE 802.X Standard Ethernet, wireless LANS. Bridges	CO1-CO3

3	**Network Layer-Design and Routing:** Virtual circuit and Datagram subnets-Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing **Network Layer-Congestion control and IP:** Rotary for mobility. Congestion control Algorithms. The Network layer in the internet	CO1, CO4
4	**Transport Layer:** Transport Services, Connection management, TCP and UDP protocols	CO1, CO3
5	**Application Layer:** Domain name system, Electronic Mail; the World WEB, Basics of Multi Media	CO1, CO3

Learning Resources
Text Books
1. Andrew S Tanenbaum, Computer Networks, Pearson Education, PHI, 4th Ed., 2003. 2. Behrouz A. Forouzan, Data Communications and Networking, TMH, 3rd Ed., 2002
References
1. S. Keshav, An Engineering Approach to Computer Networks, Pearson Education, 2nd Ed., 2005. 2. W.A. Shay, Thomson, Understanding communications and Networks, 3rd Ed., 2006
e- Resources
1. http://home.iitk.ac.in/~navi/sidbinetworkcourse/lecture1.ppt 2. http://nptel.iitm.ac.in/courses/IIT-MADRAS/Computer_Networks/index.php

Machine Learning

Course Code	20EC4601E	**Year**	III	**Semester**	II
Course Category	Program Elective II	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Linear, algebra, Statistics and Probability
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 machine learning techniques on appropriate problems	L3
CO3	Apply Evaluation, hypothesis tests and compare the performance of learning techniques forvarious problems	L3
CO4	Analyze Reinforcement learning to address the real time problems in different areas	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	-	-	-	-	-	-	2	-	2	-	2	-	-
CO2	3	-	-	-	-	-	-	3	-	3	-	-	3	-
CO3	3	-	-	-	3	-	-	3	-	3	-	-	2	-
CO4	-	2	-	-	-	-	-	2	-	2	-	-	-	2
Average* (Rounded to nearest integer)	3	2	-	-	3	-	-	3	-	3	-	2	3	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction**: What is Machine learning, Designing a Learning System, Perspectives and Issues in Machine Learning, Applications of Machinelearning.	CO1
2	**Supervised Learning**: Decision Trees, Bayes Theorem, Naive Bayes Classifier, Measuring Classifier Accuracy, Estimating HypothesisAccuracy	CO1-CO3
3	**Instance Based Learning** – Support vector machine, Ensemble Methods, k-Nearest Neighbor Learning, Expectation Maximization Algorithm, Case Based Reasoning	CO1-CO3

4	**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 sets with FP-growth	CO1-CO3
5	**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, 2nd Ed., PHI, 2010
2. A. Srinivasa Raghavan, and Vincy Joseph - Machine Learning, Kindle Edition, Wiley, 2020

References

1. Tom M. Mitchell - Machine Learning - International Edition, McGraw Hill Ed, 1997
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville - Deep Learning, MIT Press, 2016
3. Kevin P Murphy & Francis Bach - Machine Learning a Probabilistic Perspective, 1st Ed., MIT Press, 2012
4. Tan,Vipin Kumar, Michael Steinbach - Introduction to Data Mining 9th Ed., Pearson, 2013

e-Resources and other Digital Material

1. https://www.coursera.org/learn/machine-learning
2. https://nptel.ac.in/courses/106/106/106106139/

Ecology and Environment

Course Code	20CE2601A	**Year**	III	**Semester**	II
Course Category	Open Elective-II	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Pre-requisites**	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	**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**

SYLLABUS

Unit no.	**Contents**	**Mapped CO**
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, relationships between organisms.	CO1-CO2
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
3	**Environmental Geosciences & Computer Applications** Structure and composition of atmosphere, hydrosphere, lithosphere and	CO3

	biosphere. Scale of meteorology, pressure, temperature, atmospheric stability. Graphical representation of Data, creating Database tables.	
4	**Environmental Policy, Education and Ethics** Important National policies: National environmental policy, 2006 & National agricultural policy etc. Legislation: Environment Protection Act, 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.	CO4
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. Ecology, Environmental Science and Conservation. S. Chand & Company Pvt. Ltd. New Delhi, 2014 2. Sharma, P.D. Ecology and Environment, 11^{th} Ed., Rastogi Publication, Meerut,2011 3. Bharucha, E. Text Book of Environmental Studies, 2^{nd} Ed., Universities Press, Hyderabad, 2013
Reference Books
1. Nobel, B.J. and Wright, R.T. Environmental Science. Prentice Hall, 1995 2. Agarwal, S.K. Pollution Ecology. Himanshu Publication, Udaipur,1991 3. S.V.S.Rana, Essentials of Ecology and Environmental Science, PHI, New Delhi, 2011.
E-Resources & other digital material
1. 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2				2					1			2	2
CO2	3				3					2			3	3
CO3		2			2					2			2	2
CO4	3				3					2			3	3
Average * (Rounded to nearest integer)	3	2			3					2			2	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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
2	**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,	CO1, CO2, CO4

	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 analysing arrays, Generation of Random Numbers, Examples of MATLAB applications.	
3	**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-CO4
4	**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
5	**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-CO4

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Learning Resources
Text Books
1. Amos Gilat - MATLAB: An Introduction with Applications, Wiley India Pvt. Ltd, 4th Ed., 2012. 2. Rudra Pratap - Getting started with MATLAB, Oxford University Press, 2010
Reference Books
1. Agam Kumar Tyagi, MATLAB and SIMULINK for Engineers, Oxford University Press, 2012.
e- Resources & other digital material
1. https://www.udemy.com/MATLAB/Online-Course 2. https://nptel.ac.in/courses/103/106/103106118

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	Apply Transmission line principles 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2				2	2	1			1			2	2
CO2		3			3	2	1			2			3	3
CO3	2				2	2	2	2		2			2	2
CO4		3			3	2	2	3		2			3	3
Average* (Rounded to nearest integer)	3	3			3	2	2	3		2			2	2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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, co-channel interference, adjacent channel interference, analog to digital TV, transmitter requirements	CO1, CO2
2	Channel Coding and Modulation for Digital Television: Data synchronization, randomization/scrambling, forward error correction,	CO1, CO2

	interleaving, inner code, frame sync insertion, quadrature modulation, 8 VSB, bandwidth, error rate, COFDM, flexibility, bandwidth	
3	**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
4	**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
5	**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. 2. R. R. Gulati, Modern Television Practice, Principles, Technology and servicing, 2nd Ed., New Age International Publishers, 2001.
Reference Books
1. 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

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Energy Management

Course Code	20EE2601A	**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**	Applied Physics, Basics of Electrical & Electronics Engineering
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

COURSE OUTCOMES	
After the completion of the course 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:Substantial, 2: Moderate, 1:Slight)

CO/PO, PSO	**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		
AVG	**3**	**3**	**2**	**2**	**3**	**2**	**2**		**3**	**3**	**2**	**2**		

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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	CO1, CO2, CO6

	economy, long term energy scenario, energy pricing, sector wise energy consumption in India, energy and environment.	
2	**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
3	**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
4	**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
5	**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 Ed., 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.

References:

1. John. C. Andres, Energy Efficient Electric Motors, Marcel Dekker Inc. Ltd., 3rd Ed., 2005.
2. Paul W.O. Callaghan, Energy Management, McGraw hill Book Company,1st Ed., 2005

e- Resources & other digital material

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**	**Branch**	Common to All	**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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3												3	
CO 2	3			3									3	
CO 3	3			3									3	3
CO 4	3	3											3	3
Avg.	**3**	**3**		**3**									**3**	**3**

SYLLABUS

Unit No.	**Content**	**Mapped PO**
1	Introduction: What is data mining? What kinds of data can be mined? What kinds of pattern can be mined? Which technologies are used? Which kinds of applications are targeted?, Major Issues in Data Mining.	CO1
2	Getting to Know Your Data: Data objects and Attribute Types, Basic statistical descriptions of data, Measuring Data Similarity and Dissimilarity. Data Pre-processing: An overview, Data Cleaning, Data integration, Data Reduction, Data Transformation and Discretization.	CO1 CO2

3	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
4	Classification: Basic Concepts – Basic concepts, Decision Tree Induction, Rule Based Classification, Model evaluation and Selection.	CO1 CO3,CO4
5	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, 3rd Ed., Elsevier, 2012.
Reference Books
1. Michael Steinbach, Vipin Kumar, Pang, Ning Tan, Introduction to data mining, 1st Ed., Addison Wesley, 2006 2. Margaret H. Dunham, Data Mining Introductory and Advanced Topics, 1st Ed., 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	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		Blooms Level
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))

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	2			3			3		3			3
CO 2	1	2	2			3			3		3			3
CO 3	1	2	2			3			3		3			3
CO 4	1	2	2			3			3		3			3

Syllabus		
Unit No	**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	CO1,CO3

	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.	
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

Learning Resources
Text books:
1. Anil Kumar Mukhopadhyaya, Value Engineering: Concepts Techniques and applications, SAGE Publications, 2010.
Reference books
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, Mc-Graw Hill 2nd Ed., 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	**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**	**BTL**
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 No.	**Content**	**Mapped CO**
1	**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
2	**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. **Ergonomics and product design**: Ergonomics in automated systems, Expert systems for ergonomic design, Anthropometric data	CO1, CO2

	and its application in ergonomic design, Limitations of anthropometric data, Use of computerized database.	
3	**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
4	**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
5	**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, 7th Ed., Mc-Graw Hill International, 1993.
Reference books
1. P. V. Karpovich and W. E. Sinning, Physiology of Muscular Activity, 7th Ed., 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, 2nd Ed., CRC Press, 1997. 4. K. H. E. Kroemer, H. B. Kroemer, K. E. Kroemer Elbert, Ergonomics: How to design for ease and efficiency, 2nd Ed., Pearson Publications, 2001.

Digital Signal Processing Lab

Course Code	20EC3651	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Signals and 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	Examine the frequency response and impulse response of discrete-time LTI systems (L3).
CO2	Interpret discrete-time signals using DFT & FFT (L3).
CO3	Design IIR and FIR digital filters for real time DSP applications (L6)
CO4	Apply Multirate signal processing concepts to various applications (L3)
CO5	Make an effective report of the 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3							1	1	1		1	2	1
CO2	3							1	1	1		1	2	1
CO3			3					1	2	1		2	2	1
CO4	2							1	2	1		1	2	1
CO5								1	3	3		1	2	1
Average * (Rounded to nearest integer)	3		3					1	2	1		1	2	1

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
	Part A – Using MATLAB	
1	Frequency response of a system described by a difference equation. (First order and Second order Systems)	CO1, CO5
2	Implementation of discrete time systems in time domain. (First order and Second order Systems)	CO1, CO5
3	DFT & IDFT of the given sequences. (4-Point or 8-point sequences)	CO2, CO5
4	Properties of DFT (Linearity, Time reversal etc.)	CO2, CO5
5	Fast Fourier Transform (4-Point or 8-point sequences)	CO2, CO5

6	Design of IIR Low Pass filter using Butterworth and Chebyshev approximations (For the given specifications)	CO3, CO5
7	Design of IIR High Pass filter using Butterworth and Chebyshev approximations. (For the given specifications)	CO3, CO5
8	Design of FIR Low Pass filters using window technique. (For the given specifications)	CO3, CO5
9	Design of FIR High Pass filter using window technique. (For the given specifications)	CO3, CO5
10	Implementation of Interpolation and Decimation. (Factor 2 or 3)	CO4, CO5
Part B – Using Code Composer Studio		
11	Linear convolution of two sequences. (4-Point or 5-point sequences)	CO1, CO5
12	Circular convolution of two sequences. (4-Point or 8-point sequences)	CO2, CO5
13	Generation of Sine wave & Square wave.	CO2, CO5

Learning Resources
Text Books
1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Ed., Pearson Education, 2007. 2. A.V. Oppenheim, R. W. Schafer, Discrete-Time Signal Processing, 3rd Ed., PHI, 2009.
Reference Books
1. Lonnie C Ludeman, Fundamentals of Digital Signal Processing, John Wiley & Sons, 2003 2. Sanjit K Mitra, Digital Signal Processing, A – Computer Based Approach, Tata Mc-Graw Hill 2nd Ed., 2003 3. Lawrence R Rabiner & Bernard Gold, Theory and Application of Digital Signal Processing - Prentice Hall.
e- Resources & other digital material
1. http://www.nptel.iitm.ac.in/ 2. http://www.ee.umanitoba.ca/~moussavi/dsp815/LectureNotes/index.html 3. http://www.ece.cmu.edu/~ee791 4. http://cobweb.ecn.purdue.edu/~ipollak/ee438/FALL04/notes/notes.html

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Antenna Design & Analysis Lab

Course Code	**20EC3652**	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**Course Type**	Lab
Credits	3	**L-T-P**	0-0-3	**Prerequisites**	EMF &W, AA&S
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	Utilize simulation software tools for antenna design L3
CO2	Model and simulate various antennas for different frequency ranges. L3
CO3	Measure the radiation characteristics of the antennas L5
CO4	Analyse the radiation characteristics of antenna arrays-L4
CO5	Make an effective report of the 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3				3								3	3
CO2	3				3								3	3
CO3				1	1		1						1	1
CO4		1			1		1						1	1
CO5										3				
Average (Rounded to nearest integer)	3	1		1			1			3			3	3

Syllabus		
S.No.	**Experimental Topics**	**Mapped CO**
1	Introduction to antenna simulation software tools	CO1, CO5
2	Design and analysis of wire antennas (Dipoles, Monopoles, Loop antennas, Yagi-Uda antenna etc.)	CO1, CO2, CO4, CO5
3	Design and analysis of wideband antennas (Conical & Bow-Tie antennas)	CO1, CO2, CO4, CO5
4	Design and analysis of microstrip antennas (Rectangular, circular and other patch shapes)	CO1, CO2, CO4, CO5
5	Measurement of radiation characteristics of Antennas	CO3, CO5
6	Analysis of Linear Antenna Arrays	CO1, CO4, CO5

- **A Minimum of TEN experiments covering all the above topics need to be conducted**

Learning Resources
Text Books
1. Constantine A. Balanis, Antenna Theory and Applications, John Wiley & Sons, 4th Ed., 2021 2. J.D Kraus, R. J. Marhefka & A.S.Khan, Antennas and Wave Propagation, TMH, 4th Ed., 2010.
Reference Books
1. E.C. Jordan and K.G. Balmain - Electromagnetic Waves and Radiating Systems, PHI,2nd Ed., 2009. 2. K.D. Prasad, Satya Prakashan, Antennas and Wave Propagation, Tech India Publications, New Delhi, 2001 3. E.V.D. Glazier and H.R.L. Lamont, Transmission and propagation, vol.5 Standard Publishers Distributors- New Delhi
e- Resources & other digital material
1. http://anlage.umd.edu/HFSSv10UserGuide.pdf 2. https://www.youtube.com/watch?v=kUDlCVOPlvY

VLSI Design Lab

Course Code	20EC3653	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**Course Type**	LAB
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Digital Circuits
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 various Combinational logic circuits using Verilog (L4)
CO2	Analyze various Sequential logic circuits using Verilog (L4)
CO3	Model arithmetic logic circuits using Verilog (L3)
CO4	Simulate memories using Verilog (L3)
CO5	Make 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	
CO2		3			3								3	
CO3	1				1								1	
CO4	1				1								1	
CO5										3				
Average * (Rounded to nearest integer)	**1**	**3**			**2**					**3**			**2**	

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
Simulate the internal structure of the following Digital IC's using VERILOG and verify the operations of the Digital IC's (Hardware) in the Laboratory		
1	Realization of Logic Gates	CO1,CO5
2	3 to 8 Decoder -74x138	CO1,CO5
3	8 x 1 Multiplexer-74x151 and 2x 4 De-multiplexer-74x155	CO1,CO5
4	BCD to 7-segment Decoder 74x49	CO1,CO5
5	4- Bit comparator-74x85	CO1,CO5
6	4-Bit Binary Adder 74x83	CO3,CO5
7	D Flip-Flop-74x74	CO2,CO5
8	Decade counter -74x90	CO2,CO5

9	4 Bit counter-74x93	CO2,CO5
10	Shift registers-74x95	CO2,CO5
11	Universal shift registers-74x194/ 195	CO2,CO5
12	RAM (16 x 4)-74x189 (Read and Write operations)	CO4,CO5
13	4-Bit ALU Design – 74x181	CO3,CO5

Learning Resources

Text Books

1. Charles H. Roth, Lizy Kurian John, Byeong Kil Lee, Digital Systems Design using Verilog, 1st Ed., Cengage Learning, 2016.
2. Jackson, Hodges, Analysis and Design of Digital Integrated Circuits, 3rd Ed., Tata McGraw Hill, 2010.

References:

1. Kang, Leblibici, CMOS Digital Integrated Circuits, 3rd Ed., Tata Mc-Graw Hill, 2001.
2. Jan M. Rabaey, Digital Integrated Circuits, 2nd Ed., Pearson Education, 2002.

e-Resources

1. https://nptel.ac.in/courses/106/105/106105165/

Soft Skills

Course Code	**20SS8651**	**Year**	III	**Semester**	II
Course Category	Skill Advanced course	**Branch**	Common to All	**Course Type**	Theory
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Nil
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	**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)

COs	**PO1**	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1								2		2				
CO2									3	3		2		
CO3								2	1	2		1		
CO4									3	3				
CO5										3				
Avg.								2		2				

Syllabus		
Unit No	**Contents**	**Mapped CO**
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.	CO1, CO2, CO5.
2	• Communication Skills – Need and Methods • Body-Language -I; How to interpret and understand other's body language • Body Language-II; How to improve one's own Body Language • Presentation Skills (Seminar Talk & Power Point Presentation)	CO1 CO2, CO4, CO5.
3	• Goal Setting- Need & Importance • Magic of Team Work. • Leadership Qualities. • Six Thinking Hats.	CO1, CO3.

4	• Accountability towards Work. • Paragraph Writing – Descriptive and Analytical with illustrations • Email Writing • Work Etiquette	CO1, CO3, CO5.
5	• Group Discussion (Open & Monitored) • Resume Preparation • Interview Skills • Mock Interviews	CO2, CO4, CO5.
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	CO5

Learning Resources

Text Books

1. Gopalaswamy Ramesh & Mahadevan Ramesh, The ACE of Soft Skills, Pearson
2. David Goleman , Working with Emotional Intelligence.
3. Krishna Mohan and Meera Banerji; Developing Communication Skills MacMillan India Ltd., Delhi.

References

1. Meenakshi Raman: Soft Skills
2. Audio—Visuals / Hand Outs (Compiled/Created by T&P Cell, P.V.P.Siddhartha Institute of Technology), Board & Chalk and Interactive Sessions

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Semester End Evaluation	• **15 marks for Report- Which includes** 5 Marks for Resume 10 Marks for PPT (5M for PPT preparation & Presentation, 5M for Report Preparation on PPT) • **35 Marks for External Exam – Which includes** 10 Marks for Viva with external examiner, 20 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)

Constitution of India

Course Code	**20MC1601**	**Year**	III	**Semester**	II
Course Category	Mandatory course	**Branch**	ECE	**Course Type**	Theory
Credits	0	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	100	**Semester End Evaluation**	0	**Total Marks**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the meaning and importance of Constitution, Fundamental rights and duties, union government, state and local governments, other statutory bodies (L2).
CO2	Create awareness about social responsibilities (L3)
CO3	To apply the functioning of Union, State and Local Governments in Indian federal system (L3)
CO4	To analyze election commission and amendment procedure for various statuary bodies (L4).

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

COs	**PO1**	**PO2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1					3	3	3		3		2		1
CO2	2					3	3	3		3		2		1
CO3	2					3	3	3		3		2		1
CO4		3				3	3	3		3		2		1
Avg.	2	3				3	3	3		3		2		1

Syllabus

Unit No	**Contents**	**Mapped CO**
1	**Introduction to Indian Constitution:** Constitutional history, constituent assembly, salient features of the constitution, significance of preamble ,amending process of the constitution	CO1
2	**Rights and Duties:** Citizenship, fundamental rights and directive principles, fundamental duties.	CO1, CO2
3	**Union Government**: President and vice president, election, removal and powers, prime minister and council of ministers, parliament, supreme court, union, state relations, emergency provisions	CO1, CO3
4	**State and Local Governments**: Governor, state legislature, assembly, chief minister and council of ministers, high court, rural and urban local governments with special reference to73rd and 74th constitutional amendment acts.	CO1, CO3
5	**Other Constitutional and Statutory Bodies**: Comptroller and auditor general, election commission, finance commission, attorney	CO1, CO4

	general and advocate general, union public service commission (UPSC), state public service commissions (SPSCs), tribunals, national human rights commission(NHRC).	

Learning Resources
Text Books
1. J.C.Johari,IndianGovernmentandPolitics,VishalPublications,Delhi, 2012 2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, , MIT Press, 2012 3. M. V. Pylee, Introduction to the Constitution of India, 5th Ed., Vikas Publishing House, Mumbai, 2007.
References:
1. D.D. Basu, Introduction to the Indian Constitution, 21st Ed., Lexis Nexis, Gurgaon, India, 2011. 2. Subhas C. Kashyap, Our Constitution, 2nd Ed., National Book Trust India, New Delhi, 2013
e-Resources:
1. https://onlinecourses.nptel.ac.in/noc20_lw02/preview

Pattern Recognition

Course Code	20EC6601	**Year**	III	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**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	Outline basic concepts of pattern recognition.(L2)
CO2	Classify decision-making algorithms in pattern recognition. (L4)
CO3	Apply Hierarchical and Partition clustering techniques in pattern recognition applications.(L3)
CO4	Analyze feature selection algorithms in pattern recognition.(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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**
CO1	2									1			1	1
CO2		3								2			2	2
CO3	3									2			2	2
CO4		2								2			2	2
Average * (Rounded to nearest integer)	**2**	**2**								**2**			**2**	**2**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction**: Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Simple pattern recognition model.	CO1
2	**Statistical Decision Making**: Introduction, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques, characteristic curves, estimating the composition of populations.	CO1,CO2
3	**Non Parametric Decision Making:** Histogram, kernel and window estimation, nearest neighbour classification techniques. Adaptive decision boundaries, adaptive discriminant functions, Minimum squared error discriminant functions, choosing a decision making techniques	CO1,CO2

4	**Clustering and Partitioning:** Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single-linkage, complete-linkage and average-linkage algorithm. Ward's method Partition clustering - Forg's algorithm, K-means's algorithm, Isodata algorithm.	CO1,CO3
5	**Pattern Pre-Processing and Feature Selection:** Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection, Applications of Pattern Recognition in bio-metric, facial recognition, Finger prints, etc	CO1,CO4

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Learning Resources

Text Books

1. Gose. Johnsonbaugh, Jost. Pattern recognition and Image Analysis, PHI. 1996
2. Tou. Rafael. Gonzalez. Pattern Recognition Principle, Pearson Education. 1975

Reference Books

1. Richard duda, Hart., David Strok, Pattern Classification, John Wiley ,2nd Ed., 2000.

2. Theodoridis, S. and K. Koutroumbas, Pattern recognition, 4th Ed. 2009, San Diego, CA: Academic Press.

Information Theory & Coding

Course Code	20EC6602	**Year**	III	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Digital Communications
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 measurement of information and errors-L2
CO2	Apply knowledge to design various source codes and channel codes-L3
CO3	Design encoders and decoders for block and cyclic codes-L4
CO4	Analyse the performance of channel coding techniques-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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2													
CO2	3								2			2	3	
CO3		3								2		2	3	
CO4		3							3	3		3	3	
Average* (Rounded to nearest integer)	3	3							3	3		2	3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Coding for Reliable Digital Transmission and storage** Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies. **Source Codes:** Shannon-fano coding, Huffman coding, Lempel Ziv Coding	CO1
2	**Linear Block Codes** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for	CO1-CO2

	Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system	
3	**Cyclic Codes** Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.	CO3,CO4
4	**Convolutional Codes** Encoding of Convolutional Codes- Structural and Distance Properties, state, tree, trellis diagrams, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.	CO3, CO4
5	**BCH Codes** Minimum distance and BCH bounds, Decoding procedure for BCH codes, Syndrome computation and iterative algorithms, Error locations polynomials for single and double error correction	CO3,CO4

Learning Resources
Text Books
1. Shu Lin, Daniel J.Costello,Jr, Error Control Coding, Fundamentals and Applications Prentice Hall, Inc., 2014. 2. Man Young Rhee, Error Correcting Coding Theory, McGraw-Hill Publishing, 1989
Reference Books
1. John G. Proakis, Digital Communications, 5th Ed., TMH, 2008. 2. Salvatore Gravano, Introduction to Error Control Codes, Oxford
e- Resources & other digital material
https://nptel.ac.in/courses/108/105/108105159/

Micro Electro Mechanical Systems

Course Code	20EC6603	**Year**	III	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**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 operation of micro devices, micro systems and their applications (L2)
CO2	Apply scaling laws that are used extensively in the conceptual design of micro devices and systems (L3)
CO3	Choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process (L3)
CO4	Simplify the design of micro devices, micro systems using the MEMS fabrication process (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2									2			2	
CO2	3									3			3	
CO3	2				2					2			2	
CO4		3			3				3	2			2	
Average * (Rounded to nearest integer)	3	3			3				3	2			2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction:** Intrinsic Characteristics of MEMS- Miniaturization, Microelectronics Integration, Mass Fabrication with Precision, Sensors and Actuators- Energy Domains and Transducers, Sensors, Actuators. **Introduction to Micro fabrication:** The Microelectronics Fabrication Process, Silicon based MEMS processes, New Materials and Fabrication Processes, Points of Consideration for Processing. **Review of Essential Electrical and Mechanical Concepts:** Conductivity of Semiconductors, Crystal	CO1 , CO2, CO4

	Planes and Orientation, Stress and Strain, Flexural beam bending analysis under simple loading conditions, Torsional deflections.	
2	**Electrostatic Sensing and Actuation:** Introduction to Electrostatic Sensors and Actuators, Parallel-Plate Capacitors, Applications of Parallel-Plate Capacitors, Interdigitated Finger Capacitors, Applications of Comb-Drive Devices. **Thermal Sensing and Actuation:** Introduction, Sensors and Actuators Based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications. **Magnetic Actuation:** Essential Concepts and Principles, Fabrication of Micromagnetic Components, Case Studies of MEMS Magnetic Actuators.	CO1 , CO2, CO3
3	**Piezoresistive Sensors:** Piezoresistive Sensor Materials, Stress Analysis of Mechanical Elements, Applications of Piezoresistive Sensors. **Piezoelectric Sensing and Actuation:** Introduction, Properties of Piezoelectric Materials, Applications.	CO1, CO2, CO4
4	**Bulk Micromachining and Silicon Anisotropic Etching:** Introduction, Anisotropic Wet Etching, Dry Etching of Silicon-Plasma Etching, Deep Reactive Ion Etching (DRIE), Isotropic Wet Etching, Gas-Phase Etchants, Native Oxide, Wafer Bonding, Case Studies. **Surface Micromachining:** Basic Surface Micromachining Processes, Structural and Sacrificial Materials, Acceleration of Sacrificial Etch, Stiction and AntiStiction Methods, Assembly of 3D MEMS, Foundry Process.	CO1, CO3, CO4
5	**Polymer MEMS:** Introduction, Polymers in MEMS-Polyimide, SU-8, Liquid Crystal Polymer (LCP), PDMS, PMMA, Parylene, Fluorocarbo, Representative Applications-Acceleration Sensors, Pressure Sensors, Flow Sensors, Tactile Sensors. **Optical MEMS:** Passive MEMS Optical Components-Lenses, Mirrors, Actuators for Active Optical MEMS-Actuators for Small Out-of-Plane Translation, Actuators for Large In-Plane Translation Motion, Actuators for Out-of-Plane Rotation.	CO1, CO2, CO4

Learning Resources
Text Books
1. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012. 2. Stephen D Senturia, Microsystem Design, Springer Publication, 2000.
Reference Books
1. Tai Ran Hsu, MEMS & Micro systems Design and Manufacture, TMH, New Delhi, 2002.
E-Resources
1. https://nptel.ac.in/courses/108106165 2. https://www.me.iitb.ac.in/~gandhi/me645/05L1_coursecontents_mtvn.pdf

Detection and Estimation Theory

Course Code	20EC6604	**Year**	III	**Semester**	II
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Linear Algebra, Random Process
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 fundamentals of signal/ parameter detection and estimation principles (L2)
CO2	Apply suitable detection and estimation techniques to solve the problems of different systems (L3)
CO3	Analyse the signal and parameter estimation problems to make inferences (L4)
CO4	Analyse the signal detection problems to support generalizations (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3							1	2	2				
CO2	2							1	2	2			2	1
CO3		3						2	2	3			2	1
CO4		3						1	3	2			2	1
Average* (Rounded to nearest integer)	3	3						1	2	2			2	1

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Fundamentals of Estimation Theory:** Role of Estimation in Signal Processing, Unbiased Estimation, Minimum variance unbiased (MVU) estimators, Finding MVU Estimators, Cramer-Rao Lower Bound, Linear Modelling, Sufficient Statistics, Use of Sufficient Statistics to find the MVU Estimator **Experimental Topics-** Minimum variance unbiased estimation Cramer-Rao lower bound Generalized MVU	CO1, CO2
2	**Deterministic Parameter Estimation:** Least Squares Estimation, Best Linear Unbiased Estimation, and Maximum Likelihood	CO1-CO3

	Estimation **Experimental Topics-** Least Squares Estimation BLUE	
3	**Random Parameter Estimation**: Bayesian Philosophy, Selection of a Prior PDF, Bayesian linear model, Minimum Mean Square Error Estimator, Maximum a Posteriori Estimation **Experimental Topics-** Minimum Mean Square Error Estimator Maximum a Posteriori Estimation	CO1-CO3
4	**Hypothesis Testing:** Bayes' Detection, MAP Detection, ML Detection, Minimum Probability of Error Criterion, Neyman-Pearson Criterion, Multiple Hypothesis, Composite Hypothesis Testing: Generalized likelihood ratio test (GLRT), Receiver Operating Characteristic Curves. **Experimental Topics-** Generalized likelihood ratio test (GLRT) Receiver Operating Characteristic Curves	CO1, CO2, CO4
5	**Detection of Signals in White Gaussian Noise (WGN):**Binary Detection of Known Signals in WGN, M-ary Detection of Known Signals in WGN, Matched Filter Approach **Experimental Topics-** Binary Detection of Known Signals in WGN M-ary Detection of Known Signals in WGN	CO1, CO2, CO4

Learning Resources

Text Books

1. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Vol I, Prentice-Hall, 1993.
2. S. M. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, Vol II, Prentice-Hall, 1998.

Reference Books

1. H. Vincent Poor, An Introduction to Signal Detection and Estimation, 2nd Ed., Springer, 1998
2. Harry L. Van Trees, Detection, Estimation and Modulation Theory, Part- I, II, & III, John Wiley & Sons, 2004
3. Louis L. Scharf, Statistical Signal Processing: Detection, Estimation and Time Series Analysis, Prentice Hall, 1991
4. Carl W. Helstrom, Elements of Signal Detection & Estimation, Prentice Hall, 1994
5. M. D. Srinath, P. K. Rajasekaran and R. Visawanath, Introduction to Statistical Signal Processing with Applications, Prentice Hall, 1995
6. KungYao, Flavio Lorenzelli, and Chiao-En Chen, Detection and Estimation for Communication and Radar Systems, Cambridge University Press, 2013

e- Resources & other digital material

1. https://nptel.ac.in/courses/117/103/117103018/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-432-stochastic-processes-detection-and-estimation-spring-2004/
3. https://ece.iisc.ac.in/~spchepuri/e1244.html
4. https://www.eecs.umich.edu/courses/eecs206/public/lab/lab,all,student.pdf

Circuit Analysis

Course Code	20EC5601	**Year**	III	**Semester**	II
Course Category	**Minors**	**Branch**	ECE	**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 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)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2									2		2		2
CO2	3									3				2
CO3		3								3				2
CO4		2								2				1
Average* (Rounded to nearest integer)	3	3								3				2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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
2	**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

3	**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 forms of representations, power factor, real, reactive and apparent power.	CO1- CO3
4	**Resonance and Coupled circuits:** Series and parallel resonance, the frequency response–Quality factor and Bandwidth	CO1-CO4
5	**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 Hill, 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, McGraw Hill 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
1.https://www.youtube.com/playlist?list=PLC7D3EAEFA0CC0420&app=desktop 2.https://www.tutorialspoint.com/network_theory/network_theory_quick_guide.html 3.https://nptel.ac.in/courses/108/105/108105159/

Industrial and Medical IoT

Course Code	20EC5602	**Year**	III	**Semester**	II
Course Category	**Minor**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	IOT
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
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).

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2													
CO2	3													
CO3	3		3										3	3
CO4	3													
CO5		3												
Average* (Rounded to nearest integer)	**3**	**3**	**3**										**3**	**3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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

2	**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
3	**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 Architecture-Introduction to the I-IoT platform and architectures, OSGi, micro service, containers, and server less computing, The standard I-IoT flow.	CO1,CO3
4	**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
5	**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, 1st Ed., 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 advanced application 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

IV YEAR SYLLABUS

Semester –VII

Digital Image Processing

Course Code	20EC4701A	**Year**	IV	**Semester**	I
Course Category	Program Elective-III	**Branch**	ECE	**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 fundamentals and advances in Machine vision. (L2)
CO2	Apply the mathematical knowledge for image analysis(L3)
CO3	Analyse various image processing algorithms (L4).
CO4	Apply the image processing algorithms to real time applications. (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3									2			3	
CO2	3									3			3	
CO3		3								3			3	
CO4	3									3			3	
Average* (Rounded to nearest integer)	3	3								3			3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Digital Image fundamentals:** Digital Image Representation, Fundamental steps in image processing, Concept of grey levels. Grey level to binary image conversion, Sampling and quantization, Resolution, Relationship between pixels.	CO1,CO2, CO4
2	**Image Enhancement in Spatial Domain:** Point processing, Histogram processing, Image smoothing & Image sharpening. **Image Enhancement in frequency Domain:** Steps involved in frequency domain filtering, Image smoothing & Image sharpening.	CO1-CO4
3	**Image compression:** Redundancies and their removal methods, Fedility criteria, Image compression models, lossy and lossless compression.	CO1-CO4
4	**Image segmentation:** Detection of discontinuities, edge linking and boundary detection, thresholding, region – oriented segmentation.	CO1-CO4

5	**Colour image processing:** Colour fundamentals, Colour models, Pseudo colour image processing, full colour image processing	CO1-CO4

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Learning Resources
Text Books
1. R.C. Gonzalez & R.E. Woods, Digital Image processing, Addison Wesley/ Pearson education, 3rd Ed., 2002. 2. S Jayaraman, S Esakkirajan and T. Veerakumar, Digital Image processing, TMH, 3rd Ed., 2010
Reference Books
1. William K. Pratt, John Wilely, Digital Image Processing, 3rd Ed., 2004. 2. Alan c. Bovik - The Essential Guide to Image Processing, Academic Press, 2009. 3. A.K.Jain - Fundamentals of Digital Image processing, PHI. 1995
e- Resources & other digital material
1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IITKANPUR/Digi_Img_Pro/ui/TOC.htm 2. http://nptel.iitm.ac.in/video.php?subjectId=117105079 3. http://en.wikipedia.org/wiki/Digital_image_processing 4. http://www.filestube.com/d/digital+image+processing+gonzalez+solution

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Analog IC Design

Course Code	20EC4701B	**Year**	IV	**Semester**	I
Course Category	PE-III	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	EDAC & 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	Describe the concepts of Analog IC design(L2)
CO2	Analyze the characteristics of the Amplifiers and mirror circuits (L4)
CO3	Analyze the performance of compensation techniques of Amplifiers (L4)
CO4	Apply switched capacitor circuits and PLLs for different applications. (L3)

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2
CO1	2				2					2			2	
CO2		3			3					3			3	
CO3		2			2					2			2	
CO4	2				2					2			2	
Over all weights	2	3			2					2			2	

Syllabus

Unit No.	Contents	Mapped COs
1	**Introduction to analog IC design and current mirrors** Concepts of Analog Design - General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascode current mirrors- Active current mirrors	CO 1-CO 2
2	**Amplifiers and feedback** Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies	CO 1-CO 2

3	**Frequency response of amplifiers** General considerations-Miller effect, Association of poles with nodes, Common source stage- Source followers- Common gate stage- Cascode stage -Differential pair.	CO 1-CO 2
4	**Operational amplifier stability and frequency compensation** General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input range limitations- Slew rate- Power Supply Rejection, General consideration of stability and frequency compensation, Phase margin- Frequency compensation.	CO 1, CO 3
5	**Switched capacitor circuits and PLLs** General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL and PLL applications	CO 1, CO 4

Learning Resources
Text Book
1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw Hill, 2001, 3rd Re-print, 2016. 2. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design Oxford University Press, 3rd Ed., 2011
Reference Books
1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Ed, Wiley, 2009 2.Grebene, Bipolar and MOS Analog Integrated circuit design, John Wiley & sons, Inc., 2003
e-Resouces
1. https://nptel.ac.in/courses/108106105 2. https://www.d.umn.edu/~htang/ECE5211_doc_files/ECE5211_files/Chapter2.pdf

Microwave Antennas

Course Code	20EC4701C	**Year**	IV	**Semester**	I
Course Category	PE-III	**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	Explain the concepts of broadband and high frequency antennas. L2
CO2	Develop broadband compact antennas with different materials. L3
CO3	Analyse broadband compact antennas made of different materials. L4
CO4	Design compact antennas for multi-frequency operations 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**	**PO12**	**PSO1**	**PSO2**
CO1	2				2							2		
CO2	3				3								2	3
CO3		2			2									
CO4	2				2								2	2
Average * (Rounded to nearest integer)	3	2			3							2	2	3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Traveling wave and Broad band Antennas -** Introduction to microwaves, Frequency- Range, Bands, applications of microwaves, Traveling wave and broad band dipoles-Biconical antenna, Bow –Tie, cylindrical dipoles. Frequency independent antennas-equiangular spiral antenna and log-periodic antennas.	CO1, CO2
2	**Reflector Antennas:** Introduction, Plane Reflector, Corner Reflector – 90^{o} Corner reflector, Parabolic Reflector – Types of feeding systems, Cassegrain feed, Off-set feed.	CO1, CO2
3	**Lens Antennas:** Introduction, Non-metallic dielectric lens antennas, Fermat's Principle, Artificial Dielectric lens, E-plane Metal-Plate lens antennas H-plane Metal-Plate lens antennas.	CO1, CO3
4	**Microstrip Antennas**: Introduction, advantages, limitations, feeding techniques, applications of microstrip antennas. Design of Rectangular and Circular microstrip antennas. Fractal antennas-Types, Minkowski	CO1, CO2, CO3

	Island, Koch loop, Pascal Triangle, Sierpinski gasket and fractal dipole geometries	
5	**Dielectric Resonant Antennas**: Introduction, excitation methods applied to the DRA, analyses of the DRA- cylindrical DRA, hemispherical DRA, rectangular DRA, broad band DRAs, DRA arrays.	CO1, CO4

Learning Resources
Text Books
1. C.A. Balanis, Antenna Theory Analysis and design - John Wiley & Sons, 3rd Ed., 2005 2. J.D Kraus, R.J Marhefka & A.S.Khan - Antennas and Wave Propagation,TMH, 4th Ed., 2010.
Reference Books
1. JKwai-Man Luk, Kwok-Wa Leung; Dielectric Resonator Antennas, Research Studies Press England, 2003
e- Resources & other digital material
1. http://anlage.umd.edu/HFSSv10UserGuide.pdf 2. https://www.youtube.com/watch?v=kUDlCVOPlvY

Operating Systems

Course Code	20EC4701D	**Year**	IV	**Semester**	I
Course Category	PE-III	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Data structures, Computer Organization & 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 disk scheduling (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)

CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2
CO1	3												3	
CO2	3								2	2			3	
CO3	3								2	2			2	
CO4		2							2	2			3	
Over all weights	3	2							2	2			3	

Syllabus

Unit No.	Contents	Mapped COS
1	**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.	CO 1, CO2, CO3
2	**Process Management:** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication. **Threads:** Overview, Multi-core Programming, Multithreading	CO 1, CO 2, CO4

	Models. **Process Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms (First-Come, First-Served Scheduling, Shortest-Job-First Scheduling, Priority Scheduling, Round-Robin Scheduling.)	
3	**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.	CO 1, CO 3, CO4
4	**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.	CO 1, CO 2, CO4
5	**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**.**	CO 1, CO 2, CO4

Learning Resource
Text Books
1. Abraham Silberchatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, 9th Ed., Wiley India, 2016 2. William Stallings, Operating Systems - Internal and Design Principles, 9th Ed., Pearson, 2018
Reference Books:
1. Harvey M.Deitel, Paul J Deitel and David R.Choffnes , Operating Systems, 3rd Ed. , Pearson, 2019 2. D.M. Dhamdhere, Operating Systems - A Concept based Approach, 2nd Ed., McGraw Hill**,** 2010
_e-Resouces
1. https://onlinecourses.nptel.ac.in/noc19_cs50/ 2. http://www.youtube.com/watch?v=MaA0vFKtew&list=PL88oxI15Wi4Kw1aEY2bC5l_4pouojjtd4

Fuzzy Logic

Course Code	20EC4701E	**Year**	IV	**Semester**	I
Course Category	Program Elective III	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Linear, algebra, Statistics and Probability
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 Fuzzy logic and its applications	L2
CO2	Apply the concepts of fuzzy logic to solve the real world problems	L3
CO3	Design fuzzy systems for various engineering applications	L3
CO4	Analyse the performance of fuzzy 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	2				2					2				
CO2	3				3					3			3	3
CO3	2				2					2			2	
CO4		2			2					2				2
Average* (Rounded to nearest integer)	3	2			2					2			3	3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction** Different faces of imprecision - inexactness, Ambiguity, Undecidability, Fuzzyness and certainty, Fuzzy sets and crisp sets, Probability and fuzzy logic, Fuzzy control and knowledge based systems	CO1,CO2
2	**Fuzzy Sets and Operations** Impressive concepts, Fuzzyness and imprecision, Properties of fuzzy sets, Fuzzy representation, Conventional set operations, Intersection of Fuzzy sets, Union of fuzzy sets, the complement of fuzzy sets	CO1,CO2
3	**Fuzzy Reasoning** Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference-the-Min-Max rules implications and fuzzy additive rules of implication, Methods of decompositions and defuzzyfication -	CO1,CO2

	composite moments, composite maximum average of maximum values and centre of maximums	
4	**Methodology of Fuzzy Systems** Direct and Indirect methods with single and multiple experts, Construction from sample data - Least square method, adaptive fuzzy controllers - membership function tuning using gradient decent	CO1,CO3, CO4
5	**Applications** Fuzzy controllers - a fuzzy steam turbine controller, DC motor speed control, Fuzzy decisions making, neuro fuzzy systems, fuzzy genetic algorithms	CO1,CO3, CO4

Learning Resources

Text Books

1. Zimmermann H.J., Fuzzy Set Theory - and its Applications, Springer, 4^{th} Ed., 2007
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley Publications, 4^{th}, Ed., 2016

References

1. John Yen, Reza Langari, Fuzzy Logic, Intelligence, Control & Information, Pearson Education Inc., India, 2007
2. Zdenko Kovacic, Stjepan Bogdan, Fuzzy Controller Design Theory and Applications, CRC Press, 1^{st} Ed., 2006
3. Riza C. Berkaan, Sheldon L. Trubatch, Fuzzy Systems Design Principles, Building Fuzzy IF THEN Rule Based, IEEE Press, 1997
4. George J Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and A: Theory and Applications, Pearson, 2015
5. M. Mitchell, Introduction to Genetic Algorithms, Indian Reprint, MIT press Cambridge, 2^{nd} Ed., 2014

e-Resources

1. https://onlinecourses.nptel.ac.in/noc22_ge04/preview
2. https://eopcw.com/find/course/428/courses
3. https://www.wiley.com//legacy/wileychi/fuzzylogic/

Cellular and Mobile Communications

Course Code	20EC4702A	**Year**	IV	**Semester**	I
Course Category	Professional Elective -IV	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Analog Communications Digital Communications
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 cellular system design and technical challenges. (L2)
CO2	Analyze the effects for signal propagation (L4)
CO3	Analyze methodologies and mobile system specifications to improve the cellular capacity (L4)
CO4	Analyze digital cellular systems for next generation cellular applications. (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2									1			2	
CO2		3								2			3	
CO3		3								2			3	
CO4		3								2			3	
Average * (Rounded to nearest integer)	2	3								2			3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Cellular and Mobile Radio Systems:** Introduction to Cellular Mobile System, Performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells, Analog and Digital Cellular systems Elements of Cellular Radio System Design: General description of the problem, concept of frequency Reuse channels, Co-channel Interference Reduction Factor, desired C/I from a normal case in a omni directional Antenna system, consideration of the components of Cellular system	CO1

	Interference: Introduction to Co-Channel Interference, real time Co-Channel interference, Co- Channel measurement, design of Antenna system, Antenna parameters and their effects, diversity receiver, non-co-channel interference-different types.	
2	**Cell Coverage for Signal and Traffic:** Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long distance propagation antenna height gain, form of a point to point model.	CO1,CO2
3	**Cell Site and Mobile Antennas:** Sum and difference patterns and their synthesis, omni directional antennas, directional antennas for interference reduction, space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, high gain antennas. Frequency Management and Channel Assignment: Numbering and grouping, setup access and paging channels channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non-fixed channel assignment.	CO1,CO3
4	**Handoffs:** Handoff, dropped calls and cell splitting, types of handoff, handoff invitation, delaying handoff, forced handoff, mobile assigned handoff. Intersystem handoff, cell splitting, micro cells, vehicle locating methods, dropped call rates and their evaluation	CO1,CO3
5	**Digital Cellular and Mobile Networks:** GSM architecture, GSM channels, GSM Radio Subsystems, GSM Channels,4G evolution, Advantages of 4G over 3G,Applications of 4G, Limitations of 4G.5G evolution.	CO4

Learning Resources

Text Books

1. W.C.Y. Lee, Mobile Cellular Telecommunications, McGraw Hill, 2nd Ed, 1989.
2. T.S Rappaport, Wireless Communications, Pearson, 2nd Ed., 2002.

Reference Books

1. G. Sasi bhushana Rao, Mobile Cellular Communication, Pearson Education, New Delhi, 2013.
2. R. Blake, Wireless Communication Technology, Thompson Asia Pvt. Ltd., 2004.
3. Jon W. Mark and Zhqung, Wireless Communication and Networking, PHI, 2005.
4. Lee, Mobile Communications, Mc Graw Hill

e- Resources

1. https://nptel.ac.in/courses/106/106/1061061067/
2. https://nptel.ac.in/courses/117104099/
3. https://swayam.gov.in/nd1_noc19_ee48/preview

ASIC Design

Course Code	20EC4702B	**Year**	IV	**Semester**	I
Course Category	Professional Elective-IV	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**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	Demonstrate knowledge in ASIC Design flow, Simulation Issues ASICs Design Techniques. ASIC Construction (L2).
CO2	Design and simulation of digital ICs using Verilog (L3)
CO3	Compare different testing procedures for VLSI circuits. (L4)
CO4	Analyze the algorithms of partitioning, placement and routing (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					2			2	
CO2	3		3		3					3			3	
CO3	2	2			2					2			2	
CO4		2			2					2			2	
Average * (Rounded to nearest integer)	2	2	3		2					2			2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Types of ASICs:** Full-Custom ASICs, Standard-cell-based ASICs, Gate array-based ASICs, channelled gate array, channel less gate array, structured gate array, programmable logic devices, field programmable gate arrays, design flow. ASIC Cell Libraries. ASIC library design: transistors as resistors, transistor parasitic capacitance	CO1
2	**Verilog:** Basics of the verilog language, operators, hierarchy, procedures and assignments, timing controls and delay, logic-gate modeling, modelling delay, altering parameters. **Logic Synthesis**: A logic-synthesis example, MULTIPLEXER, inside a logic synthesizer verilog and logic synthesis.	CO1, CO2
3	**Simulation:** Types of simulation, MUX example, logic systems, how logic simulation works, delay models, static timing analysis, switch-level simulation, transistor-level simulation.	CO1, CO2

4	**Test:** The importance of test, boundary-scan test, faults, fault simulation, automatic test-pattern generation, scan test, built-in self-test, a simple test example.	CO1, CO3
5	**ASIC Construction:** Physical design, system partitioning, partitioning methods. **Floor planning and Placement**: Floor planning, placement, physical design flow, **Routing:** Global routing, detailed routing,	CO1, CO4

Learning Resources
Text Books
1. M. John Sebastian Smith, Application-Specific Integrated Circuits, Pearson Education, 2001. 2. Wayne Wolf, Modern VLSI Design, 4th Ed., Pearson Education, 2002
Reference Books
1. Jan. M. Rabaey, Digital Integrated Circuits, 2nd Ed, Prentice Hall, 2001 2. Sabih Gerez, Algorithms for VLSI Design Automation, Wiley, 1999 3. Samir Palnitkar, Verilog HDL, 2nd Ed., Pearson Education, 2003
e- Resources
1. https://nptel.ac.in/courses/117101004

RF Circuit Design

Course Code	20EC4702C	**Year**	IV	**Semester**	I
Course Category	Program Elective-IV	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	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	Interpret the properties of active and passive components at high frequency applications (L2)
CO2	Develop RF Components and transmission lines used in RF circuit design (L3).
CO3	Build independent and interconnected networks (L3).
CO4	Analyze characteristics of RF circuits (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2									2				
CO2	3									3				3
CO3	2									2			2	
CO4		3								3				
Average* (Rounded to nearest integer)	2	3								3			2	3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction:** Importance of Radio Frequency Design, Dimensions and Units, frequency Spectrum. RF behavior of Passive Components- Resistors, Capacitors and Inductors at high frequency. Chip Components and Circuit Board Considerations-Chip Resistors, Chip Capacitors, Surface-Mounted inductors. RF circuit Manufacturing Processes	CO1, CO2,CO4

2	**Active RF Components:** Semiconductor Basics – Physical Properties of Semiconductors, the PN-Junction, Schottky Contact. RF Diodes-Schottky Diode, PIN Diode, Varactor Diode, Tunnel Diode. Bipolar-Junction Transistor - Construction, Functionality and Frequency Response. RF Field Effect Transistors - Construction, Functionality, Frequency Response. Metal Oxide Semiconductor Transistors-Construction, Functionality	CO1, CO2,CO 4
3	**Transmission Line Analysis:** Examples of Transmission Lines – Two-Wire Lines, Coaxial Line, Microstrip Lines. Equivalent Circuit Representation, basic laws, Circuit parameters for a Parallel –Plate Transmission Line. General Transmission line equation, characteristic impedance, lossless transmission line model, Microstrip Transmission lines	CO1, CO2,CO 4
4	**Single and Multiport Networks:** Basic definitions, interconnecting networks-series and parallel connection of networks, Cascading networks, ABCD network representation. Network properties and applications, interrelations between parameter sets. Scattering Parameters-Definition of S-parameters, chain scattering matrix	CO1,CO 3
5	**RF Transistor Amplifier Design:** Characteristics of Amplifiers – Amplifier Matching Basics, Power amplifiers, Broadband Amplifiers, High Power Amplifiers, multistage amplifiers.	CO1, CO2,CO 4

Learning Resources
Text Books
1. Reinhold Ludwing and Gene Bogdnov, RF Circuit Design: Theory and applications by Pearson Education Asia Publication, New Delhi, 2001 2. Joseph Carr, Secrets of RF Design 3rd Ed., Tata McGraw-Hill Publishing Company Limited.
Reference Books
1. Mathew M. Radmanesh, Radio frequency and microwave electronic illustrated,Pearson Education, 2001
e- Resources
1. https://nptel.ac.in/courses/117/102/117102012/#

Database Management Systems

Course Code	20EC4702D	**Year**	IV	**Semester**	I
Course Category	Program 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	Understand the basic concepts of database management systems (L2)
CO2	Apply SQL to find solutions to a broad range of queries (L3).
CO3	Apply normalization techniques to improve database design (L3)
CO4	Analyze a given database application scenario to use ER model for conceptual design of the database

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		2		
CO2	3				3			3		3		3	3	
CO3	2							2		2				
CO4		2						2		2				2
Average* (Rounded to nearest integer)														

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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 DBMSs**.**	CO1
2	**Relational Model:** The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas. SQL: Data	CO1, CO2

	Definition, Constraints, and Basic Queries and Updates, SQL: Advanced Queries, Assertions, Triggers, and Views	
3	**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, Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues, Relational Database Design Using ER-to-Relational Mapping.	CO1,CO3
4	**Database Design Theory:** Functional Dependencies, Normal forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multi valued Dependencies and Fourth Normal Form,	CO1,CO4
5	**Transaction Processing:** Introduction, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability & Serializability, Transaction Support in SQL. **Introduction to Concurrency Control:** Two-Phase Locking Techniques: Types of Locks and System Lock Tables, Guaranteeing Serializability by Two-Phase Locking.	CO1

Learning Resources
Text Books
1. Ramez Elmasri, Shamkant B. Navathe, Database Systems Models, Languages, Design and Application Programming, 6th Ed., Pearson 2. Abraham Silberschatz, Henry F Korth, S. Sudarshan, Data base System Concepts, 5th Ed., McGraw Hill.
Reference Books
1. Raghurama Krishnan, Johannes Gehrke, Data base Management Systems, 3rd Ed., TMH. 2. C.J.Date, Introduction to Database Systems, 8th Ed. , Pearson
e- Resources
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/

DSP Processors

Course Code	20EC4702E	**Year**	IV	**Semester**	I
Course Category	Professional Elective-V	**Branch**	ECE	**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 digital signal processing techniques. (L2)
CO2	**Identify** various sources of errors. (L3)
CO3	**Illustrate** Architectural features of programmable DSP devices. (L3)
CO4	**Analyze** the performance of processor based on pipelining concepts. (L4)
CO5	**Develop** basic DSP algorithms using DSP Processors.(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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2									1			1	1
CO2	2									2			2	2
CO3	3									2			2	2
CO4		2								2			2	2
CO5	2									2			2	2
Average * (Rounded to nearest integer)	**2**	**2**								**2**			**2**	**2**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Computational accuracy in DSP Implementations:** Number formats for signals and coefficients in DSP systems, dynamic range and precision, sources of error in DSP implementations, A/D conversion errors, DSP computational errors, D/A conversion errors, compensating filter.	CO1,CO2
2	**Architectures for Programmable DSP Devices**: Basic architectural features, DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing.	CO1,CO3

3	**Execution Control and Pipelining:** Hardware looping, interrupts, stacks, relative branch support, pipelining and performance, pipeline depth, interlocking, branching effects, interrupt effects, pipeline programming models	CO1,CO4
4	**Programmable Digital Signal Processors**: Introduction, Commercial Digital Signal Processing devices, architecture of TMS320C54xx Digital Signal Processors, addressing modes of the TMS320C54xx processors, memory Spaces of TMS320C54xx processors, program control, TMS320C54xx instructions and programming, on Chip peripherals, interrupts, pipeline operation of the TMS320C54xx processors	CO1,CO3
5	**Implementations of Basic DSP Algorithms & Interfacing:** Introduction, The Q-notation, FIR Filters, IIR Filters, interpolation filters, decimation filters, PID controller, adaptive filters, 2-D Signal Processing, Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).	CO1,CO5

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Learning Resources
Text Books
1. Avtar Singh, S.Srinivasan, Digital Signal Processing, Cengage Learning, 2004. 2. Phil Lapsley, DSP Processor Fundamentals: Architectures and Features, IEEE Press, 1997.
Reference Books
1. Sen M.Kuo, Real-Time Digital Signal Processing, 2nd Ed., Wiley Student Edition, 2010. 2. B.Venkata Ramani, M.Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, Tata McGraw Hill, 2004. 3. Jonatham Stein, Digital Signal Processing, Wiley Student Edition, 2005
e- Resources
1. https://ocw.snu.ac.kr/node/25239 2. https://nptel.ac.in/courses/108106149

Global Positioning Systems

Course Code	20EC4703A	**Year**	IV	**Semester**	I
Course Category	PE	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Satellite communication
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 characteristics of GPS signals and transceivers (L2).
CO2	Illustrate different types of **GPS errors** (L3)
CO3	Analyse various **standard formats of GPS** (L4)
CO4	Differentiate GPS applications (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		2		
CO2	3									3				
CO3		2								2				
CO4		3					3			3		3		3
Average* (Rounded to nearest integer)	**3**	**3**					**3**			**3**		**3**		**3**

Syllabus		
Unit No.	**Contents**	Mapped CO
1	**Introduction to GPS:** Overview of GPS, GPS segments, GPS satellite generations, current GPS satellite constellation, control sites.	CO1, CO4
2	**GPS Details:** GPS signal structure, GPS modernization, types of GPS receivers, time systems, pseudo range measurements, Carrier-phase measurements and cycle slips.	CO1, CO2
3	**GPS errors and Biases:** GPS ephemeris errors, Selective availability, satellite receiver and clock error, multipath error, Ionospheric error, tropospheric error	CO1, CO2
4	**GPS standard formats:** RINEX, NGS-SP3, RTCM SC-104 and NMEA 0183.	CO1, CO3
5	**GPS Applications:** GPS for utilities industry, forestry and natural resources, precision farming.	CO1, CO4

Learning Resources
Text Books
1. Ahmed EI-Rabbany, Introduction to GPS the Global Positioning System: Artech House. 2. Christopher J. Hegarty (eds), Elliott D. Kaplan- Understanding GPS: Principles and Applications, 2nd Ed.- Artech House
Reference Books
1. James Bao-Yen Tsui, Fundamentals of Global Positioning System Receivers: A Software Approach, John Wiley & Sons, Inc,2000
e- Resources
1. https://ocw.mit.edu/courses/12-540-principles-of-the-global-positioning-system-spring-2012/

Wireless Sensor Networks

Course Code	20EC4703B	**Year**	IV	**Semester**	I
Course Category	Professional Elective-V	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Data Communication Networks
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 overview of wireless sensor networks and enabling technologies for wireless sensor networks (L2)
CO2	**Apply** the design principles of WSN architectures and operating systems for simulating environment situations. (L3)
CO3	**Apply** various concepts for assignment of MAC addresses. (L3)
CO4	**Select** the appropriate infrastructure, topology, joint routing and information aggregation for wireless sensor networks (L3)
CO5	**Analyse** the sensor network platform and tools state-centric programming. (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	2	-	-	-	2	-	2	-	-
CO2	3	-	3	-	-	3	3	-	-	3	-	-	-	3
CO3	2	-	-	-	2	-	-	-	-	2	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	2	-	-	2	-
CO5	-	2	-	-	2	-	-	2	-	2	-	-	2	-
Average* (Rounded to nearest integer)	2	2	3		2	3	3	2		2		2	2	3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**OVERVIEW OF WIRELESS SENSOR NETWORKS**: Single-Node Architecture - Hardware Components- Network Characteristics- unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks- Types of wireless sensor networks.	CO1,CO2

2	**ARCHITECTURES:** Network Architecture- Sensor Networks-Scenarios- Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments-Introduction to TinyOS and nesC- Internet to WSN Communication	CO1,CO2
3	**NETWORKING SENSORS**: MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - SMAC, - B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy-Efficient Routing, Geographic Routing.	CO1,CO3
4	**INFRASTRUCTURE ESTABLISHMENT**: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control	CO1,CO4
5	**SENSOR NETWORK PLATFORMS AND TOOLS:** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.	CO1,CO5

Learning Resources
Text Books
1. Holger Karl and A. Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005. 2. Feng Zhao and Leonidas J.Guibas, Wireless Sensor Networks-An Information Processing Approach, Elsevier, 2007 3. 3. Waltenegus Dargie , Christian Poellabauer, Fundamentals Of Wireless Sensor Networks - Theory And Practice, John Wiley & Sons, 2011
Reference Books
1. Kazem Sohraby, Daniel Minoli, and TaiebZnati, Wireless Sensor Networks-Technology, Protocols and Applications, John Wiley, 2007. 2. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003
e- Resources
1. http://pages.di.unipi.it/bonuccelli/sensori.pdf

Radar Engineering

Course Code	20EC4703C	**Year**	IV	**Semester**	I
Course Category	Professional Elective-II	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Antennas and Propagation
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	Explain the basic concepts of Radars.(L2)
CO2	Choose the suitable Radar for given requirements.(L3)
CO3	Analyze the effect of various parameters on the performance of radar (L4).
CO4	Compare various tracking systems (L4).
CO5	Apply various techniques in radar receivers for detection of signals.(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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2									2		2		
CO2	3									2				
CO3		3								2				
CO4		2								2		2		
CO5	2									2				
Average * (Rounded to nearest integer)	3	3								2		2		

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction to Radar:** Radar equation, radar block diagram and operation, radar frequencies, applications of Radar, prediction of range performance, minimum detectable signal, receiver noise, signal to noise ratio, integration of radar pulses, transmitter power, Pulse repetition frequency and range ambiguities.	CO1 ,CO3
2	**CW and FMCW Radars:** The Doppler effect, CW radar, Frequency-modulated CW radar: range and Doppler measurement, FMCW altimeter; multiple frequency CW radar. **Radar Clutter:** Introduction to radar clutter, surface clutter radar equation, sea clutter, detection of targets in clutter.	CO1-CO3

3	**MTI and Pulse Doppler Radar**: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters, Non-coherent MTI, MTI versus Pulse Doppler Radar.	CO1- CO3
4	**Tracking Radar:** Tracking with radar, sequential lobing, conical scan, monopulse tracking radar-amplitude comparison monopulse radar with one angular coordinate, phase comparison monopulse radar, low-angle tracking, tracking in range, comparison of trackers.	CO1,CO4
5	**Detection of Radar Signals in Noise :** Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters Matched Filter with Non-white Noise. Radar Receivers – Noise Figure and Noise Temperature. Displays – types. Duplexers – Branch type and Balanced type.	CO1,CO5

Learning Resources
Text Books
1. Merrill I. Skolnik, Introduction to Radar Systems –3rd Ed., McGraw-Hill. 2. Peyton Z. Peebles, Jr., Radar Principles, Wiley India Pvt. Ltd., 2009
Reference Books
1 Merrill I. Skolnik, Introduction to Radar Systems, 2nd Ed, Tata McGraw- Hill 2. Simon kingsley, Understanding Radar Systems, McGraw-Hill,1stEd., 1992
e- Resources
1. https://nptel.ac.in/courses/108105154

Deep Learning

Course Code	**20EC4703D**	**Year**	IV	**Semester**	I
Course Category	Program Elective-V	**Branch**	ECE	**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	Explain the basics and architecture of deep neural networks L2
CO2	Apply Convolution Neural Network for Vision applicationsL3
CO3	Apply deep learning algorithms for Natural Language processing L3
CO4	Analyse the various components of Deep Neural networks. 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2				2							2		
CO2	2				2								3	
CO3	2				2								2	
CO4		2			2								2	
Average * (Rounded to nearest integer)	2	2			2							2	2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptron, Perceptron Learning Algorithm Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks	CO1, CO4
2	Feed Forward Neural Networks, Backpropagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Ada Grad, RMS Prop, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis	CO1-CO3
3	Principal Component Analysis and its interpretations, Singular Value Decomposition, Auto encoders and relation to PCA, Regularization in auto-encoders, Denoising auto encoders, Sparse	CO1-CO4

	auto encoders, Contractive auto-encoders Regularization: Bias Variance Trade-off, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout	
4	Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization Learning Vectorial Representations Of Words Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks	CO1-CO4
5	Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs Encoder Decoder Models, Attention Mechanism, Attention over images	CO1-CO3

Learning Resources

Text Books

1. Ian Good fellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Reference Books

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

e- Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs35/course

Embedded and Real Time Systems

Course Code	20EC4703E	**Year**	IV	**Semester**	I
Course Category	Program Elective-V	**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	**Illustrate** the Embedded Systems and its constituents. (L2)
CO2	**Apply** design methodologies for embedded systems. (L3)
CO3	**Build** fundamental embedded system. (L3)
CO4	**Develop** embedded systems with specifications and technological choice. (L3)
CO5	**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	PO 10	PO 11	PO12	PSO1	PSO2
CO-1	2									2			2	
CO-2	2									2			2	
CO-3	2									2			2	
CO-4	3					2				3			3	
CO-5	2				2					2			2	
Average* (Rounded to nearest integer)	2									2			2	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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,CO2
2	**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.	CO1,CO3
3	**Devices in Embedded Systems:** Types of supporting devices for	CO1,CO4

	an embedded system – various forms of ROM, RAM devices, interrupt sources, Interrupt Service Mechanism, serial port devices, parallel port devices, timers and counting devices.	
4	**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 andAdvanced Buses.	CO1,CO4
5	**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.	CO1,CO5

Learning Resources
Text Books
1. Raj Kamal, Embedded Systems Architecture, Programming and Design, 2nd Ed., McGraw Hill 2. Shibu KV, Introduction to Embedded System, Mc-Graw Hill.
References
1. Peckol, Embedded system Design, John Wiley & Sons, 2010 2. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013 3. Dr. K.V.K.K. Prasad, Embedded/Real-Time Systems, Dream Tech press
e- Resources
1. Microsoft PowerPoint - pcp_embedded_system_intro (iitb.ac.in) 2. NPTEL :: Electrical Engineering - Embedded Systems

Disaster Management and Preparedness

Course Code	20CE2701A	**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**	Environmental Science
Continuous Evaluation:		**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 & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
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**

Syllabus

Unit No.	**Contents**	**Mapped CO**
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
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
3	**Disaster Mitigation and Preparedness** Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural	CO3

	measures; risk analysis, vulnerability and capacity assessment; early warning systems, Role of remote sensing and GIS in disaster management.	
4	**Post Disaster Response** Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, disease control, security, 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.	CO4
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, Disaster Risk Reduction in South Asia, Prentice Hall,2004 3. Singh B.K., Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication,2008
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) IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC, Feb. 2007
e-Resources
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	**20EC2701A**	**Year**	IV	**Semester**	I
Course Category	Open Elective	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
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	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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2							2		2		2		
CO2	3							3		3		3		
CO3	2							2		2		2		2
CO4		3			3	3		3		3		3	3	3
CO5		2						2		2		2		
Average * (Rounded to nearest integer)	2	3			3	3		2		2		2	3	3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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? , Selecting the Problem, Necessity of Defining a problem. Research Design –Features of Good Design, Important Concepts related to Research Design, Basic Principles of Experimental Designs.	CO1, CO2
2	**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 –	CO1-CO3

	Collection of Secondary data. **Data Preparation**: Data Preparation Process, Some problems in Preparation Process, Missing Values and Outliers, Types of Analysis, Statistics in Research.	
3	**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
4	**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
5	**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, 2nd 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

Reference Books

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

1. https://www.youtube.com/watch?v=8iFfzYVuCuM
2. https://onlinecourses.nptel.ac.in/noc22_ge08
3. https://www.youtube.com/watch?v=GSeeyJVD0JU

E – Waste Management

Course Code	**20EC2701B**	**Year**	IV	**Semester**	I
Course Category	Open Elective	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
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	Understand the environmental impacts of e-waste. (L2)
CO2	Apply concepts of e-waste management hierarchy.(L3)
CO3	Distinguish the role of various national and internal act and laws applicable for e-waste management and handling.(L4)
CO4	Analyze the e – waste management measures proposed under national and global legislations. (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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					2	2			2		2		2
CO2	2					2	2			2		2		2
CO3		2				2	2			2		2		2
CO4		3				3	3			3		3		3
Average* (Rounded to nearest integer)	2	3				2	2			2		2		2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**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
2	**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	CO1, CO2

	stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India.	
3	**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
4	**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
5	**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. Johri R., E-waste: Implications, Regulations and Management in India and Current Global Best practices, TERI Press, New Delhi 2. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009
Reference Books
1. Fowler B, Electronic Waste, 1st Ed., (Toxicology and Public Health Issues), 2017 Elsevier
e-Resources
1. https://news.mit.edu/2013/ewaste-mit

Non - Conventional Energy Resources

Course Code	20EE2701A	**Year**	IV	**Semester**	I
Course Category	OE-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** the process of energy collection, quantification, storage, conversion and applications of non-conventional sources. (L2)
CO2	**Apply** the knowledge of energy conversion for harvesting energy from different sources like light, heat, wind etc. (L3)
CO3	**Apply** basic laws of physics for the production of energy from Solar, wind, ocean, biomass, geothermal, fuel cell and hydrogen energy sources. (L3)
CO4	**Analyze** the theory and designing wind mills, MHD, Fuel cells. (L4)
CO5	**Examine** the performance of solar and wind generating units and economic aspects of MHD biomass and Ocean energy sources. (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&b Strength of correlations (3: High, 2: Moderate, 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's**
1	**Principles of Solar Radiation**: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface. Measurement of Solar Radiation: Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working.	CO1-CO3, CO6
2	**Solar Energy Collection and Storage**: Solar Light Energy: Photovoltaic effect, characteristics of photovoltaic cells, conversion efficiency, solar batteries and	CO1-CO3, CO5- CO6

	applications of photovoltaic energy conversion. Solar Heat Energy: Sensible, latent heat of Heat storage, solar ponds. Applications- solar heating/cooling technique, solar distillation and drying.	
3	**Wind Energy**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria **Ocean Energy:** OTEC, types of OTEC plants, mini-hydel power plants	CO1-CO6
4	**Bio-Mass:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters. **Geothermal Energy:** Resources, methods of harnessing the energy.	CO1, CO3, CO5, CO6
5	**MHD Generators**: Basic principles of MHD generator and Hall Effect, different types of MHD generators. **Fuel Cells:** Introduction, principle of fuel cells, thermodynamic analysis of fuel cells, types of fuel cells, fuel cell batteries, applications of fuel cells.	CO1, CO3, CO4,CO6

Learning Resources

Text Books

1. G.D. Rai, Non-Conventional Energy Sources, Khanna publishers, 5th Ed., 2014.
2. S. Rao and B. B.Parulekar, Energy Technology- Non conventional, Renewable and Conventional, Khanna, 3rd Ed., 1999.

Reference Books

1. Ashok V Desai, Non-Conventional Energy, New age publishers, 1st Ed., 1990.
2. B.H.Khan, Non-Conventional Energy Sources, Tata Mc Graw-hill, 2nd Ed., 2013.
3. B.T. Nijaguna, Biogas Technology, New Age International, 1st Ed., 2002.
4. Tiwari and Ghosal, Renewable Energy resources, Narosa, 2nd Ed., 2005

e-Resources

1. https://www.coursera.org/learn/renewable-energy-technology-fundamentals
2. https://nptel.ac.in/courses/121106014

Fundamentals of Data Science

Course Code	20IT2701A	**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**	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& Strength of correlations (3: High, 2: Moderate, 1: Low)

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**
CO1	3												3	
CO2	3	3	3										3	
CO3	3		3										3	
CO4	3	3											3	
Avg	**2**													

Syllabus

Unit No.	**Contents**	**Mapped CO**
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
2	**Modelling Methods:** Choosing evaluating models: Problems to machine learning tasks, Evaluating models,	CO1 CO2 CO4
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
4	**Unsupervised methods:** **Clustering Analysis:** Preparing Data, K-Means Algorithm **Association Rules:** Overview of Association rules, Mining Associations rules	CO1 CO2 CO4

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, Dream Tech, 2015 2. Arun K Pujari, Data Mining Techniques, University Press, 3rd Ed., 2013
Reference Books
1. Sanjeev J. Wagh, Manisha S. Bhende and A. D. Thakare: Fundamentals of Data Science, 1st Ed., 2021
e-Resources
http://nptel.ac.in

Operations Research

Course code	20ME2701A	**Year**	IV	**Semester**	I
Course category	Open Elective	**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 basics of linear programming, transportation, queueing , sequencing of jobs, replacement, inventory and simulation problems	L2
CO2	Apply linear programming, transportation and assignment models to solve real life problems	L3
CO3	Apply Sequencing, queueing, Game and Replacement theories to solve problems	L3
CO4	Apply knowledge of inventory control and simulation to solve practical industrial problems	L3

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**	**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**	**Mapped CO**
1	**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.	CO1 CO2
2	**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.	CO1 CO2
3	**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	CO1 CO3

	for processing 2 jobs through n machines with different order of sequence.	
4	**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	CO1 CO3
5	**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	CO1 CO4

Learning Resource
Text books:
1. S.D.Sharma, Operations Research, Kedarnath & Ramnath publications, 15th Ed.,2013. 2. Taha, Introduction to Operations Research, Pearson Education, New Delhi, 8th Ed., 2008
Reference books
1. A.M .Natarajan, P. Balasubramani and A.Tamilarasi, Operations Research, Pearson Education, New Delhi, 4th Ed., 2009. 2. R.Pannerselvam, Operations Research, PHI Publications, Noida,2nd Ed.,2009 3. Wagner, Operations Research, PHI Publications, 2nd Ed.,Noida,2007 4. J.K.Sharma, Operation Research, 4th Ed., MacMilan publishers Ltd. New Delhi,2009
e-Resources
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	**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	Discuss the basic concepts of MIS, Decision making, Applications of MIS, Decision support systems, BPR and E- Commerce.	L2
CO2	Interpret the MIS decision making and its applications.	L3
CO3	Categorise Decision support systems and Business Process Re-Engineering	L3
CO4	Summarise the Electronic commerce environment and its opportunities.	L3

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

Syllabus		
UNIT No.	**Contents**	**Mapped CO**
1	**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
2	**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
3	**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	CO1, CO2

	processing, Transaction processing, Application processing, TQM of Information systems, Programming languages for system coding.	
4	**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
5	**E-Commerce:** Electronic commerce environment and opportunities: back ground, electronic commerce Environment, Modes of electronic commerce: Approaches to safe electronic commerce, Overview, Secure transport protocols, Secure Transactions, Secure Electronic Payment Protocol, and Secure Electronic Transaction.	CO1, CO4

Learning Resource

Text books

1. W.S. Jawadekar, Management Information Systems: A Global Digital Enterprise Perspective, 5th Ed., McGraw Hill, 2013.
2. D. Minoli, Web Commerce Technology Hand Book, 1st Ed., McGraw Hill, 2000.

Reference books

1. K.C. Laudon and J. Laudon, Management Information Systems: Managing a Digital firm, 11th Ed., Pearson Education, 2012.
2. D. Gordon and M. Oslon, Management Information Systems: Conceptual Foundations, Structure and Development, 2nd Ed., McGraw Hill Education Pvt Ltd, India, 2001.
3. R.G. Murdic, J.E. Ross and J.R. Clagget, Information Systems for Modern Management, 3rd Ed., PHI, 2008.
4. K.Ravi and A.B. Whinston, Frontiers of Electronic Commerce, 1st Ed., Pearson India, 2002.

e-Resources

1. http://nptel.ac.in/courses/112106134/
2. http://nptel.ac.in/courses/112106131/

Environmental Management and Audit

Course Code	20CE2702A	**Year**	IV	**Semester**	I
Course Category	Open Elective-4	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	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 & Strength of correlations (High:3, Medium: 2, Low:1)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
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**

Syllabus

Unit No.	**Contents**	**Mapped CO**
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
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
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

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
5	**Environmental Audit Introduction** Environmental audit Significance for Industry-Elements of Environmental audit. Process of environmental audit-Pre audit-Activity -Activities at site- Post audit.	CO5

Learning Resources

Text Books

1. Agarwal, K.M., Sikdar, P.K. Deb. S.C, A Text Book of Environment, Macmillan India Ltd,2005
2. Sharma, R.D. , Organizational Management, Light and Life Publishers, New Delhi, 1976
3. Varma and Agarwal, Theory & Amp; practice of Management Forward Book Depot, New Delhi

Reference Books

1. Kovntz, H and C. Danvel : Essential of management, 2nd Ed., Tata Mc Graw Hill, 1978
2. Erickson, P.A. Environmental Impact Assessment, Principles and Erickson, 1977

e-Resources

http://nptel.ac.in

Telecommunications

Course Code	**20EC2702A**	**Year**	IV	**Semester**	I
Course Category	Open Elective	**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	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
1	**Telecommunication Systems:** Evolution of Tele Communication Systems, Simple telephone communication, Telephones, Telephone System, Facsimile, Internet Telephony, Tele Communication Standards.	CO1 – CO4
2	**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
3	**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

4	**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers.	CO1 – CO4
5	**Satellite Communication:** Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Navigation Satellite Systems.	CO1 – CO4

Learning Resources

Text Books

1. L. E. Frenzel Jr., Principles of Electronic Communication Systems, 4^{th} Ed., Mc Graw Hill, 2016.
2. Thiagarajan Viswanathan, Telecommunication Switching Systems and Networks, PHI

Reference Books

1. P.Gnanasivam, Telecommunication Switching and Networks, New Age International
2. W. C. Y. Lee, Wireless & Cellular Telecommunications, McGraw-Hill, 3^{rd} Ed., 2006.
3. W. Tomasi, Advanced Electronic Communication Systems, 4^{th} Ed, Pearson Education, 2013.
4. Dennis Roddy, Electronic Communications, 4^{th} Ed, Pearson Education, 2003.

Satellite Communications

Course Code	**20EC2702B**	**Year**	IV	**Semester**	I
Course Category	Open Elective	**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	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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2					1				1				1
CO2		3				1	2	2		2				2
CO3		3				2				2				2
CO4	2					1				2				2
Over All Weights	2	3				1	2	2		2				2

Syllabus

Unit No.	**Contents**	**Mapped CO**
1	**Introduction:** Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications.	CO1
2	**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
3	**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
4	**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

5	**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. T. Pratt, C. Bostian and J. Allnutt, Satellite Communications, WSE, Wiley, 2nd Ed., 2003
2. W.L. Pritchard, R. A Nelson and H. G.Suyderhoud, Satellite Communications Engineering, Pearson, 2nd Ed., 2003.

Reference Books

1. M. Richharia, Satellite Communications : Design Principles - BS Publications, 2nd Ed., 2003
2. D.C Agarwal, Satellite Communication - Khanna Publications, Mc.Graw Hill, 5th Ed., 2008.
3. K.N. Raja Rao, Fundamentals of Satellite Communications –PHI, 2004.
4. Dennis Roddy, Satellite Communications –McGraw Hill, 2nd Ed., 1996

e- Resources

https://nptel.ac.in/courses/117/105/117105131/3.https://nptel.ac.in/courses/108/105/108105159/

Utilization of Electrical Power

CourseCode	20EE2702A	**Year**	IV	**Semester**	I
Course Category	OE-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	**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)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1														
CO2	3					1								
CO3	3						1							
CO4		3				1								
CO5		3					1							
CO6		3				3			3	3				

Syllabus

Unit No.	**Contents**	**Mapped Co**
1	**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 time duty, types of industrial loads, applications of electric drives.	CO1 CO2 CO4 CO6
2	**Electric Heating & Electric Welding** Advantages and methods of electric heating, methods of heat transfer, Stefan's law, design of heating elements, resistance heating,	CO1 CO2

	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.	CO4 CO6
3	**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
4	**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
5	**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 Ed., 2012. 2. E. Openshaw Taylor, Utilization of Electrical Energy, Orient Longman, 15th Ed., 2012.
Reference Books
1. J.B.Gupta, Utilization of Electric Power and Electric Traction, S.K. Kataria & Sons, 10th Ed., 2012. 2. C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Ltd., 2015.
e- Resources
https://nptel.ac.in/courses/108105060

Fundamentals of Artificial Intelligence

Course Code	20IT2702A	**Year**	IV	**Semester**	I
Course Category	Open Elective	**Branch**	IT	**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 Level**
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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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**
1	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
2	Heuristic search technique: Generate and test, Hill climbing, Best First search, Problem reduction, Constraint satisfaction.	CO1, CO2
3	Knowledge Representation issues: Representations and mappings. Representing knowledge using rules: Procedural knowledge Vs Declarative knowledge, Forward Vs Backward reasoning, matching.	CO3
4	Symbolic reasoning under uncertainty: Introduction to Non monotonic reasoning, Implementation in DFS and BFS. Weak, strong slot and filler structures: Semantic nets, Frames,	CO4
5	Planning: Goal stack planning, Hierarchical planning Expert Systems: Expert system shells, Knowledge acquisition.	CO5

Learning Recourses
Text Books
1. E.Richand, Artificial Intelligence, 2nd Ed., K. Knight, TMH
References
1. Patterson, Artificial Intelligence and Expert Systems, PHI 2. J.C.Giarrantana, G.D.Riley, Expert Systems Principles and Programming, 4th Ed., Thomson 3. Ivan Bratka, PROLOG Programming for Artificial Intelligence, 3rd Ed.,Pearson
e-Resources
1. http://www.jntuk-coeerd.in/ 2. http://nptel.ac.in/video.php?subjectId=106105079 3. 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-4	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Basic electrical and electronics
Continuous Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Blooms Level**
Upon successful completion of the course, the student will be able to		
CO1	Explain the concepts related to elements of Mechatronic systems.	L2
CO2	Summarize the construction and working of sensors used in building mechatronicsystems.	L3
CO3	Illustrate various types of actuation systems and their components.	L3
CO4	Develop mathematical models using building blocks and make use of these models to find the dynamic response.	L3
CO5	Summarize the construction and working of closed loop controllers, Microprocessor and Micro controllers.	L3
CO6	Illustrate the features and applications of digital logic, PLC and of Fuzzy logic.	L3

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
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

Syllabus

Unit No.	**Contents**	**Mapped CO**
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 sensors – Proximity and Range sensors, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive	CO1 CO2

	proximity switch. Light sensors – Photodiodes, phototransistors, tactile sensors – PVDF tactile sensor, micro-switch and reed switch, Piezoelectric sensors, vision sensor	
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
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
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. **Microprocessors and Micro Controllers:** Introduction, Architecture of a microprocessor (8085), Architecture of a Micro controller, Difference betweenmicroprocessor and a micro controller.	CO1 CO5
5	**Digital Logic:** Digital logic, number systems, logic gates, Boolean algebra, Karnaugh maps, application of logic gates, sequential logic, transducer Signal Conditioning and devicesfor 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 Resource

Text books

1. W Bolton, Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering, 3rd Ed., Pearson Education, 2005.
2. Devdas shetty, Richard A. kolk, Mechatronics System Design, 5th Indian reprint, 2009, PWS Publishing Company, 2009

Reference books

1. Newton C Braga, Mechatronics Source Book, Thomson Publications, Chennai.
2. N. Shanmugam, Mechatronics, Anuradha Agencies Publishers.
3. C.W.Desilva, Control sensors and actuators, Prentice Hall.
4. Stiffler .A.K, Design with Microprocessors for Mechanical Engineers, McGraw- Hill, 1992

e-Resources

1. https://onlinecourses.nptel.ac.in/noc22_me54/course

Robotics

Course code	20ME2702B	**Year**	IV	**Semester**	I
Course category	Open Elective-4	**Offering 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	**Level**
CO1	Understand the basic anatomy of robots, actuators, end effectors, robot sensors, programming and applications.	L2
CO2	Understand the working principles of robot actuators, end effectors	L2
CO3	Apply robot programming skills	L3
CO4	Apply knowledge of robot sensors and their applications in industries	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	1
CO2	3	3											3	1
CO3	3	3	2		2								3	1
CO4	3		2										3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
1	**Introduction:** Automation and robotics – History of robots -Robot anatomy – classification of robots, major components-robot specifications, selection of robots.	CO1
2	**Robot actuators**- Pneumatic, Hydraulic actuators, electric & stepper motors **End Effectors**- types of end effectors, grippers and tools, Requirements and challenges of end effectors.	CO1, CO2
3	**Robot Programming: -** Robot programming languages - programming methods - off and on-line programming - Lead through method - Teach pendent method, simple programs.	CO1, CO3
4	**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	CO1, CO4
5	**Applications of robots:** Application of robots in industry - material handling, processing operations, assembly, and inspection operations.	CO1, CO4

Learning Resource
Text books:
1. Mikell P. Groover. Industrial Robotics Technology Programming and Applications, McGraw Hill, Singapore, 1995. 2. Richard D.Klafter, Robotic Engineering, Prentice Hall
Reference books
1. Saeed B.Niku, Introduction to Robotics, Prentice Hall 2. John J. Craig, Introduction to Robotics, Addison Wesley
e-Resources
1. http://nptel.ac.in/downloads/112101098/

Managerial Economics and Financial Analysis

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		**BL**
CO1	Understand basics of managerial economics, demand forecasting, cost analysis, industrial organization, financial accounting and capital and capital budgeting.	L2
CO2	Apply the managerial economics, e-commerce, demand forecasting and cost analysis techniques in economics related problems.	L3
CO3	Summarize different types of industrial organization	L3
CO4	Analyze the financial accounting and depreciation related problems.	L4

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

CO	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 No	**Contents**	**Mapped CO**
1	**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
2	**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 of Inputs, Cobb-Douglas Production function-Economies of Scale **Cost Analysis**: Cost concepts, Determination of Break Even Point	CO1 CO2

	(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.	
3	**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
4	**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
5	**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. R. Panneerselvam, Engineering economics, 2^{nd} Ed., PHI Learning Pvt. Ltd., 2013 .
2. J.V.Prabhakar Rao, Managerial Economics and Financial Analysis, Maruthi Publications, 2011.

Reference Books

1. A R Aryasri, Managerial Economics and Financial Analysis, TMH, 2011.
2. S.N Maheswari, S .K Maheswari Financial Accounting, Vikas Publishing House Pvt Ltd., NewDelhi, 4^{th} Ed.,2006.
3. Suma Damodaran, Managerial Economics, Oxford, 2011.
4. S.A. Siddiqui & A.S. Siddiqui, Engineering economy- Theusen & Theusen, 8^{th} Ed.,1993, Prentice Hall.

e-Resources

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 Elective	**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		**Level**
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts, techniques and applications of Human Resource Management.	L2
CO2	Describe job design, job Analysis, job evaluation and different levels of recruitment	L2
CO3	Illustrate different Training and development of human resources	L3
CO4	Summarize e-Human Resource Management and Human resource for small scale industries	L3

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	1		2			3					3	1	1	3
CO 2	1		2			3					3	1	1	3
CO 3	1		2			3					3	1	1	3
CO 4	1		2			3					3	1	1	3

Syllabus

Unit No.	Content	Mapped CO
1	**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
2	**Analysis of Work, Designing Jobs and Job Evaluation:** Nature of Job analysis, Job Analysis and Competitive Advantage, The Process	CO1, CO2

	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 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.	
3	**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
4	**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
5	**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. K. Aswathappa, Human Resource Management, Text & Cases
Reference books
1. S. Khandkar, Human Resource Management, S. Chand Publications 2. C. B. Mamoria& V. S. P. Rao, Personnel Management - Text & Cases, Himalaya 3. Gary Dessler, Human Resource Management, Pearson Education
e-resources
https://nptel.ac.in/courses/110105069

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		**BL**
CO1	Understand the basic concepts and factors for starting and successful running of different forms of an enterprise.	L2
CO2	Describe characteristics, values and attitudes of an entrepreneur.	L2
CO3	Illustrate different forms of Entrepreneurial structures and Intrapreneurship.	L3
CO4	Summarize critical Factors for starting a new enterprise and ethics to be followed during running of enterprise.	L3

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 No	**Content**	**Mapped CO**
1	**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
2	**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
3	**Forms of Entrepreneurial structures**: Sole Proprietorship-meaning, merits and limitations, Partnership-Meaning, Forms, merits and limitations.	CO1, CO3

	Corporations-Meaning, merits and limitations, Limited Liability partnerships and corporations, Franchising-Meaning, types, merits and limitations.	
4	**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
5	**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. Moharanas and Dash C.R, Entrepreneurship development, RBSA Publishing, Jaipur 2. Collins and Lazier.W, Beyond entrepreneurship, Prentice Hall, New Jersey, 1992 3. Hisrich Peters Sphephard, Entrepreneurship, Tata McGraw Hill **4.** S.K. Mohanty, Fundamentals of entrepreneurship, Prentice Hall of India
Reference Books
1. Dr. Vasant Desai, Small scale industries and entrepreneurship, Himalayan Publishing House. 2. Dr. Vasant Desai, Management of small scale industries, Himalayan Publishing House. 3. J.C. Saboo Megha Biyani, Management of small scale industries, Himalayan Publishing House. 4. David Oates, A Guide to Entrepreneurship, Jaico Publishing House, Mumbai,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 Elective	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	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 in understanding 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 (H:High(3), M: Medium(2), L:Low(1))

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	-	-	-	-	-	-	-	3	3	-	2	-	-	3
CO 2	-	-	-	-	-	-	-	3	3	-	2	-	-	3
CO 3	-	-	-	-	-	-	-	3	3	-	2	-	-	3
CO 4	-	-	-	-	-	-	-	3	3	-	2	-	-	3
CO 5	-	-	-	-	-	-	-	3	3	-	2	-	-	3

Syllabus

Unit No.	Content	Mapped CO
1	**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
2	**Foundations of Individual Behaviour: Perception:** Definition of Perception-Factors of Perception- The Perception Process-	CO2

	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.	
3	**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
4	**Formation of Teams and Group Dynamics: Formation of Teams-** Definition of 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
5	**Organizational Change and Culture: Organizational Change-** Definition- Change Models- Organizational resistance to change Management of Change Process- Organizational Culture- Definition-Objectives-Distinction between Organizational Culture and Organisational Climate	CO5

Learning Resource
Text books:
1. Fred Luthans, Organizational Behaviour, McGraw Hill, 11th Ed., 2001. 2. Stephen P. Robins, Organisational Behaviour, PHI Learning / Pearson Education, 11th Ed., 2008.
Reference books
1. Hellrigal, Slocum and Woodman, Organizational Behaviour, Cengage Learning, 11th Ed., 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 Tata McGraw Hill, 2008. 6. Hitt, Michael .A. Organizational Behaviour- A Strategic Approach, Wiley, India, 2008.

Industrial Engineering & Management

Course Code	20HS7701F	**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		**Blooms Level**
CO1	Understand the basic concepts of management, organizational structures, leadership, operations management and project management.	L2
CO2	Explain the leadership qualities and concept of plant layout.	L2
CO3	Apply different quality control techniques.	L3
CO4	Illustrate various operations management Techniques	L3
CO5	Solve operations management and project management problems	L3

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	1					3		2			3		2	3
CO 2	1					3		2			3		2	3
CO 3	1					3		2			3		2	3
CO 4	1					3		2			3		2	3
CO 5	1					3		2			3		2	3

Syllabus

Unit No.	**Contents**	**Mapped CO**
1	**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. **Organizational Structures**: Basic concepts related to Organization – Depart mentation and Decentralization, Flat and Tall	CO1

	organizations, Organizational chart, Line organization, Line and staff organization, functional organization	
2	**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, comparison of rural and urban sites. Plant Layout – definition, objectives, types of production, types of plant layout – various data analyzing forms-travel chart.	CO1, CO2
3	**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
4	**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
5	**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, Dhanpat Rai
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 Ed., 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

e-Resources

https://nptel.ac.in/courses/112107292

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		**BL**
CO1	Understand the concepts of project management.	L2
CO2	Explain procedure for analyzing the project risk, market risk and firm risk.	L2
CO3	Apply social-cost benefit analysis on a project.	L3
CO4	Analyze a project by applying various network techniques for planning, scheduling and controlling of different activities of a project.	L4
CO5	Analyze various aspects to be considered for technical and financial analysis of the Project and the Environmental appraisal	L4

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	2	1							2		3	2	2	1
CO 2	2	1							2		3	2	2	1
CO 3	2	1							2		3	2	2	1
CO 4	2	1							2		3	2	2	1
CO 5	2	1							2		3	2	2	1

Syllabus

Unit No.	Contents	Mapped CO
1	**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

2	**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
3	**Cost-Benefit Analysis:** Introduction, need for social cost benefit analysis, Procedure of social cost benefit analysis, Main feature of social cost benefit analysis, **Cost-Benefit Analysis Approaches:** UNIDO approach, Little-Mirrless approach, SCBA in India, Public investment decision making in India, Limitation of SCBA.	CO1 CO3
4	**Network Techniques for Project Management:** 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
5	**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, 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, 1995. 3. L.S. Srinath, PERT & CPM Principles & Applications, 3rd Ed., East west Press,2001.
e- Resources
1. https://nptel.ac.in/courses/105/106/105106149/
2. https://nptel.ac.in/courses/110/104/110104073/

Verilog HDL

Course Code	20SA8754	**Year**	IV	**Semester**	I
Course Category	Skill advanced course	**Branch**	ECE	**Course Type**	Lab
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Digital Circuits
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 the basics of Hardware Description Languages, Program structure and basic language elements of Verilog (L2)
CO2	Analyze various Verilog descriptions for Combinational circuits (L4)
CO3	Simulate arithmetic logic circuits using Verilog (L3)
CO4	Model various Verilog descriptions for Sequential circuits.(L3)
CO5	Make 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	1				1								1	
CO2		2			2				2				2	
CO3	1				1				2				1	
CO4	3				3				2				3	
CO5										2				
Average* (Rounded to nearest integer)	2	2			2				2	2			2	

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
Simulate the internal structure of the following Circuits using VERILOG		
1	Verilog Description for all two input basic gates.	CO1
2	Verilog Description for three/four input Logical operations(two experiments)	CO2
3	Verilog Description for Arithmetic operations(Three experiments)	CO3
4	Verilog Description for multiplexers using dataflow/behavioural method (two experiments)	CO2
5	Verilog Description for flip-flops	CO4
6	Verilog Description for ripple counters(two experiments)	CO4

7	Verilog Description for synchronous counters(two experiments)	CO4

❖ **Minimum 10 experiments to be conducted covering all the topics**

Learning Resources
Text Books
1. Samir Palnitkar, Verilog HDL, Pearson Education 2. J. Bhasker, Verilog HDL Synthesis: A Practical Primer, BS publishers
References
1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog, TMH
e-Resources
https://nptel.ac.in/courses/106/105/106105165

Low Power VLSI Design

Course Code	20EC6701	**Year**	IV	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**Course Type**	Theory
Credits	4	**L-T-P**	3-1-0	**Prerequisites**	Digital 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 concepts of low power VLSI(L2)
CO2	Apply different circuit techniques to manage the leakage currents(L3)
CO3	Apply the knowledge of architectural approaches. (L3)
CO4	Analyze and Design Low-Voltage Low-Power combinational circuits. (L4)
CO5	Analyze the functionality of Low- voltage low -power memories(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					2			2	
CO2	2		2		2					2			2	
CO3	2				2					2			2	
CO4		3			3					3			3	
CO5		2			2					2			2	
Average* (Rounded to nearest integer	2	3	2		2					2			2	

S.No.	Syllabus	Mapped COS
1	**Low power CMOS VLSI design :** Introduction, sources of power dissipation, static power dissipation, active power dissipation. **Circuit techniques for low power design**: Introduction, designing for low power, circuit techniques for leakage power reduction	CO1,CO2
2	**Low-Power Design Approaches:** Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach-Pipelining and Parallel Processing Approaches	CO1,CO3

3	**Low voltage low power adders**: Introduction, standard adder cells, CMOS adder's architectures, low voltage low power design techniques, current mode adders.	CO1,CO4
4	**Low voltage low power multipliers**: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier.	CO1,CO4
5	**Low-Voltage Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.	CO1,CO5

Learning Resources

Text Book

1. Kiat Seng Yeo, Kaushik Roy, Low Voltage, Low Power VLSI Subsystems, TMH,2012
2. Sung-Mo Kang, Y.Leblebici, CMOS Digital Integrated Circuits – Analysis and Design, TMH, 2011.

References

1. Yeo Rofail, Gohl, CMOS/BiCMOS ULSI Low Voltage, Low Power, Pearson Education Asia 1st Indian reprint, 2009
2. A.P. Chandrakasan, Robert W. Brodersen, Low Power Digital CMOS Design, Springer Science
3. Jan M. Rabaey, Anantha P. Chandrakasan, BorivojeNikolic, Digital Integrated Circuits: a Design Perspective, Pearson Education, 2nd Ed., 2009

e-Resources

1. 1.https://www.nptelvideos.com/course.php?id=422
2. 2.http://leda.elfak.ni.ac.rs/education/projektovanjeVLSI/predavanja/10%20 Low%20Power%20Design%20in%20VLSI.pdf
3. 3.https://www.egr.msu.edu/classes/ece410/salem/files/s16/lectures/Ch2_S2 _N.pdf

Software Defined Radio

Course Code	20EC6702	**Year**	IV	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**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	
After successful completion of the course, the student will be able to	
CO1	Understand the principles of Software Defined Radio.(L2)
CO2	Choose appropriate digital signals for RF signal processing/ implementation. (L3)
CO3	Apply Digital Signal Synthesis for Generation and Implementation.(L3)
CO4	Analyse RF Signals and digital systems. (L4)

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

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2									2				
CO2	3				3					3			3	
CO3	2				2					2			2	2
CO4		3			3					3			3	3
Average * (Rounded to nearest integer	2	3								3			3	3

Syllabus		
Unit No.	**Contents**	**Mapped COs**
1	**Introduction to Software Radio** The Need for Software Radios, What Is a Software Radio, Characteristics and Benefits of a Software Radio, Design Principles of a Software Radio.	CO1,CO2
2	**Radio Frequency Implementation Issues:** The Purpose of the RF Front-End, Dynamic Range: The Principal Challenge of Receiver Design, RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Importance of the Components to Overall Performance, Transmitter Architectures and Their Issues.	CO1,CO2, CO4

3	**Multirate Signal Processing** Introduction, Sample Rate Conversion Principles, Polyphase Filters, Digital Filter Banks, Timing Recovery in Digital Receivers Using Multirate Digital Filters.	CO1,CO2, CO4
4	**Digital Generation of Signals** Introduction, Comparison of Direct Digital Synthesis with Analog Signal Synthesis, Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Bandpass Signal Generation	CO1,CO3, CO4
5	**Digital Hardware Choices:** Introduction, Key Hardware Elements, DSP Processors.	CO1,CO3 CO4

Learning Recourses
Text Books
1. Jeffrey H.Reed, Software Radio: A Modern Approach to Radio Engineering, Reprint by Pearson Education & Inc., 2002 2. Joseph Mitola, III, Software Radio Architecture: Object Oriented Approaches to Wireless Systems Engineering, John Wiley and Sons, 2000
Reference Books
1. Markus Dillinger, K.Madani and N. Alonistioti, Soft Defined Radio, 1st Ed., Wiley
e-Resources
1. https://nptel.ac.in/courses/108107107 2. https://archive.nptel.ac.in/courses/108/107/108107107/

EMI /EMC

Course Code	20EC6703	**Year**	IV	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**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	Familiarize with the fundamentals in the field of EMI / EMC (L2).
CO2	Analyze various EMI sources and measurements(L4)
CO3	Apply various techniques for EM radiation measurements (L3)
CO4	Apply various Conducted Interference measurement for EM radiation (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2						2			2		2		2
CO2		3					3			3		3		3
CO3	3						3			3				2
CO4	2						2			2				
Average * (Rounded to nearest integer)	**2**	**3**					**3**			**3**		**3**		**2**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Introduction**: History and concept of EMI, Definitions of EMI/EMC, Electromagnetic environment, Practical experiences and concerns, frequency spectrum conservation, mechanisms of EMI generation, EMI testing, Methods of elimination of EMI and Biological effects of EMI	CO1, CO2
2	**Natural and manmade sources of EMI/EMC**: Sources of Electromagnetic noise, typical noise paths, modes of noise coupling, designing for EM compatibility, lightening discharge, electro static discharge (ESD), electromagnetic pulse (EMP).	CO1, CO2

3	**EMI from Apparatus / Circuits and open area test sides:** Electromagnetic emissions, noise form relays and switches, non-linearities in circuits, passive inter modulation, transients in power supply lines, EMI from power electronic equipment, EMI as combination of radiation and conduction. Open area test sides: OATS measurements, measurement precautions.	CO1,CO3
4	**Radiated Interference Measurements:** anechoic chamber, TEM cell, reverberating chamber, GTEM cell, comparison of test facilities.	CO1,CO3
5	**Conducted Interference Measurement**: Characterization of conduction currents / voltages, conducted EM noise and power line, conducted EMI from equipment, immunity to conducted EMI, characteristics of EMI filters and power line filter design.	CO1,CO3, CO4

Learning Resources
Text Books
1.V.P.Kodali, Engineering Electromagnetic Compatibility, 2nd Ed., IEEE Press, 2000 2. Clayton R Paul, Introduction to Electromagnetic Compatibility, John Wiley Sons, 2010
Reference Books
1. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi
e- Resources
1. https://en.wikipedia.org/wiki/Electromagneticcompatibility 2. https://www.element.com/nucleus/2017/whats-the-difference-emc-vs-emi

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Introduction to Robotics

Course Code	20EC6704	**Year**	IV	**Semester**	I
Course Category	**Honors**	**Branch**	ECE	**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	Summarize the history of robotics, technological advances and types of End Effectors (L2)
CO2	Utilize the knowledge gained on different robotic drive systems, actuators and their control (L3)
CO3	Make use of the Sensors based on different applications (L3)
CO4	Predict the future applications of robotics (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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2												1	
CO2	2					2							1	
CO3	2					2			2				2	
CO4	3								3				2	1
Average* (Rounded to nearest integer)	**2**								**3**				**2**	1

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	**Fundamentals of Robotics:** Introduction, History of robotics, Robot anatomy, work volume, robot drive systems, control systems and dynamic performance, precision of movement, end effectors, robotic sensors, applications	CO1, CO2
2	**Control systems & Components:** control systems concepts, models, control system analysis, activation and feedback components, position sensors, velocity sensors power transmission systems, joint control design	CO2, CO3
3	**End effectors:** Types of end effectors, mechanical grippers, tools as end effectors, end effector interface, considerations in gripper selection and design,	CO2, CO4

4	**Sensors:** Transducers & sensors, tactile sensors, proximity and range sensors, use of sensors in robotics	CO1, CO3
5	**Robot Programming:** Robot language structure, methods of robot programming, motion interpolation, WAIT, SIGNAL and Delay Commands, limitations of lead through methods	CO3, CO4

Learning Resources
Text Books
1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel & Nicholas G. Odrey, Industrial Robotics Technology, Programming & Applications, Tata McGraw Hill, 2008. 2. Mittal R K & Nagrath I J, Robotics and Control, TMH
Reference Books
1. John J. Craig, Addison Wesley, Introduction to Robotics, Pearson 2. K. S. Fu, Gonzalez & Hee, Robotics, McGraw Hill 3. Saeed B.Niku, Introduction to Robotics, Prentice Hall
e- Resources
1. http://nptel.ac.in/downloads/112101098/ 2. https://nptel.ac.in/courses/107/106/107106090/

Communication Systems

Course Code	20EC5701	**Year**	IV	**Semester**	I
Course Category	**Minor**	**Branch**	ECE	**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).

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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2									2		2		
CO2		3								3				
CO3		3								3				
CO4	2									2				2
Average* (Rounded to nearest integer)	2	3								3		2		2

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	Block diagram of communication system, Need for modulation. **Amplitude Modulation:** Time domain and frequency domain description of AM, single tone modulation, Generation of AM waves: square law Modulator, Switching modulator. **Demodulation of AM waves**: Square law detector, Envelope detector. DSBSC, SSBSC and VSBSC Modulations.	CO1,CO3
2	**Angle Modulation:** Basic concepts of Phase and Frequency Modulation, Single tone frequency modulation, Narrow band FM, Wide band FM.	CO1,CO3

	Generation of FM waves: Indirect FM, Direct FM. Foster-Seeley Discriminator, Zero crossing detectors.	
3	**Pulse Modulation:** Generation & Demodulation of Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Position Modulations. **Waveform Coding Techniques:** Introduction, Pulse code modulation (PCM), Delta modulation, Adaptive delta modulation, Differential Pulse Code Modulation (DPCM).	CO1,CO2
4	**Digital Modulation Techniques:** Coherent Phase Shift Keying, Coherent Frequency Shift Keying, Quadrature Phase Shift Keying, Non Coherent Frequency Shift Keying, Differential Phase Shift keying. **Multiplexing:** Time Division Multiplexing and Frequency Division Multiplexing.	CO1, CO3
5	**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, 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
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**	I
Course Category	**Minor**	**Branch**	ECE	**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 architectural models (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 communication protocols 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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
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
Avg.	2	2								2			2	2

Syllabus

Unit No.	Contents	Mapped CO
1	**Introduction** M2M and IoT, Layered Architectures, System Components, Applications	CO1,CO2
2	**Concepts of IOT Networking** IOT Networking, Types of Networks, Devices-Actuators and Controllers, Gateways; Security, Wireless Sensor Networks.	CO1,CO2
3	**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
4	**Network and Transport Layers** Need for IP IPv6, 6Low PAN: Addresses, Header Format,	CO1,CO4

	Routing and Forwarding, Header Compression, Fragmentation, Security Considerations, TCP and 6Low PAN	
5	**Application Layer** Architectures, Request/Response: REST Architecture, HTTP, XMPP, CoAP Publish/Subscribe: MQTT,AMQP	CO1,CO5

Learning Resources

Text Books

1. R. Herrero, Fundamentals of IoT Communication Technologies, Springer, 1st Ed., 2022
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry-IoT Fundamentals: Networking Technologies, Protocols and Use cases for the Internet of 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

1. https://nptel.ac.in/courses/106/105/106105166/

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. Women's' 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.