# Shivaji University

# Kolhapur

Revised Syllabus

## T. Y. B. Tech.

## Electronics and Computer Science

## To be implemented from

## Academic Year 2026-27

**SHIVAJI UNIVERSITY, KOLHAPUR**

**NAME OF FACULTY:** SCIENCE AND TECHNOLOGY

**PROGRAMME NAME AND CODE:** ELECTRONICS AND COMPUTER SCIENCE

**PART:** THREE

# Preamble

The Third Year B. Tech. Mechanical Engineering Curriculum of Shivaji University is designed to equip students with strong theoretical knowledge, practical skills, and emerging technological competencies required in modern industries and research environments. The syllabus emphasizes the integration of core Mechanical Engineering principles with advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), Computational Fluid Dynamics (CFD), Additive Manufacturing, and Smart maintenance systems to meet the demands of Industry 4.0.

The curriculum provides a balanced blend of design, manufacturing, thermal sciences, fluid mechanics, quality engineering, maintenance engineering, and system analysis. Courses such as Design of Machine Elements, Fluid Mechanics and Machinery, Metrology and Quality Control, Mechanical System Design, and Industrial Fluid Power strengthen the students' analytical and problem-solving abilities while developing a solid engineering foundation. The laboratory courses and project work encourage experiential learning, hands-on practice, innovation, teamwork, and industry-oriented skill development.

Special emphasis has been given to multidisciplinary learning and emerging domains through programme electives and minor courses including Computational Fluid Dynamics, Failure Analysis, Additive Manufacturing, Total Productive Maintenance, and Heat Power Engineering. These subjects prepare students to address real-world engineering challenges related to sustainability, automation, product reliability, smart manufacturing, energy efficiency, and predictive maintenance.

The inclusion of AI and ML applications across various subjects reflects the evolving needs of modern engineering industries. Students are introduced to data-driven approaches, intelligent monitoring systems, optimization techniques, and predictive analysis tools that enhance engineering decision-making and operational efficiency.

The curriculum also focuses on Outcome-Based Education (OBE), promoting critical thinking, creativity, communication skills, ethical values, and lifelong learning. Through laboratory work, industrial visits, assignments, mini-projects, students gain exposure to industrial practices and develop professional competencies required for higher studies, entrepreneurship, research, and employment in diverse sectors.

Overall, this syllabus aims to develop competent, innovative, and socially responsible mechanical engineers capable of contributing effectively to technological advancement, industrial growth, and sustainable development at national and global levels.

# Program Learning Outcomes (PLOs) / Program Outcomes (POs)

- **PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- **PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- **PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- **PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis and interpretation of data to provide valid conclusions. (WK8).
- **PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- **PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national and international laws. (WK9)
- **PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- **PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- **PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- **PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

# Program Educational Objectives (PEOs)

1. **Professional Competence and Career Growth**
   Graduates will apply fundamental knowledge of mechanical engineering to solve real-world engineering problems and establish successful careers through professional employment, higher education, research, or entrepreneurship in core and allied fields.

2. **Lifelong Learning and Technological Adaptability**
   Graduates will engage in continuous learning and adapt to emerging technologies such as automation, artificial intelligence, and advanced manufacturing to meet evolving industrial and societal needs.

3. **Ethics, Leadership, and Social Responsibility**
   Graduates will demonstrate ethical practices, environmental awareness, leadership qualities, teamwork, and effective communication skills while contributing to sustainable development in multidisciplinary environments.

**Eligibility for Admission-**

**Eligibility for F.Y. B.Tech.**

(First Year - Engineering or Technology ( 4 years duration ))

(1) Maharashtra State Candidature Candidate.-

The candidate,-

(i) should be a citizen of India;

(ii) (ii) should have Passed 10+2 examination or its equivalent examination with Physics and Mathematics as compulsory subjects along with Chemistry or Biotechnology or Biology or Technical Vocational subject or Computer Science or Information Technology or Informatics Practices or Agriculture or Engineering Graphics or Business Studies or Electronics or Entrepreneurship and obtained at least forty five per cent marks (at least forty per cent marks, in case of Reserved categories, Economically Weaker Section and Persons with Disability candidates belonging to the Maharashtra State only) in the above subjects taken together and The Candidate should have appeared in all the subjects in PCM MHT-CET 2026 and obtained non zero score in PCM MHT-CET 2026 conducted by the Competent Authority; (There candidates are eligible to apply for all 29 major disciplines declared by AICTE)

Or

(iii) Should have passed 10+2 examination or its equivalent examination with Physics and Chemistry as compulsory subjects along with the Mathematics or Biotechnology or Biology or Technical Vocational subject or Computer Science or Information Technology or Informatics Practices or Agriculture or Engineering Graphics or Business Studies or Electronics or Entrepreneurship as one of the subject and obtained at least forty five per cent marks (at least forty per cent marks, in case of Reserved categories, Economically Weaker Section and Persons with Disability candidates belonging to the Maharashtra State only) in the above subjects taken together and the candidate should have appeared in all the subjects in MHT-CET 2025 and obtained non zero score in Physics, Chemistry and Biology (PCB) MHT-CET 2025 conducted by the Competent Authority is eligible for admission to any of the following Courses under major disciplines declared by concerned Appropriate Authority or All India Council for Technical Education (AICTE), namely:- (a)Agriculture Engineering;
(b)Biotechnology; (c)Food Engineering; (d)Leather Technology; (e)Packaging Technology; (f) Pharmaceutical Engineering; (g)Printing Engineering; (h)Fashion Technology; or (i) Textile Chemistry;

Or

(iv) Should have passed minimum three years Diploma in Engineering and Technology and obtained at least forty five per cent marks (at least forty per cent marks, in case of Reserved categories, Economically Weaker Section and Persons with Disability candidates belonging to the Maharashtra State only) ;

Or

(v) Passed three years Diploma of Vocation (D. Voc.) stream in the same or allied sector;

**Eligibility for Direct Second Year B.Tech.**

**(Direct Second Year (Lateral Entry)- Engineering /Technology (3 Years duration)**

The candidate,-
should be a citizen of India;
should have passed minimum three years or two years (Lateral Entry) Diploma Course in Engineering and Technology with at least forty five per cent. marks ( at least forty per cent. marks in case of Candidates of Reserved categories, Economically Weaker Section and Persons with Disability category belonging to Maharashtra State) in any branch of Engineering and Technology from an All India Council for Technical Education (AICTE) or Central Government or State Government approved Institution or its equivalent;

Or

should have passed B.Sc. Degree from a University Grants Commission (UGC) or Association of Indian Universities recognized University with at least forty five per cent. marks ( at least forty per cent. marks in case of candidates of Reserved categories, Economically Weaker Section and Persons with Disability category belonging to Maharashtra State) and passed HSC or its equivalent examination with Mathematics as a subject;

Or

should have passed three years D. Voc. Stream in the same or allied sector;
and Any other eligibility criteria and requirement declared from time to time by the appropriate authority as defined under the Act.

**STANDARD OF PASSING AND DETERMINATION OF SGPA/CGPA, GRADING AND DECLARATION OF RESULTS**

**Passing criteria:**

1. Passing with 40% marks is mandatory in ESE theory. The duration of ESE theory examination will be 02:30 Hrs. For Engineering Graphics subject of F. Y. B. Tech, it will be of 03:00 Hrs. Combined passing marks (MSE+ISE/CA+ESE) for theory course are 40%.
2. MSE will be based on 50% syllabus from beginning (First Three Units).
3. No compulsory passing for MSE.
4. Compulsory passing percentage for ISE/CA of theory and practical is 40%.
5. Compulsory passing percentage for ESE practical / oral examination 40%.
6. Student should clear all first year passing heads before admits to third year and clear all second year passing heads before admits to fourth year.
7. Aggregate of a particular year (both the semesters) shall considered as a separate head of passing for the result of that concerned year and 45 % aggregate score is mandatory. The student not fulfilling this criterion can improve the score of 45% aggregate through appearing in re-examination for maximum of three theory courses.
8. If student fails to improve the score of 45% aggregate through appearing in re-examination then he/she can improve the score of 45% aggregate by re-appearing in subsequent concern odd semesters (3, 5, 7) or concern even semesters (4, 6, 8) ESE of theory course examination in next academic year.

The Semester Grade Point Average (SGPA) shall be calculated for each semester and Cumulative Grade Point Average (CGPA) shall be calculated at the end of all semesters.
The standard of passing shall be in accordance with the following table:

| Marks Obtained | Numerical Grade (Grade Point) | | CGPA | Letter Grade |
|---|---|---|---|---|
| Absent | 0 (zero) | | - | - |
| 0 – 39 | 0 (zero) | | 0.0 – 4.99 | F (Fail) |
| 40 – 49 | 5 | | 5.00 – 5.49 | C |
| 50 – 59 | 6 | | 5.50 – 6.49 | B |
| 60 – 69 | 7 | | 6.50 – 7.49 | B+ |
| 70 – 79 | 8 | | 7.50 – 8.49 | A |
| 80 – 89 | 9 | | 8.50 – 9.49 | A+ |
| 90 – 100 | 10 | | 9.50 – 10.0 | O (Outstanding) |

## Note :

The award of the final Grade for the degree of B. Tech. shall be calculated based on CGPA.

## Calculation of SGPA and CGPA:

1. Semester Grade Point Average **(SGPA)**

$$\textbf{SGPA} = \frac{\sum(\text{Course credits} \times \text{Grade points obtained}) \text{ of a Semester}}{\sum(\text{Course credits}) \text{ of respective Semester}}$$

2. Cumulative Grade Point Average **(CGPA)**

$$\textbf{CGPA} = \frac{\sum(\text{Total credits of a Semester} \times \text{SGPA of respective Semester}) \text{ of all Semesters}}{\sum(\text{Total course credits}) \text{ of all Semesters}}$$

1. Marks obtained > = 0.5 shall be rounded off to next higher digit.
2. The SGPA & CGPA shall be rounded off to 2 decimal points.
3. CGPA will be calculated cumulatively from Sem. I to Sem. VIII for regular students and from Sem. III to Sem. VIII for lateral entry students.

**Note:** An equivalent certificate of CGPA to percentage of marks will be provided to student on candidate's demand after remitting prescribed fees by Shivaji University.

## Awards of Grades for Re-Examination:

1. There will be Re-examination for all failure ESE theory/practical courses in a year after even semester immediately the result declaration of ESE and before the commencement of next academic year.
2. A student will apply for re-examination before the last date of such application and will appear for re-examination.
3. In such cases In Semester Examination performance of a student will not be wiped out.
4. The weightage similar to ESE will be given to re-examination.
5. A student who is eligible for re-examination but remains absent for re-examination will be given grade 'Absent'.
6. If the student fails in an odd semesters (1, 3, 5, 7) and/or even semesters (2, 4, 6, 8) in ESE of theory/practical credit course in an academic year shall be allowed to appear for re-examination.
7. There will be ESE examination of theory and practical courses of semester 1, 3, 5 and 7 at the end of odd semester, there will be ESE examination of theory and practical courses of semester 2, 4, 6 and 8 at the end of even semester and there will be re-examination for all ESE theory and practical courses from semester 1 to semester 8 after one month of

declaration of result of even semester.

8. If the student fails to clear the ESE of theory/practical course even in re-examination conducted after even semesters (2, 4, 6, 8) in a year, he/she shall have to re-appear in subsequent concern odd semesters (3, 5, 7) or concern even semesters (4, 6, 8) ESE of theory/practical credit course examination in next academic year for the failed ESE of theory/practical credit course examination of concern odd semester or concern even semester that she/he has failed in previous academic year.
9. The candidate can apply for revaluation of photocopy of re-examination for ESE of theory/practical course conducted after even semesters (2, 4, 6, 8).
10. A student will be awarded a grade given in Table of **R. R. B. Tech. 9** depending upon the cumulative marks obtained by him/her in Re-examination.

# Shivaji University, Kolhapur

T. Y. B. Tech. (NEP 2.0 Pattern)

**Question Paper Pattern**

ESE-End Semester Examination

**25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.

- **Instructions for Paper Setter**

Que.1: MCQ's based on All Units (Carries 12 Marks).

Que.2: Solve any Two [based on Unit 1, 2, 3] (6*2 = 12 Marks).
a)
b)
c)

Que.3: Solve any Two [based on Unit 4, 5, 6] (6*2 = 12 Marks).
a)
b)
c)

Que.4: Solve any Two [based on Unit 4, 5, 6] (6*2 = 12 Marks).
a)
b)
c)

Que.5: Solve any Two [based on Unit 4, 5, 6] (6*2 = 12 Marks).
a)
b)
c)

# Second Year Exit: Teaching Methodology, Assessment and Evaluation

**[I] As per R. R. B. Tech. 12.2 Rule: Award of Degree**

If a student passes all the courses of first year, second year and earns the requisite number of credits, the student will become entitled to Undergraduate Diploma (Two years or four semesters) in the programme of his/her major subject. If he/she wants to exit, can exit the programme with UG Diploma certificate. However, for the award of two years UG Diploma Certificate in Major with 88 credits, an additional 8 credits from Exit Courses are required to earn.

**[II] Second Year Exit Course:**

**Methodology 1:**

1. The students should complete two online certification courses (NPTEL) related to their programme, each of 3 credits. In addition to this, they will also need to complete 2 credits worth of two Virtual Lab work related to online certification courses. These additional 8 credits earn by students shall be based upon skill based vocational courses or internship/Apprenticeship.

2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study or programme. The skill based vocational courses shall be analogous to the Baskets/Areas provided by the concerned BoS.

3. The student must complete two virtual lab work that adds 2 credits to simulate practical or experimental learning experiences in a controlled virtual environment.

4. **Examination scheme:** The marks gained from the two NPTEL Courses (3 credits each) are converted to a total of 100 marks. The report for the two Virtual Lab work of 2 credits will be

evaluated for 25 marks. The report should include a detailed write-up and analysis of the virtual lab experiments conducted, encompassing the methodology, results, and conclusions.

5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and follow the instructions to compete the course. Similarly, for Virual Lab, the students are required to visit to website https://www.vlab.co.in and create their account. Log in the account and join the required lab and follow the instructions to compete the course (need to perform all listed experiments under that Lab). To fulfill the requirement of 06 credits, students can go for two courses each of 12 weeks.

**Methodology 2:**

1. The students should complete two online certification courses (NPTEL) related to their programme, each carrying 2 credits. In addition to this, they will also need to complete 4 credits worth of two physical internship/Apprenticeship (each of 40 hrs) work from relevant industry. These additional 8 credits earned by the students shall be based upon skill based vocational courses or internship/Apprenticeship.

2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study/programme. The skill-based vocational courses shall be analogous with the list provided by the concerned BoS.

3. The student should complete two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices that adds 4 credits to simulate practical or experimental learning experiences in a controlled virtual environment.

4. **Examination scheme:** The marks gained from the two NPTEL Courses (2 credits each) are converted to a total of 100 marks. The report for the performed two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices of 4 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of two

physical internship/Apprenticeship (each of 40 hrs) work along with certificate of internship/Apprenticeship from relevant industrial practices conducted, encompassing the methodology, results, and conclusions.

5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and follow the instructions to compete the course.

## Guidelines for Open Elective Courses: Teaching Methodology, Assessment and Evaluation

Open Elective (OE) courses other than faculty of Science and Technology through Massive Open Online Courses (MOOCs) allowing students to engage with a broad spectrum of ideas and knowledge areas. The OE courses are likely to be available online and can be completed at the student's own pace within a set timeframe. For OE course, students are required to visit to the website https://swayam.gov.in for registration and create an account. Afterward, students should Login the account and join the course assigned by the course coordinator and follow the instructions to compete the course through self-learning mode. Additionally, the respective institution should download the relevant study materials to ensure students have access to them as needed. Minimum 25 students can register for one OE course in the concerned institute. There will be one course coordinator for one OE course. Students need to cover OE Courses of 08 credits. These 08 credits over semesters III to V. OE courses are chosen from faculty other than Faculty of Science and Technology. It is offered in Second and Third year as per Semester wise credit distribution table. Students need to take up the courses of 08 credits over semesters III to V.

1. **For Semester-III,** OE theory course of 3 credits consists of Mid Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.
2. **For Semester-III,** OE practical lab course of 1 credit consists of In Semester Evaluation/Continuous Assessment (ISE/CA) of 25 Marks and End Semester Examination-Practical Oral Examination (ESE-POE) of 25 Marks. Course Coordinator assigned by Institute should complete the selected course practical through expert of that course. The lab exercises and demonstrations prepared by concern expert must be aligned with the specific OE course that the students have chosen.
3. **For Semester-IV,** OE theory course of 2 credits consists of Mid

Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.

4. **For Semester-V,** OE theory course of 2 credits consists of Mid Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.
5. The Mid Semester Examination (MSE) of 30 Marks based on selected OE Course will be conducted by Concerned Departmental Course Coordinator. The course expert of concerned faculty should set question paper of MSE and evaluate the same.
6. Online submitted assignments by students using SWAYAM platform for concerned OE course will be used for In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks by Concerned Departmental Course Coordinator appointed for particular course by Principal of the Institute. Assignments may be of varied in nature for OE course.
7. The ESE of OE courses will be conducted by the University. The setting of question papers for both MSE and ESE, as well as the evaluation of the concerned OE course, should be carried out by the course expert from the Board of Studies (BoS) of the respective faculty in accordance with the provisions under Panel of Paper Setters, Examiners, and Moderators – Clauses 41(f) and 48(3)(a).
8. MSE will be based on 50% syllabus from beginning (First 50% Weeks).
9. ESE paper setting weightage will be 25% on syllabus covered for MSE (First 50% Weeks) and 75% on remaining syllabus (Last 50% Weeks). The number of optional questions marks in a theory paper shall be 25 to 30 percent of the maximum marks.

**Note: One OE course may be floated by the institute for 60 intake.**

# Open Electives Courses Offered to the students under Faculty of Science and Technology

# In line with New Education Policy 2020

# (Effective from Academic year 2025-26)

## Open Electives

The students need to cover Open Elective Courses (OE) of 08 credits. These 08 credits over semesters III to V.

Semester wise credit distribution table for OE is given below

| Sr. No. | Semester | Open Elective | Teaching scheme | | | Credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 01 | III | OE-01 | 3 | - | - | 3 |
| | III | OE-01 Lab | - | - | 2 | 1 |
| | IV | OE-02 | 2 | - | - | 2 |
| 02 | V | OE-03 | 2 | - | - | 2 |
| | **Total** | | **7** | **-** | **2** | **8** |

Semester wise baskets of OE from faculty other than Faculty of Science and Technology, Viz. Faculty of Commerce and Management, Faculty of Humanities and Faculty of Interdisciplinary Studies is given below

**List of Open Elective Courses might be taken by students under Faculty of Science and Technology**

**Semester – III**

**Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.**

| Sr. No. | Name of the Course | Category | Duration (Weeks) | Credit Points | Institute Offering Course | Name of Professor/ Resource person | Link |
|---|---|---|---|---|---|---|---|
| 01 | Principles of Economics | Economics | 12 | 03 | IIT Madras | Prof. Sabuj Kumar Mandal | https://onlinecourses.nptel.ac.in/noc25_ec15/preview |
| 02 | German - I | Humanities and Social Science | 12 | 03 | IIT Madras | Prof. Milind Brahme | https://onlinecourses.nptel.ac.in/noc25_hs121/preview |
| 03 | Science, Technology and Society | Humanities and Social Science | 12 | 03 | IIT Guwahati | Prof. Sambit Mallick | https://onlinecourses.nptel.ac.in/noc25_hs189/preview |
| 04 | Environment and Development | Humanities and Social Science | 12 | 03 | IIT Guwahati | Prof. Ngamjahao Kipgen | https://onlinecourses.nptel.ac.in/noc25_hs195/preview |
| 05 | Logistics & Supply Chain Management | Humanities and Social Science | 12 | 03 | IIT Kharagpur | Prof. Vikas Thakur | https://onlinecourses.nptel.ac.in/noc25_hs205/preview |
| 06 | Introduction to Film Studies | Humanities and Social Sciences English studies | 12 | 03 | IIT Madras | Prof. Aysha Viswamohan | https://onlinecourses.nptel.ac.in/noc25_hs138/preview |
| 07 | Entrepreneurship | Management | 12 | 03 | IIT Madras | Prof. C Bhaktavatsala Rao | https://onlinecourses.nptel.ac.in/noc25_mg81/preview |
| 08 | Managerial Skills for Interpersonal Dynamics | Management | 12 | 03 | IIT Roorkee | Prof. Santosh Rangnekar | https://onlinecourses.nptel.ac.in/noc25_mg91/preview |
| 09 | Automation in Production Systems and Management | Management | 12 | 03 | IIT Kharagpur | Prof. Pradip Kumar Ray | https://onlinecourses.nptel.ac.in/noc25_mg135/preview |
| 10 | Numerical Methods for Engineers | Multidisciplinary | 12 | 03 | IIT Madras | Prof. Niket Kaisare | https://onlinecourses.nptel.ac.in/noc25_ge59/preview |

## Semester – IV

**Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.**

| Sr. No. | Name of Course | Category | Duration (Weeks) | Credit Points | Institute Offering Course | Name of Professor/ Resource person | Link |
|---|---|---|---|---|---|---|---|
| 01 | Indian Business History | Humanities And Social Sciences | 08 | 02 | IIT Guwahati | Prof. Vipul Dutta | https://onlinecourses.nptel.ac.in/noc25_hs32/preview |
| 02 | Probability and Stochastic for Finance | Economic Sciences | 08 | 02 | IIT Kanpur | Prof. Joydeep Dutta | https://onlinecourses.nptel.ac.in/noc25_ma58/preview |
| 03 | Enhancing Soft Skills and Personality | Humanities and Social Sciences | 08 | 02 | IIT Kanpur | Prof. T. Ravichandran | https://onlinecourses.nptel.ac.in/noc25_hs87/preview |
| 04 | Mastering Speaking and Presentations: A case Based Approach | Humanities and Social Sciences | 08 | 02 | IIT Kharagpur | Prof. Seema Singh | https://onlinecourses.nptel.ac.in/noc25_hs96/preview |
| 05 | The Science of Happiness and Wellbeing | Humanities and Social Sciences | 08 | 02 | IIT Kharagpur | Prof. Priyadarshi Patnaik Prof. Manas K Mandal | https://onlinecourses.nptel.ac.in/noc25_hs103/preview |
| 06 | Philosophical Foundations Of Social Research | Humanities And Social Sciences | 08 | 02 | IIT Guwahati | Prof. Sambit Mallick | https://onlinecourses.nptel.ac.in/noc25_hs63/preview |
| 07 | Emotional Intelligence | Humanities and Social Science | 08 | 02 | IIT Kharagpur | Prof. Rabindra Kumar Pradhan | https://onlinecourses.nptel.ac.in/noc25_hs16/preview |
| 08 | Employment Communication: A Lab based course | Humanities and Social Science | 08 | 02 | IIT Kharagpur | Prof. Seema Singh | https://onlinecourses.nptel.ac.in/noc25_hs17/preview |
| 09 | Soft Skill Development | Humanities and Social Science | 08 | 02 | IIT Kharagpur | Prof. Priyadarshi Patnaik Prof. V. N. Giri Prof. D. Suar | https://onlinecourses.nptel.ac.in/noc25_hs72/preview |
| 10 | Social Behavior and the Brain: An Introduction to Social Neuroscience | Humanities and Social Science, Psychology, Neuroscience, Cognitive Science | 08 | 02 | IIT Kanpur | Prof. Ark Verma | https://onlinecourses.nptel.ac.in/noc25_hs101/preview |
| 11 | Economic Growth And Development | Humanities and Social Sciences | 08 | 02 | IIT Guwahati | Prof. Rajshree Bedamatta | https://onlinecourses.nptel.ac.in/noc25_hs11/preview |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12 | Effective Writing | Humanities and Social Sciences | 08 | 02 | IIT Roorkee | Prof. Binod Mishra | https://onlinecourses.nptel.ac.in/noc25_hs14/preview |
| 13 | Centre-State Relations in India | Law | 08 | 02 | IIT Kharagpur | Prof. Uday Shankar | https://onlinecourses.nptel.ac.in/noc25_lw04/preview |
| 14 | Foundation Course in Managerial Economics | Management | 08 | 02 | IIT Kharagpur | Prof. Barnali Nag | https://onlinecourses.nptel.ac.in/noc25_mg25/preview |
| 15 | International Marketing | Management | 08 | 02 | IIT Kharagpur | Prof. Biswarup Ghosh | https://onlinecourses.nptel.ac.in/noc25_mg32/preview |
| 16 | Introduction to System Dynamics Modeling | Management | 08 | 02 | IIT Bombay | Prof. Jayendran Venkateswaran | https://onlinecourses.nptel.ac.in/noc25_mg37/preview |
| 17 | Management of New Products and Services | Management | 08 | 02 | IIT Kharagpur | Prof. KBL Srivastava | https://onlinecourses.nptel.ac.in/noc25_mg44/preview |
| 18 | Business Forecasting | Management | 08 | 02 | IIT Bombay | Prof. Pankaj Dutta | https://onlinecourses.nptel.ac.in/noc25_mg66/preview |
| 19 | Yoga and Positive Psychology for Managing Career and Life | Management | 08 | 02 | IIT Bombay | Prof. Ashish Pandey | https://onlinecourses.nptel.ac.in/noc25_mg75/preview |
| 20 | Roadmap for patent creation | Multidisciplinary | 08 | 02 | IIT Kharagpur | Prof. Gouri Gargate | https://onlinecourses.nptel.ac.in/noc25_ge30/preview |

## Semester – V

**Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.**

| Sr. No. | Name of Course | Category | Duration (Weeks) | Credit Points | Institute Offering Course | Name of Professor/ Resource person | Link |
|---|---|---|---|---|---|---|---|
| 01 | Enhancing Study Skills | Multidisciplinary | 08 | 02 | Indira Gandhi National Open University, New Delhi | Dr. P. Lakshmi; Dr. G. Mythili | https://onlinecourses.swayam2.ac.in/nou25_ge69/preview |
| 02 | Community Engagement and Social Responsibility | Multidisciplinary | 10 | 02 | Dayalbagh Educational Institute, Agra, Uttar Pradesh | Prof. Akshay Kumar Satsangi | https://onlinecourses.swayam2.ac.in/ugc25_ge10/preview |
| 03 | Economic Environment and Business Strategy | Economics | 8 | 02 | IIT Kanpur | Prof. Sukumar Vellakkal | https://onlinecourses.nptel.ac.in/noc25_ec16/preview |
| 04 | Corporate Social Responsibility | Management | 8 | 02 | IIT Kharagpur | Prof. Aradhna Malik | https://onlinecourses.nptel.ac.in/noc25_mg139/preview |
| 05 | Soft Skill Development | Humanities and Social Science | 8 | 02 | IIT Kharagpur | Prof. Priyadarshi Patnaik, Prof. V. N. Giri, Prof. D. Suar | https://onlinecourses.nptel.ac.in/noc25_hs142/preview |
| 06 | Developing Soft Skills and Personality | Humanities and Social Science | 8 | 02 | IIT Kanpur | Prof. T Ravichandran | https://onlinecourses.nptel.ac.in/noc25_hs174/preview |
| 07 | Introduction to Advanced Cognitive Processes | Humanities and Social Science | 8 | 02 | IIT Kanpur | Prof. Ark Verma | https://onlinecourses.nptel.ac.in/noc25_hs177/preview |
| 08 | Entrepreneurship and IP Strategy | Humanities and Social Science | 8 | 02 | IIT Kharagpur | Prof. Gouri Gargate | https://onlinecourses.nptel.ac.in/noc25_hs213/preview |
| 09 | Artificial Intelligence, Law and Justice | Law | 8 | 02 | NALSAR University of Law | Prof. Krishna Ravi Srinivas | https://onlinecourses.nptel.ac.in/noc25_lw12/preview |
| 10 | Innovation, Business Models and Entrepreneurship | Management | 8 | 02 | IIT Roorkee | Prof. Rajat Agrawal Prof. Vinay Sharma | https://onlinecourses.nptel.ac.in/noc25_mg95/preview |
| 11 | Organization Development and Change in 21st Century | Management | 8 | 02 | IIT Bombay | Prof. Ashish Pandey | https://onlinecourses.nptel.ac.in/noc25_mg103/preview |

## Guidelines for Multidisciplinary Minor (MDM) Programmes

As per the directives of the Government of Maharashtra, engineering colleges are encouraged to update their curricula in alignment with the guidelines of the National Education Policy (NEP) 2020. As part of this transformative initiative, the 'Minor Programme' has been introduced to promote multidisciplinary learning at the undergraduate level. These programmes are structured to provide students with interdisciplinary knowledge, enhancing their core academic disciplines and preparing them to meet the evolving demands of the global job market.

Minor programmes across various disciplines have been introduced to provide students with the opportunity to explore fields beyond their core B. Tech curriculum. These programmes enable students from specific branches to broaden their knowledge and skill sets. For example, a student pursuing Mechanical Engineering can opt for a Minor in Computer Science and Engineering, thereby acquiring interdisciplinary expertise that enhances both academic depth and professional flexibility. However, students enrolled in the Computer Science and Engineering (CSE) programme are restricted from choosing MDM's in Artificial Intelligence and Data Science, CSE (Data Science), and CSE (Artificial Intelligence and Machine Learning) in order to prevent overlap between the core curriculum of CSE and the content of these minors, ensuring that students gain diverse and non-redundant knowledge through their minor specializations. **(Refer Table: MDM Courses)**

## Common guidelines to students:

1. The Multidisciplinary Minor (MDM) must be compulsorily chosen from engineering discipline different from the student's Major engineering programme. Students should take MDM from the list of MDM Offered by Other Departments/Branches/ programmes only. Ex: A Student of Mechanical Engineering should take MDM from other departments/branches/Programmes except MDM offered by Mechanical Engineering Dept. **(Refer Table: MDM Courses)**
2. The entry point for any compulsory MDM programme is the 3rd semester. The required credits for MDM courses must be acquired from the 3rd semester of second year to the final year of UG Programme.
3. A student is required to continue with the selected Minor programme consistently throughout all six semesters.
4. No changes to the selected Minor programme will be permitted under any circumstances.
5. A student may choose only one Minor programme (track), from the list of MDM courses offered by the institute.
6. The allotment of the MDM course will be based on the marks obtained by the student in the first year for Sem-I and Sem-II combinely.
7. The compulsory MDM programme will admit a maximum of 75 students into its minor course, with selection strictly based on first-year academic merit. Preference order for allocating MDM minor will follow the hierarchy: Candidates with no backlogs first, then those with one backlog, followed by those with two backlogs, and so on.
8. All students must complete the Google form provided by the Institute, indicating their preferences to MDM programme within the specified deadline. Students should ensure that they enter their accurate first year marks in the form along with the attachment of marksheets of Sem-I and Sem-II to avoid any discrepancies.

## (Refer Table: MDM Courses)

## List of S. Y. B. Tech. and T.Y.B.Tech MDM Courses Offered by the Various Programmes under the Faculty of Science and Technology at Shivaji University, Kolhapur

| Sr. No. | Name of the Programme (Major) Offering MDM | Name of the corresponding Minor Programme to be offered | Semester | Name of the MDM Course offered by the Major Programme | Teaching scheme | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | |
| 01 | Mechanical Engineering | 1. Computer Science and Engineering<br>2. Electronics and Computer Science<br>3. Computer Science and Engineering (AIML)<br>4. Civil Engineering<br>5. Electronics and Telecommunication Engineering<br>6. Computer Science and Engineering (Data Science)<br>7. Electrical Engineering<br>8. Artificial Intelligence & Data Science<br>9. Electrical and Computer Engineering | III | MDM 01: Thermodynamics | 2 | - | - | 2 |
| | | | IV | MDM 02: Theory of Machines | 2 | - | - | 2 |
| | | | V | MDM 03: Heat Power Engineering | 3 | - | 2 | 4 |
| | | | VI | MDM 04: Machine Design | 2 | - | - | 2 |
| 02 | Computer Science and Engineering | 1. Mechanical Engineering<br>2. Civil Engineering<br>3. Electronics and Telecommunication Engineering<br>4. Electrical Engineering<br>5. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Data Structures using C | 2 | - | - | 2 |
| | | | IV | MDM 02: Object Oriented Programming | 2 | - | - | 2 |
| | | | V | MDM 03: Java Programming | 3 | - | 2 | 4 |
| | | | VI | MDM 04: Database Engineering | 2 | - | - | 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 03 | Electronics and Computer Science | 1. Mechanical Engineering<br>2. Civil Engineering<br>3. Electrical Engineering<br>4. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Logic Design | 2 | - | - | 2 |
| | | | IV | MDM 02: Electronics Measurements | 2 | - | - | 2 |
| | | | V | MDM 3 Fundamentals of Robotics and Drone Technology | 3 | - | 2 | 4 |
| | | | VI | MDM 4 : Embedded C Programming | 2 | - | - | 2 |
| 04 | Computer Science and Engineering (AIML) | 1. Mechanical Engineering<br>2. Civil Engineering<br>3. Electronics and Telecommunication Engineering<br>4. Electrical Engineering<br>5. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Object Oriented Programming | 2 | - | - | 2 |
| | | | IV | MDM 02: Introduction to AI | 2 | - | - | 2 |
| | | | V | MDM 03: Database Management | 3 | - | 2 | 4 |
| | | | VI | MDM 04: Internet of Things | 2 | - | - | 2 |
| 05 | Civil Engineering | 1. Mechanical Engineering<br>2. Computer Science and Engineering<br>3. Electronics and Computer Science<br>4. Computer Science and Engineering (AIML)<br>5. Electronics and Telecommunication Engineering<br>6. Computer Science and Engineering (Data Science)<br>7. Electrical Engineering<br>8. Artificial Intelligence & Data Science<br>9. Electrical and Computer Engineering<br>10. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Building Construction | 2 | - | - | 2 |
| | | | IV | MDM 02: Waste Management | 2 | - | - | 2 |
| | | | V | MDM 3 : Infrastructure Engineering | 3 | - | 2 | 4 |
| | | | VI | MDM 4: Concrete Technology | 2 | - | - | 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 06 | Electronics and Telecommunication Engineering | 1. Mechanical Engineering<br>2. Computer Science and Engineering<br>3. Computer Science and Engineering (AIML)<br>4. Civil Engineering<br>5. Computer Science and Engineering (Data Science)<br>6. Electrical Engineering<br>7. Artificial Intelligence & Data Science<br>8. Electrical and Computer Engineering<br>9. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Electronics System | 2 | - | - | 2 |
| | | | IV | MDM 02: Electronics Measurements | 2 | - | - | 2 |
| | | | V | MDM-3: Fundamentals of Robotics and Drone Technology | 3 | - | 2 | 4 |
| | | | VI | MDM-4:Mobile Technology | 2 | - | - | 2 |
| 07 | Computer Science and Engineering (Data Science) | 1. Mechanical Engineering<br>2. Civil Engineering<br>3. Electronics and Telecommunication Engineering<br>4. Electrical Engineering<br>5. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: C Programming | 2 | - | - | 2 |
| | | | IV | MDM 02: Python Programming | 2 | - | - | 2 |
| | | | V | MDM 03:Programming using Java | 3 | - | 2 | 4 |
| | | | VI | MDM 4:Database concepts and Design | 2 | - | - | 2 |
| 08 | Electrical Engineering | 1. Mechanical Engineering<br>2. Computer Science and Engineering<br>3. Electronics and Computer Science<br>4. Computer Science and Engineering (AIML)<br>5. Civil Engineering<br>6. Electronics and Telecommunication Engineering<br>7. Computer Science and Engineering (Data Science)<br>8. Artificial Intelligence & Data Science<br>9. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Introduction to Electrical and Electronics Circuits | 2 | - | - | 2 |
| | | | IV | MDM 02: Electrical Power System | 2 | - | - | 2 |
| | | | V | MDM 03:Electrical Machines | 3 | - | 2 | 4 |
| | | | VI | MDM 04:Power Electronics and Embedded System | 2 | - | - | 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 09 | Artificial Intelligence & Data Science | 1. Mechanical Engineering<br>2. Civil Engineering<br>3. Electronics and Telecommunication Engineering<br>4. Electrical Engineering<br>5. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Fundamentals of AI | 2 | - | - | 2 |
| | | | IV | MDM 02: Python for Data Science | 2 | - | - | 2 |
| | | | V | MDM 03: Machine Learning | 3 | - | 2 | 4 |
| | | | VI | MDM 04: Deep Learning | 2 | - | - | 2 |
| 10 | Electrical and Computer Engineering | 1. Mechanical Engineering<br>2. Civil Engineering<br>3. Electronics and Telecommunication Engineering<br>4. Mechanical and Mechatronics Engineering (Additive Manufacturing) | III | MDM 01: Renewable Energy Sources | 2 | - | - | 2 |
| | | | IV | MDM 02: Python Programming | 2 | - | - | 2 |
| | | | V | MDM 03: Operating System | 3 | - | 2 | 4 |
| | | | VI | MDM 04: Electrical Design Estimation And Costing | 2 | - | - | 2 |
| 11 | Mechanical and Mechatronics Engineering (Additive Manufacturing) | 1. Computer Science and Engineering<br>2. Electronics and Computer Science<br>3. Computer Science and Engineering (AIML)<br>4. Civil Engineering<br>5. Electronics and Telecommunication Engineering<br>6. Computer Science and Engineering (Data Science)<br>7. Electrical Engineering<br>8. Artificial Intelligence & Data Science<br>9. Electrical and Computer Engineering | III | MDM 01: Computer Aided Design (CAD) | 2 | - | - | 2 |
| | | | IV | MDM 02: Product Design & Development | 2 | - | - | 2 |
| | | | V | MDM 03: Fundamentals of Design for Product Manufacturing (FDPM) | 3 | - | 2 | 4 |
| | | | VI | MDM 04:Ergonomics & Human Factors | 2 | - | - | 2 |

**Third Year Exit: Teaching Methodology, Assessment and Evaluation**

**[I] As per R. R. B. Tech. 12.3 Rule: Award of Degree**

If a student passes all the courses of first year, second year and third year and earns the requisite number of credits, the student will become entitled to three years Bachelor's Degree in Vocational in the faculty of his/her major subject. If he/she wants to exit, can exit the programme with three years Bachelor's Degree in Vocational. However, for the award of three years Bachelor's Degree in Vocational in the faculty of his/her major subject with 132 credits, an additional 8 credits from Exit Courses are required to earn.

**[II] Third Year Exit Course:**

**Methodology 1:**

1. The students should complete two online certification courses (NPTEL) related to their programme, each of 3 credits. In addition to this, they will also need to complete 2 credits worth of two Virtual Lab work related to online certification courses. These additional 8 credits earn by students shall be based upon skill based vocational courses or internship/Apprenticeship.
2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study or programme. The skill based vocational courses shall be analogous to the Baskets/Areas provided by the concerned BoS.
3. The student must complete two virtual lab work that adds 2 credits to simulate practical or experimental learning experiences in a controlled virtual environment.
4. **Examination scheme:** The marks gained from the two NPTEL Courses (3 credits each) are converted to a total of 100 marks. The

report for the two Virtual Lab work of 2 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of the virtual lab experiments conducted, encompassing the methodology, results, and conclusions.

5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and follow the instructions to compete the course. Similarly, for Virual Lab, the students are required to visit to website https://www.vlab.co.in and create their account. Log in the account and join the required lab and follow the instructions to compete the course (need to perform all listed experiments under that Lab). To fulfill the requirement of 06 credits, students can go for two courses each of 12 weeks.

**Methodology 2:**

1. The students should complete two online certification courses (NPTEL) related to their programme, each carrying 2 credits. In addition to this, they will also need to complete 4 credits worth of two physical internship/Apprenticeship (each of 40 hrs) work from relevant industry. These additional 8 credits earned by the students shall be based upon skill based.

   vocational courses or internship/Apprenticeship.
2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study/programme. The skill-based vocational courses shall be analogous with the list provided by the concerned

BoS.

3. The student should complete two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices that adds 4 credits to simulate practical or experimental learning experiences in a controlled virtual environment.
4. **Examination scheme:** The marks gained from the two NPTEL Courses (2 credits each) are converted to a total of 100 marks. The report for the performed two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices of 4 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of two physical internship/Apprenticeship (each of 40 hrs) work along with certificate of internship/Apprenticeship from relevant industrial practices conducted, encompassing the methodology, results, and conclusions.
5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and

# Emerging (Specialization) Minor (18 Credits) in Electronics and Computer Science

**to be implemented from Academic Year 2026-27**
**(As per GR NEP-2022(67/23) / Tanshi -2, Dated 04th July 2023)**

| Emerging Course with a Maximum of 18- 20 Credits | | | | | |
|---|---|---|---|---|---|
| **Sr. No.** | **Semester** | **Course Code** | **Course Title** | **Mode** | **Credits** |
| 1 | III | ECS-EMR-0211 | Introduction to consumer electronics | Online/offline certification Course of total 18 credits | 3 |
| 2 | IV | ECS -EMR-0221 | 5G Technology | | 3 |
| 3 | V | ECS -EMR-0311 | 6G Technology | | 3 |
| 4 | VI | ECS -EMR-0321 | Radio Engineering | | 3 |
| 5 | VII | ECS -EMR-0411 | Embedded Linux | | 3 |
| 6 | VIII | ECS -EMR-0421 | Quantum Computing | | 3 |

# Shivaji University, Kolhapur

## S.Y (Sem- III) B.Tech. Electronics and Computer Science

| Course Category | Emerging Minor |
|---|---|

**Introduction to Consumer Electronics**

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | -- | | MSE | 30 Marks |
| Tutorials | -- | | ISE/CA | 10 Marks |
| Total Credits | 3 | | ESE | 60 Marks |
| | | | **Total Marks** | 100 Marks |

Prerequisites: Basic Electronics Engineering

**Course Objectives:**

| | |
|---|---|
| **1** | Understand the fundamentals of consumer electronics |
| **2** | Explain the principles and operation of various types of audio systems |
| **3** | Understand television, display, and multimedia technologies. |
| **4** | Study the operation of consumer electronic appliances. |
| **5** | Understand office automation equipment and their applications. |
| **6** | Explore modern smart consumer electronics, IoT devices, and wireless technologies. |

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

| | |
|---|---|
| **CO1** | Explain the fundamentals of consumer electronic devices and systems. |
| **CO2** | Describe the operation of audio systems and sound equipment. |
| **CO3** | Illustrate the working of television, display, and multimedia systems. |
| **CO4** | Explain the operation and applications of consumer electronic appliances. |
| **CO5** | Describe the working principles of office automation equipment. |
| **CO6** | Analyze smart consumer electronic devices, IoT technologies, and security aspects. |

| | Course Contents | COs | Hours |
|---|---|---|---|
| **Unit 1** | **Fundamentals of Consumer Electronics**<br>Introduction to Consumer Electronics ,Evolution of Consumer Electronic Products ,Basic Electronic Components used in Consumer Devices ,Power Supplies (Linear and SMPS) , Basic Sensors and Actuators in Consumer Electronics , Safety Standards, Energy Rating and EMI/EMC ,Introduction to IoT-enabled Consumer Appliances | CO1 | **(06)** |
| **Unit 2** | **Audio Systems**<br>Basic characteristics of sound signal : Intensity and loudness, pitch, frequency response, fidelity, sensitivity and selectivity, Audio Amplifiers: Mono, stereo, block diagram of Hi- Fi amplifier and its working, use of bass, treble tone controls, Microphone: Working principle and Types condenser, crystal, dynamic moving coil, Speakers: Working principle and types- electrostatic, dynamic, Public Address System (PA system) and Home theatre : Block diagram and working principle | CO2 | **(06)** |
| **Unit 3** | **Television and Display Technologies**<br>Closed circuit television (CCTV): functional block diagram, working Principle, Liquid crystal display (LCD) television: Principle, Block diagram and working ,Block diagram and working principle: Light emitting diode(LED) TV, Organic light emitting diode(OLED) TV, | CO3 | **(06)** |

| | | | |
|---|---|---|---|
| | Direct to Home (DTH) television : Block diagram and working principle , Smart interactive TV : Features and applications | | |
| **Unit 4** | **Consumer Electronic Appliances**<br>Photocopier: Block diagram and working principle , Microwave Oven: Block diagram, single chip controllers, types, safety instructions, electrical specifications, Washing Machine: Block diagram, electrical specifications, types and features of (Automatic, Semiautomatic) washing machine ,Digital Camera and Camcorder: Working principle, picture processing, picture storage, electrical specification , Scanner: Working principle, Specifications, types of scanners, interface cables, ports and connectors , Bar code reader: Working principle , applications | CO4 | **(06)** |
| **Unit 5** | **Office Automation Appliances**<br>Laser Printer: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure , Smart Interactive Board: Working principle, features and specifications ,LED Projector: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure ,Biometric Attendance system: Hardware and software components , working principle , Video conferencing system: Components and working principle | CO5 | **(06)** |
| **Unit 6** | **Modern Consumer Electronics and Smart Devices**<br>Smartphones and Tablets ,Smart Watches and Wearable Devices ,Smart Home Automation ,Wi-Fi, Bluetooth, ZigBee and NFC ,Voice Assistants , IoT-based Consumer Products , Security and Privacy in Smart Devices | CO6 | **(06)** |
| **Text Books** | | | |
| 01 | Bali S.P.- Consumer Electronics Pearson Education India, New Delhi,2007;ISBN:9788131717592 | | |
| 02 | Bali R and Bali S.P.- Audio video systems: principle practices and troubleshooting Khanna Book Publishing Co.(P) Ltd.,New Delhi,2014;ISBN:9780070067172 | | |
| 03 | K. R. Botkar- Consumer Electronics, Vidhyarthi Griha Prakashan, Pune | | |
| **Reference Books** | | | |
| 01 | R. R. Gulati- Modern Consumer Electronics- New Age International (P) Ltd. | | |
| 02 | B. R. Gupta<br>-Consumer Electronics S. K. Kataria & Sons | | |

# Shivaji University, Kolhapur

## Second Year (Sem- IV) B.Tech. Electronics and Computer Science

| Course Category | Emerging Minor |
|---|---|

**5G Technology**

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | -- | 3 Hrs./Week | MSE | 30 Marks |
| Tutorials | -- | | ISE/CA | 10 Marks |
| Total Credits | 3 | | ESE | 60 Marks |
| | | | **Total Marks** | 100 Marks |

Prerequisites: Basic knowledge of Digital Communication. ,Fundamentals of Wireless Communication, Computer Networks and Mobile Communication.

**Course Objectives:**

| | |
|---|---|
| **1** | To understand the evolution of mobile communication technologies leading to 5G. |
| **2** | To study the architecture and enabling technologies of 5G networks. |
| **3** | To understand radio access technologies, spectrum, and massive MIMO. |
| **4** | To explore network virtualization, SDN, and Network Slicing. |
| **5** | To study applications of 5G in IoT, Industry 4.0, Smart Cities, and Healthcare. |
| **6** | To understand security challenges and future trends in 5G communication. |

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

| | |
|---|---|
| **CO1** | Explain the evolution and key features of 5G communication systems. |
| **CO2** | Describe the architecture and components of 5G networks. |
| **CO3** | Analyze enabling technologies such as Massive MIMO, Beamforming, and mmWave communication. |
| **CO4** | Explain the concepts of SDN, NFV, and Network Slicing in 5G. |
| **CO5** | Identify various applications and use cases of 5G technology. |
| **CO6** | Discuss security challenges and future developments in next-generation wireless networks. |

| | Course Contents | COs | Hours |
|---|---|---|---|
| **Unit 1** | **Introduction to Mobile Communication Evolution**<br>Evolution from 1G to 5G, Limitations of previous generations, Requirements of 5G, Key features of 5G, ITU IMT-2020 requirements, Performance metrics. | CO1 | 06 |
| **Unit 2** | **5G Network Architecture**<br>5G Core Network, Next Generation Radio Access Network (NG-RAN), Service-Based Architecture (SBA), Control Plane and User Plane Separation (CUPS), Deployment models (NSA & SA). | CO2 | 06 |
| **Unit 3** | **5G Radio Technologies**<br>New Radio (NR), OFDM Numerology, Massive MIMO, Beamforming, Millimeter Wave Communication, Small Cells, Spectrum Allocation. | CO3 | 06 |
| **Unit 4** | **Network Virtualization and Slicing**<br>Software Defined Networking (SDN), Network Function Virtualization (NFV), Edge Computing, Mobile Edge Computing (MEC), Network Slicing concepts and applications. | CO4 | 06 |

| | | | |
|---|---|---|---|
| **Unit 5** | **Applications of 5G**<br>Internet of Things (IoT), Smart Cities, Industry 4.0, Autonomous Vehicles, Healthcare, Smart Agriculture, AR/VR, Smart Manufacturing. | CO5 | 06 |
| **Unit 6** | **Security and Future Trends**<br>5G Security Architecture, Authentication and Privacy, Cybersecurity Challenges, AI in 5G Networks, Towards 6G Communication, Future Research Directions. | CO6 | 06 |
| **Text Books** | | | |
| 01 | **Afif Osseiran, Jose F. Monserrat and Patrick Marsch**, *5G Mobile and Wireless Communications Technology*, Cambridge University Press. | | |
| 02 | **Jonathan Rodriguez**, *Fundamentals of 5G Mobile Networks*, Wiley. | | |
| 03 | **Sassan Ahmadi**, *5G NR: Architecture, Technology, Implementation and Operation of 3GPP New Radio Standards*, Academic Press. | | |
| 04 | **Larry Peterson and Oğuz Sunay**, *5G Mobile Networks: A Systems Approach*, Open Networking Foundation. | | |
| **Reference Books** | | | |
| 01 | **Erik Dahlman, Stefan Parkvall and Johan Skold**, *5G NR: The Next Generation Wireless Access Technology*, Academic Press. | | |
| 02 | **Haralabos Sarimveis and Symeon Chatzinotas**, *5G and Beyond Wireless Systems*, Springer. | | |
| 03 | **William Stallings**, *Wireless Communications and Networks*, Pearson. | | |
| 04 | **Theodore S. Rappaport**, *Wireless Communications: Principles and Practice*, Pearson. | | |
| 05 | **Andreas F. Molisch**, *Wireless Communications*, Wiley. | | |

# Shivaji University, Kolhapur

## Second Year (Sem- V) B.Tech. Electronics and Computer Science

| Course Category | Emerging Minor |
|---|---|

**6G Technology**

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | -- | 3 Hrs./Week | MSE | 30 Marks |
| Tutorials | -- | | ISE/CA | 10 Marks |
| Total Credits | 3 | | ESE | 60 Marks |
| | | | **Total Marks** | 100 Marks |

Prerequisites: Fundamentals of Digital Communication. ,Basics of Wireless and Mobile Communication. ,Basic knowledge of Computer Networks and Internet of Things (IoT).

**Course Objectives:**

| | |
|---|---|
| **1** | To understand the evolution of wireless communication from 5G to 6G. |
| **2** | To study the architecture, vision, and enabling technologies of 6G networks. |
| **3** | To understand advanced communication technologies such as THz communication, AI-native networks, and Intelligent Reflecting Surfaces. |
| **4** | To explore integrated communication, sensing, computing, and network intelligence in 6G. |
| **5** | To study emerging applications enabled by 6G technology. |
| **6** | To understand security, sustainability, and future research directions in 6G communication. |

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

| | |
|---|---|
| **CO1** | Explain the evolution, vision, and key performance indicators of 6G communication systems. |
| **CO2** | Describe the architecture and enabling technologies of 6G networks. |
| **CO3** | Analyze advanced communication technologies including THz communication, AI-native networking, and Intelligent Reflecting Surfaces. |
| **CO4** | Explain integrated communication, sensing, edge intelligence, and digital twin technologies in 6G. |
| **CO5** | Identify potential applications of 6G in smart industries, healthcare, transportation, and immersive communication. |
| **CO6** | Discuss security, sustainability, standardization, and future research challenges of 6G. |

| | Course Contents | COs | Hours |
|---|---|---|---|
| **Unit 1** | **Introduction to 6G Communication**<br>Evolution from 1G to 6G, Limitations of 5G, Vision and Requirements of 6G, ITU IMT-2030 Framework, Key Performance Indicators (KPIs), Design Goals and Challenges of 6G. | CO1 | 06 |
| **Unit 2** | **6G Network Architecture**<br>6G Architecture Overview, AI-Native Network Architecture, Integrated Space-Air-Ground-Sea Networks (SAGSIN), Cloud-Native Core, Edge Intelligence, Open RAN (O-RAN), Network Softwarization. | CO2 | 06 |

| | | | |
|---|---|---|---|
| **Unit 3** | **Enabling Technologies for 6G**<br>Terahertz (THz) Communication, Visible Light Communication (VLC), Intelligent Reflecting Surfaces (IRS), Massive MIMO Evolution, Cell-Free Massive MIMO, Ultra-Massive MIMO, Reconfigurable Intelligent Surfaces (RIS). | CO3 | 06 |
| **Unit 4** | **AI, Sensing and Intelligent Networking**<br>Artificial Intelligence and Machine Learning in 6G, Integrated Communication and Sensing (ISAC), Digital Twins, Semantic Communication, Edge AI, Federated Learning, Network Automation. | CO4 | 06 |
| **Unit 5** | **Applications of 6G**<br>Extended Reality (XR), Metaverse, Holographic Communication, Autonomous Transportation, Industry 5.0, Smart Healthcare, Smart Agriculture, Internet of Everything (IoE), Smart Cities, UAV Communication. | CO5 | 06 |
| **Unit 6** | **Security, Sustainability and Future Trends**<br>6G Security Architecture, Quantum Communication and Quantum Key Distribution (QKD), Privacy Preservation, Green Communication, Energy-Efficient Networks, Standardization Activities, Future Research Challenges and Roadmap Beyond 6G. | CO6 | 06 |
| **Text Books** | | | |
| 01 | **Khaled M. Rabie**, *6G Wireless Communications and Mobile Networking*, Wiley. | | |
| 02 | **Wanshi Chen, Feng Lyu and Xuemin (Sherman) Shen**, *6G Mobile Wireless Networks*, Springer. | | |
| 03 | **Kai-Kit Wong, Chau Yuen and Mohamed-Slim Alouini (Editors)**, *6G Wireless Systems: Vision, Requirements, Challenges, Insights and Opportunities*, IEEE/Wiley. | | |
| 04 | **Amit Kumar, Mohsen Guizani and Adnan Al-Anbuky (Editors)**, *Toward 6G Communication Networks: Vision, Enabling Technologies and Applications*, CRC Press. | | |
| **Reference Books** | | | |
| 01 | **Yang Yang, Mischa Dohler and Hamid Gharavi (Editors)**, *6G Mobile Wireless Networks*, Springer. | | |
| 02 | **Michele Zorzi, H. Vincent Poor, Andrea Zanella and others (Editors)**, *Towards 6G Networks: Use Cases and Technologies*, Wiley. | | |
| 03 | **Theodore S. Rappaport et al.**, *Wireless Communications and Applications Above 100 GHz*, Pearson. | | |
| 04 | **Erik Dahlman, Stefan Parkvall and Johan Skold**, *5G NR: The Next Generation Wireless Access Technology*, Academic Press. | | |
| 05 | **William Stallings**, *Wireless Communications and Networks*, Pearson. | | |

# Shivaji University, Kolhapur

## Second Year (Sem- VI) B.Tech. Electronics and Computer Science

| Course Category | Emerging Minor |
|---|---|

**Radio Engineering**

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | -- | | MSE | 30 Marks |
| Tutorials | -- | | ISE/CA | 10 Marks |
| Total Credits | 3 | | ESE | 60 Marks |
| | | | **Total Marks** | 100 Marks |

Prerequisites: Electronic Devices and Circuits, Analog Communication, Network Theory, Electromagnetic Fields, Signals and Systems.

**Course Objectives:**

| | |
|---|---|
| **1** | To introduce the basic principles and concepts of radio engineering. |
| **2** | To understand radio wave propagation and different radio communication systems. |
| **3** | To study the operation of radio transmitters, receivers, and antennas. |
| **4** | To familiarize students with modulation techniques used in radio communication. |
| **5** | To develop an understanding of modern radio communication technologies and applications. |
| **6** | To create awareness of current trends and future developments in radio engineering. |

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

| | |
|---|---|
| **CO1** | Explain the fundamentals of radio engineering and radio communication systems. |
| **CO2** | Describe the principles of radio wave propagation, antennas, and transmission lines. |
| **CO3** | Explain the working of radio transmitters and receivers. |
| **CO4** | Analyze different modulation techniques used in radio communication. |
| **CO5** | Identify the components and operation of modern radio communication systems. |
| **CO6** | Describe the applications and future trends in radio engineering. |

| | Course Contents | COs | Hours |
|---|---|---|---|
| **Unit 1** | **Fundamentals of Radio Engineering**<br>Introduction to radio engineering, History and evolution of radio communication, Electromagnetic spectrum, Radio frequency bands, Radio communication system block diagram, Radio wave generation, Applications of radio engineering. | CO1 | **(06)** |
| **Unit 2** | **Radio Wave Propagation**<br>Propagation of radio waves, Ground wave propagation, Sky wave propagation, Space wave propagation, Ionosphere and its characteristics, Factors affecting propagation, Propagation losses, Radio horizon. | CO2 | **(08)** |
| **Unit 3** | **Radio Transmitters and Receivers**<br>Basic transmitter architecture, AM and FM transmitters, Radio frequency amplifiers, Receiver architecture, Superheterodyne receiver, Frequency conversion, Intermediate frequency amplifier, Automatic Gain Control (AGC), Receiver performance parameters | CO3 | **(06)** |

| | | | |
|---|---|---|---|
| **Unit 4** | **Antennas and Transmission Lines**<br>Introduction to antennas, Antenna parameters, Dipole antenna, Monopole antenna, Yagi-Uda antenna, Parabolic reflector antenna, Transmission lines, Standing Wave Ratio (SWR), Impedance matching, Applications of antennas. | CO4 | **(06)** |
| **Unit 5** | **Radio Communication Systems**<br>AM and FM broadcasting systems, Two-way radio communication, Marine and aeronautical radio communication, Satellite radio communication, Digital radio, Software Defined Radio (SDR), Mobile radio systems. | CO5 | **(06)** |
| **Unit 6** | **Modern Trends in Radio Engineering**<br>Wireless communication technologies, Internet of Things (IoT) communication, Cognitive radio, RFID systems, Spectrum management, Radio regulations and standards, Future trends and emerging applications | CO6 | **(06)** |

| **Text Books** | |
|---|---|
| 01 | Simon Haykin - *Communication Systems* - Wiley. |
| 02 | Wayne Tomasi - *Electronic Communication Systems* - Pearson. |
| 03 | Dennis Roddy - *Electronic Communications* - McGraw-Hill. |
| 04 | John D. Kraus and Ronald J. Marhefka - *Antennas for All Applications* - McGraw-Hill. |
| **Reference Books** | |
| 01 | Theodore S. Rappaport - *Wireless Communications: Principles and Practice* - Pearson. |
| 02 | B. P. Lathi - *Modern Digital and Analog Communication Systems* - Oxford University Press. |
| 03 | John G. Proakis and Masoud Salehi - *Fundamentals of Communication Systems* - Pearson. |
| 04 | George Kennedy and Bernard Davis - *Electronic Communication Systems* - McGraw-Hill. |
| 05 | John D. Ryder - *Networks, Lines and Fields* - Prentice Hall. |

| Shivaji University, Kolhapur | | | | |
|---|---|---|---|---|
| **Second Year (Sem- VII) B.Tech. Electronics and Computer Science** | | | | |
| **Course Category** | **Emerging Minor** | | | |
| **Embedded Linux** | | | | |
| **Teaching Scheme** | | | **Examination Scheme** | |
| Lectures | -- | | MSE | 30 Marks |
| Tutorials | -- | | ISE/CA | 10 Marks |
| Total Credits | 3 | | ESE | 60 Marks |
| | | | **Total Marks** | 100 Marks |

Prerequisites: C Programming, Microprocessors & Microcontrollers, Operating Systems, Embedded Systems

**Course Objectives:**

| | |
|---|---|
| **1** | Understand the architecture, components, and boot process of Embedded Linux operating systems. |
| **2** | Apply Linux commands, shell scripting, and system programming concepts for embedded application development. |
| **3** | Configure and customize the Linux kernel, bootloader, and root file system for embedded platforms. |
| **4** | Design and develop basic Linux device drivers for embedded peripherals and hardware interfaces. |
| **5** | Develop network-enabled Embedded Linux applications using inter-process communication (IPC), multithreading, and socket programming. |
| **6** | Build and deploy Embedded Linux-based solutions for IoT, industrial automation, robotics, and communication systems. |

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

| | |
|---|---|
| **CO1** | Explain the architecture, file system, boot process, and essential features of Embedded Linux. |
| **CO2** | Develop Linux-based applications using shell scripting, system calls, process management, and file handling. |
| **CO3** | Configure, compile, and customize the Linux kernel, bootloader, and embedded root file system for ARM-based platforms. |
| **CO4** | Develop and test basic Linux kernel modules and character device drivers for embedded hardware interfaces. |
| **CO5** | Implement inter-process communication, multithreading, networking, and serial communication in Embedded Linux applications. |
| **CO6** | Design and implement complete Embedded Linux-based systems for real-world applications such as IoT, smart agriculture, industrial control, and communication systems. |

| | Course Contents | COs | Hours |
|---|---|---|---|
| **Unit 1** | **Introduction to Embedded Linux**<br>Introduction to Embedded Systems, Linux Operating System Overview, Desktop Linux vs Embedded Linux, Linux Architecture, Linux Kernel Components, Linux File System Hierarchy, Linux Boot Process, Basic Linux Commands and Shell Environment | CO1 | **(06)** |
| **Unit 2** | **Linux Programming Fundamentals**<br>Linux System Calls, File Handling in Linux, Process Management, Process Creation using fork() and exec(), Signal Handling, Shell Scripting, Introduction to Makefiles, | CO2 | **(08)** |

| | | | |
|---|---|---|---|
| **Unit 3** | **Embedded Linux System Development**<br>Cross Compilation, Cross Compiler Toolchain, BusyBox, Root File System, Bootloader (U-Boot) Fundamentals, Linux Kernel Configuration, Kernel Compilation Process, Device Tree Basics | CO3 | **(06)** |
| **Unit 4** | **Linux Device Driver Development**<br>Introduction to Linux Device Drivers, Kernel Modules, Module Programming, Character Device Drivers, Device Files, GPIO Driver Programming, Introduction to Interrupt Handling | CO4 | **(06)** |
| **Unit 5** | **Inter-Process Communication and Networking**<br>Pipes, Message Queues, Shared Memory Semaphores, POSIX Threads, Socket Programming TCP/IP Basics, Serial Communication in Linux | CO5 | **(06)** |
| **Unit 6** | **Embedded Linux Applications and Case Studies (6 Hours)**<br>Embedded GUI Overview, Embedded Linux for IoT, Embedded Linux Security Basics, Power Management, Embedded Multimedia Applications, Raspberry Pi as Embedded Linux Platform, BeagleBone Black Overview, Industrial and Automotive Applications, Case Studies in Smart Agriculture, Robotics, and Communication Systems | CO6 | **(06)** |

| | **Text Books** |
|---|---|
| **1** | Karim Yaghmour, *Building Embedded Linux Systems*, O'Reilly. |
| **2** | Christopher Hallinan, *Embedded Linux Primer*, Pearson. |
| **3** | Craig Hollabaugh, *Embedded Linux: Hardware, Software and Interfacing*, Addison-Wesley. |
| **4** | |

| | **Reference Books** |
|---|---|
| **1** | Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman, *Linux Device Drivers*, O'Reilly. |
| **2** | Robert Love, *Linux Kernel Development*, Addison-Wesley. |
| **3** | W. Richard Stevens, *Advanced Programming in the UNIX Environment*, Pearson. |
| **4** | P. Raghavan, *Embedded Linux System Design and Development*, CRC Press. |
| | |

# Shivaji University, Kolhapur

## Final Year (Sem- VIII) B.Tech. Electronics and Computer Science

| Course Category | Emerging Minor |
|---|---|

**Quantum Computing**

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | -- | | MSE | 30 Marks |
| Tutorials | -- | | ISE/CA | 10 Marks |
| Total Credits | 3 | | ESE | 60 Marks |
| | | | **Total Marks** | 100 Marks |

Prerequisites: Engineering Mathematics, Digital Electronics, Programming Fundamentals, Basic Engineering Physics.

**Course Objectives:**

| | |
|---|---|
| **1** | To introduce the basic concepts and principles of quantum computing. |
| **2** | To understand qubits, quantum states, and basic quantum gates. |
| **3** | To learn the construction and working of simple quantum circuits. |
| **4** | To familiarize students with basic quantum algorithms and their applications. |
| **5** | To provide hands-on exposure to quantum computing using simulation tools such as Qiskit. |
| **6** | To create awareness about the potential applications and future scope of quantum computing. |

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

| | |
|---|---|
| **CO1** | Explain the basic concepts and principles of quantum computing. |
| **CO2** | Describe qubits, quantum states, superposition, entanglement, and basic quantum gates. |
| **CO3** | Develop simple quantum circuits using quantum gates. |
| **CO4** | Demonstrate basic quantum algorithms using quantum computing simulators. |
| **CO5** | Use basic quantum computing tools such as Qiskit to implement simple quantum programs. |
| **CO6** | Identify the applications and future scope of quantum computing in engineering and technology. |

| | Course Contents | COs | Hours |
|---|---|---|---|
| **Unit 1** | **Introduction to Quantum Computing**<br>Definition and history of quantum computing, Need for quantum computing, Classical computing vs quantum computing, Basic concepts of quantum mechanics, Qubits and quantum states, Superposition and measurement, Bloch sphere representation, Applications and future scope of quantum computing. | CO1 | **(06)** |
| **Unit 2** | **Quantum Gates and Quantum Circuits**<br>Quantum bits (Qubits), Single-qubit quantum gates (Pauli-X, Pauli-Y, Pauli-Z, Hadamard, Phase gates), Multi-qubit gates (CNOT, SWAP), Quantum circuit model, Circuit representation and notation, Design and analysis of simple quantum circuits. | CO2 | **(08)** |
| **Unit 3** | **Quantum Algorithms**<br>Introduction to quantum algorithms, Deutsch's Algorithm, Deutsch-Jozsa Algorithm (basic concept), Grover's Search Algorithm (basic concept), Shor's Factoring Algorithm (overview), Comparison of classical and quantum algorithms, Applications of quantum algorithms. | CO3 | **(06)** |

| | | | |
|---|---|---|---|
| **Unit 4** | **Quantum Programming and Simulation**<br>Introduction to quantum programming, Quantum computing platforms, IBM Quantum Experience, Basics of Qiskit, Creating simple quantum circuits using Qiskit, Running quantum circuits on simulators, Interpretation of simulation results. | CO4 | **(06)** |
| **Unit 5** | **Applications of Quantum Computing**<br>Quantum cryptography, Quantum Key Distribution (QKD), Quantum communication, Applications in optimization, Artificial Intelligence and Machine Learning, Drug discovery, Financial modeling, Healthcare, Scientific research and engineering applications. | CO5 | **(06)** |
| **Unit 6** | **Challenges and Future Trends in Quantum Computing**<br>Challenges in quantum computing, Quantum noise and decoherence (basic concepts), Quantum error correction (overview), Quantum hardware technologies, Current industrial developments, Future trends in quantum computing, Career opportunities and emerging research areas. | CO6 | **(06)** |

| | |
|---|---|
| | **Text Books** |
| 01 | Chris Bernhardt - Quantum Computing for Everyone - MIT Press. |
| 02 | Robert S. Sutor - Dancing with Qubits: How Quantum Computing Works and How It Can Change the World - Packt Publishing. |
| 03 | Jack D. Hidary - Quantum Computing: An Applied Approach - Springer. |
| 04 | Michael A. Nielsen and Isaac L. Chuang - Quantum Computation and Quantum Information - Cambridge University Press. |
| | **Reference Books** |
| 01 | Scott Aaronson - Quantum Computing Since Democritus - Cambridge University Press. |
| 02 | Eleanor G. Rieffel and Wolfgang H. Polak - Quantum Computing: A Gentle Introduction - MIT Press. |
| 03 | N. David Mermin - Quantum Computer Science: An Introduction - Cambridge University Press. |
| 04 | Noson S. Yanofsky and Mirco A. Mannucci - Quantum Computing for Computer Scientists - Cambridge University Press. |
| 05 | Maria Schuld and Francesco Petruccione - Supervised Learning with Quantum Computers - Springer. |

**Design Thinking Course: Teaching Methodology, Assessment, and Evaluation**

- The Non Credit Course under Design Thinking Category is offered to the students in Fifth or Sixth Semester through Massive Open Online Courses (MOOCs), and students may select a course from the following list or relevant course available on the respective online platform at that time. The course should have duration of not less than 4 weeks and not more than 6 weeks with minimum of 20 lectures and maximum of 30 lectures.
- The course is learned in online mode and can be completed by the student at their own pace within the prescribed duration.
- For enrollment, students are required to visit the SWAYAM or Coursera platform, register, and create their individual accounts.
- After successful registration, students must log in to their accounts, enroll in the course, and follow all instructions provided to complete the course.
- A Departmental Course Coordinator shall be appointed for the respective course.
- Students must submit all weekly assignments available on the respective platform, or those assigned by the Course Coordinator with prior approval from the respective Course Coordinator for assessment and evaluation.
- The Institute shall issue a Course Completion Certificate to students only after fulfilment of the following requirement:

    - Successful Completion and submission of 100% of the weekly assignments.

- Students are expected to adhere to all course guidelines and complete the course within the stipulated timeframe specified on the respective platform or by the Course Coordinator.

**Online Platform- Swayam**

**1] Course Title- Design Thinking**

Instructor- Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr. Deepali Raheja, Dr. Mansi Kapoor Sri Balaji University Pune

**Course Information**

Welcome to the captivating world of Design Thinking! This online course is designed to introduce you to the essential principles and techniques of Design Thinking—a powerful approach to problem-solving and innovation that has gained widespread recognition across various sectors in today's contemporary era.

In this course, you will discover that Design Thinking is much more than mere thinking. It is a mindset—an innovative and human-centric approach to identifying problems, designing effective solutions, and delivering outcomes that address unmet human needs.

Are you ready to unlock your creative potential and become a visionary leader in the business world? Join us on an exhilarating journey as we dive deep into the transformative power of design thinking through our immersive MOOC course on "Design Thinking."

Prepare to embark on a dynamic adventure where you will explore cutting-edge methodologies, challenge conventional thinking, and develop the essential skills to drive innovation. By participating in this course, you will be equipped with actionable strategies to tackle complex problems, discover untapped opportunities, and create value in today's ever-evolving business landscape.

Get ready to unleash your imagination, collaborate with like-minded individuals, and revolutionize your approach to problem-solving. Enroll now and embrace the boundless possibilities that await you!

This course adopts the Learner-Centric Model approach developed by IIT Bombay while planning, designing, and conducting this MOOC.

**Learning Objectives-**

This course will help you gain a strong foundation in design thinking principles and equip you with the necessary skills to apply this methodology in your future endeavors. Also, this course will help you to develop a problem-solving mindset and the ability to approach challenges from a human-centered perspective.

**Course outline-**

Week 0: Welcome to the course
Week 1: Foundation of Design Thinking
Week 2: Empathy-Foundation and Tools of Empathy
Week 3: Define-Foundation and Tools
Week 4: Ideate-Foundation and Tools

Week 5: Prototype & Foundation and
Tools Week 6: Learn From Practitioner

**Syllabus-**

| Week/ Module | Topics |
|---|---|
| Week 0 | • Demo Video<br>• Welcome to the course<br>• Course Schedule<br>● Grading Policy<br>● Exam Details<br>● FAQ |
| Week 1 | **Foundation of Design Thinking**<br>• Introduction to Design Thinking<br>• Significance of Design Thinking<br>• Key Tenets of Design Thinking<br>• Design Thinking Process- 4 Critical Questions<br>• Design Thinking Process<br>• Wicked Problems<br>• How Design Thinking is Different from Traditional Thinking<br>• The Knowledge Funnel<br>• Cognitive Bias: What Design Thinkers Should Avoid |
| Week 2 | **Empathy-Foundation and Tools of Empathy**<br>• Foundation of Empathy<br>• Purpose of empathy<br>• Observation as a tool of empathy<br>• Methods of Observation<br>• Empathetic Interview<br>• Stakeholder maps<br>• Jobs to be done<br>• Empathy Maps |
| Week 3 | **Define- Foundation and tools**<br>• Rules of Defining<br>• Importance of Defining<br>• Customer Journey Map<br>• Customer experience<br>• Persona |
| Week 4 | **Ideate-Foundation and Tools**<br>• Introduction to Ideation<br>• Double Diamond<br>• Brainstorming<br>• Rules for Brainstorming<br>• Mind Mapping<br>• Worst Possible Idea |
| Week 5 | **Prototype -Foundation and Tools**<br>• Concept of Prototyping<br>• Paper prototype<br>• Story Board prototype<br>• Scenario prototype<br>• Low fidelity and high fidelity<br>Test Foundation and Tools<br>• Introduction to Test |
| Week 6 | **Learn from Practitioner**<br>• Interview 1 Mr Rohit Dubepatil – Director ORAH Nutrichem.Pvt.Ltd<br>• Interview 2 Dr Bala Ramadurai<br>• Interview 3Mr Abhijeet Kumar- Founder StepBeta<br>• Interview 4 Ms Savita Rajiv |

**Online Platform- Coursera**

**Course Title- Design Thinking and Innovation Instructor: B K Chakravarthy – IIT Bombay**

**Syllabus-**

**Module 1-Innovation by Design:**

Introducing the fundamental concepts of design thinking and the 7 Concerns for Innovation. This module will establish the foundation for understanding how design can solve complex problems by focusing on user needs and iterative innovation. Understand the principles of design thinking. Familiarize yourself with the 7 Concerns for Innovation. Recognize the importance of collaboration in the innovation process.

**Module 2- The resolve to solve a problem:**

Every design project is initiated by a _need', which becomes _The Cause' of the entire journey that follows. This need may be a commercial requirement, a social necessity or a specific niggling problem with an existing product. The recognition of such a need is a key trigger for the project and it can be identified by any of the stakeholders connected to the product – a product manufacturer or marketer, a user or a product designer.

**Module 3- Understanding the problem space:**

To study and understand an existing product or similar products in the market, it is critical that the environment in which the product is used, which designers like to call 'The Context' is understood comprehensively. This means that a designer must study the users and their perspectives on the product. Often, this involves several rounds of interaction and observation.

**Module 4- Arriving at a Design insight:**

At this stage, the designer analyses all the information gathered and methodically lists out their observations and perceptions of any notable issues in the use of the product. Such analysis results in the thorough, all-round 'Comprehension' of the product as it functions within the context of its use. The design insights thus arrived at give rise to creative ideas, and form the basis of the intervention that follows.

**Module 5- Creating a product brief:**

The Check is an essential step in understanding what requirements the product should ultimately meet and what problems the design intervention should address. The check, which is often a document in the form of a product brief, is created from the design insights and must be approved by the client. The product brief is an important point of reference throughout the journey as concepts and prototypes are created and evaluated.

**Module 6- Generating ideas and concepts:**

At this stage called 'The Conception ', the designer arrives at multiple ideas to come up with solutions for the problems listed using the product brief. At this crucial stage, ideas are proposed and grouped into clusters. This makes possible the consideration of multiple concepts. Finally, the team zeros in on one all-encompassing concept that best addresses all aspects of the product.

**Module 7- Building Mockups and prototypes:**

The final concept is further refined with reference to criteria like materials available or desirable, and the conditions in which the product is to be manufactured. At this penultimate stage, the designer creates several style options according to the user profile and selects one that best addresses all the aesthetic concerns. The chosen product design is showcased by 'Crafting' small-scale mock-up models, CAD models, or working prototypes. A final version of the product that meets all conditions in the product brief is then taken up for production

## SCHEME OF INSTRUCTION & SYLLABI

**Name of Programme:** Electronics and Computer Science

**Scheme of Instructions:** Third Year B. Tech. in Electronics and Computer Science

**Semester–V**

| Sr. No. | Course Category | Course Code | Course Title | L | T | P | Contact Hrs/Wk | Course Credits | EXAM SCHEME | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | MSE | ISE/CA | ESE | TOTAL |
| 1 | PCC | ECS0251 | Signal & System | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 2 | PCC | ECS0252 | Power Electronics | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 3 | PCC | ECS0253 | Python Programming | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 4 | PEC | ECS0254 | PEC-1 | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 5 | MDM | ECS0255 | Multi-disciplinary Minor–03 | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 6 | OE | ECS0256 | Open Elective-03 | 2 | -- | -- | 2 | 2 | 30 | 10 | 60 | 100 |
| 7 | PCC | ECS0257 | Power Electronics Lab | -- | -- | 2 | 2 | 1 | – | 25 | 25 | 50 |
| 8 | PCC | ECS0258 | Python Lab | -- | -- | 2 | 2 | 1 | – | 25 | 25 | 50 |
| 9 | PEC | ECS0259 | PEC-1 LAB | -- | -- | 2 | 2 | 1 | – | 25 | -- | 25 |
| 10 | MDM | ECS02510 | Multi-disciplinary Minor–03 Lab | -- | -- | 2 | 2 | 1 | – | 50 | -- | 50 |
| 11 | EL | ECS02511 | Mini Project-I | -- | -- | 2 | 2 | 1 | -- | 25 | -- | 25 |
| | | | **Total** | **17** | **--** | **10** | **27** | **22** | **180** | **210** | **410** | **800** |

L-Lecture T-Tutorial P-Practical

MSE-Mid Semester Examination ISE/CA-In Semester Evaluation/Continuous Assessment ESE-End Semester Examination (For Laboratory End Semester performance)

| Course Category | Basic Science Courses (BSC) | Engineering Science Courses (ESC) | Programme Core Course (PCC) | Programme Elective Course (PEC) | Open Elective other than Particular Programme (OE/MDM) | Vocational and Skill Enhancement Course (VSEC) | Humanities Social Science and Management (HSSM) | Experiential Learning (EL) | Co-curricular and Extracurricular Activities (CCA) |
|---|---|---|---|---|---|---|---|---|---|
| **Last Sem. Cumulative Sum** | **16** | **16** | **22** | **–** | **11** | **06** | **15** | **–** | **02** |
| **Semester Credits** | **–** | **–** | **11** | **04** | **06** | **–** | **–** | **01** | **–** |
| **Cumulative Sum** | **16** | **16** | **33** | **04** | **17** | **06** | **15** | **01** | **02** |

**PROGRESSIVE TOTAL CREDITS: 88 + 22 = 110**

## SCHEME OF INSTRUCTION & SYLLABI

**Name of Programme:** Electronics and Computer Science

**Scheme of Instructions:** Third Year B. Tech.in Electronics and Computer Science

**Semester–VI**

| Sr. No. | Course Category | Course Code | Course Title | L | T | P | Contact Hrs/Wk | Course Credits | EXAM SCHEME | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | MSE | ISE/CA | ESE | TOTAL |
| 1 | PCC | ECS0261 | Digital Signal Processing | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 2 | PCC | ECS0262 | Software Engineering | 3 | 1 | -- | 4 | 4 | 30 | 10 | 60 | 100 |
| 3 | PCC | ECS0263 | Artificial Intelligence | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 4 | PEC | ECS0264 | PEC-II | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 5 | PEC | ECS0265 | PEC-III | 3 | -- | -- | 3 | 3 | 30 | 10 | 60 | 100 |
| 6 | MDM | ECS0266 | Multi-disciplinary Minor–04 | 2 | -- | -- | 2 | 2 | 30 | 10 | 60 | 100 |
| 7 | PCC | ECS0267 | PEC – II Lab | -- | -- | 2 | 2 | 1 | -- | 50 | 25 | 75 |
| 8 | PCC | ECS0268 | Artificial Intelligence Lab | -- | -- | 2 | 2 | 1 | -- | 50 | 25 | 75 |
| 9 | EL | ECS0269 | Mini Project-II | -- | -- | 4 | 4 | 2 | -- | 50 | -- | 50 |
| | | | **Total** | **17** | **1** | **8** | **26** | **22** | **180** | **210** | **410** | **800** |

L-Lecture T-Tutorial P-Practical

MSE-Mid Semester Examination ISE/CA-In Semester Evaluation/Continuous Assessment ESE-End Semester Examination (For Laboratory End Semester performance)

| Course Category | Basic Science Courses (BSC) | Engineering Science Courses (ESC) | Programme Core Course (PCC) | Programme Elective Course (PEC) | Open Elective other than particular Programme (OE/MDM) | Vocational and Skill Enhancement Course (VSEC) | Humanities Social Science and Management (HSSM) | Experiential Learning (EL) | Co-curricular and Extracurricular Activities (CCA) |
|---|---|---|---|---|---|---|---|---|---|
| **Last Sem. Cumulative Sum** | **16** | **16** | **33** | **04** | **17** | **06** | **15** | **01** | **02** |
| **Semester Credits** | **–** | **–** | **12** | **06** | **02** | **–** | **–** | **02** | **–** |
| **Cumulative Sum** | **16** | **16** | **45** | **10** | **19** | **06** | **15** | **03** | **02** |

**PROGRESSIVE TOTAL CREDITS: 110 + 22 = 132**

## Exit Course for Electronics and Computer Science after Third Year

| Exit option: Award of B. Vocational in Major with 132 credits and an additional 8 credits from following Exit Courses | | | | |
|---|---|---|---|---|
| **Sr. No** | **Course Code** | **Course Title** | **Mode** | **Credits** |
| 1 | ECS-EC-0211 | PLC and SCADA<br>1) Basics of PLC (2)<br>2) PLC programming (3)<br>3) Introduction to SCADA (3) | Online/offline certification Course or project of total 8 credits | 8 |
| **OR** | | | | |
| 2 | ECS-EC-0212 | Digital Marketing<br>1) Introduction to Digital Marketing (2)<br>2) Application Design (3)<br>3) Mobile Marketing (3) | | 8 |

| **List of Electives: Verticals** | | | |
|---|---|---|---|
| **Specialization** | Core Electronics | AIML/CSE/IT | Communication |
| **Elective-I** | Microprocessor and Microcontroller | Embedded LINUX | Communication Engineering |
| **Elective-II** | Network Analysis | Mobile Technology | Antenna and Wave Propagation |
| **Elective-III** | Biomedical Instrumentation | Ethical Hacking | Electromagnetics |
| **Elective-IV** | Linear Integrated Circuits | IoT Communication Protocol | Wireless Communication |
| **Elective-V** | Robotics | Digital Communication and Information The opry and Coding | RF and Microwave |
| **Elective-VI** | Renewable Energy | System on Chip | Satellite Communication |

**Signal & System**

**Lectures : 3 Hrs. / Week**

**Credit : 3**

**Tutorial : NA**

**Evaluation Scheme**

**MSE :** 30 Marks

**ISE/CA :** 10 Marks

**ESE :** 60 Marks

**Course Objectives:** The objective of the course is to

1. To understand basic of CT & DT signals and their representation.
2. To understand basic of CT & DT system and their representation
3. To analyze CT & DT signals using Fourier transform
4. To compute DFT and IDFT
5. To analyze signals using Z-transform
6. To apply realization techniques for systems

**Course Outcomes:**

| COs | At the end of successful completion of the course, the student will be able to | Blooms Taxonomy |
|---|---|---|
| CO1 | Demonstrate use of signals and their representation. | Understand |
| CO2 | Represent CT & DT system. | Understand |
| CO3 | Use Fourier transform for analysis of CT & DT signals. | Analyze |
| CO4 | Compute DFT and IDFT. | Analyze |
| CO5 | Analyze signals using Z-transform. | Analyze |
| CO6 | Realize the systems. | Analyze |

| Unit No | Content | Hours |
|---|---|---|
| Unit 1 | **Signals and Classification of Signals** | |
| | Continuous time signals & discrete time, analog & digital, even &odd signals, periodic &non-periodic, deterministic &non-deterministic, energy & power, Basic CT & DT signals: unit impulse, unit step, unit ramp, complex exponential & sinusoidal, Basic operations on signals, sampling and reconstruction of signal | **07 Hrs.** |
| Unit 2 | **System and Classification of Systems** | |
| | System Representation, properties of systems: continuous time Systems & discrete Systems, system with and without memory, causal and non-causal system, linear and nonlinear system, Time invariant and time variant system, Stability of system, Impulse response representation, convolution integral, convolution sum, properties of convolution. | **07 Hrs.** |
| Unit 3 | **Fourier Transform** | |
| | Fourier Transform, Fourier Transform of CT and DT signals, Properties of Fourier Transform, Fourier transform using properties, Limitations of Fourier Transform. | **07 Hrs.** |
| Unit 4 | **Discrete Fourier Transform** | |
| | Discrete Time Fourier Transform, Discrete Fourier Transform, Inverse Discrete Fourier Transform (IDFT): Direct method, DFT using Twiddle factor, Properties. | **07 Hrs.** |
| Unit 5 | **Z transform** | |
| | Introduction of Z-transform, ROC, properties of ROC, Unilateral Z- transform, properties of Z transform, Inverse Z-transform: long division method, PFE method, residue method. | **08 Hrs.** |
| Unit 6 | **System Realization** | |
| | Continuous time system representation by differential equation, discrete time system representation by difference equation, transfer function in Z-domain, Realization of discrete time systems by Direct from I and Direct Form II | **06 Hrs.** |

**References:**

| Reference Books | |
|---|---|
| 1 | S. Palani, “Signals and Systems”, Ane Books Pvt. Ltd |
| 2 | 2 P. Ramesh Babu, R. Ananda natarajan, “Signals and Systems” 4th Edition, SCITECH publication |
| 3 | 3 A. Anand Kumar, “Signals and Systems”, PHI publication |

**Text Books:**

| Text Books | |
|---|---|
| 1 | Alan Oppenheim, Alan S. Willsky, “Signals and Systems”, 2nd Edition, PHI Publication. |
| 2 | Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley Publication |
| 3 | Michael J. Roberts, “Fundamentals of signals & systems”, Tata McGraw Hill Publication, 2007. |

**Instructions regarding Examinations:**

1. Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40%
2. Mid sem. examination will be based on 50% syllabus from beginning (First Three Units).
3. No compulsory passing for MSE.
4. ESE paper setting weightage will be 25% on syllabus covered for MSE (First Three Units) and 75% on Remaining syllabus (Last Three Units).

Passing percentage for ESE practical examination 40%

**Power Electronics**

| | | | | |
|---|---|---|---|---|
| **Lectures** | **:** | **3 Hrs. / Week** | **Evaluation Scheme** | |
| **Credit** | **:** | **3** | **MSE** | **:** 30 Marks |
| **Practical** | **:** | | **ISE/CA** | **:** 10 Marks |
| | | | **ESE** | **:** 60 Marks |

**Course Objectives:** The objective of the course is to

1. Make students aware of semiconductor power devices with its firing circuits.
2. Prepare students to design and simulate Controlled rectifier circuits.
3. Make students aware to the Utilization of Choppers and Inverters
4. Explain Industrial applications of Power Electronics Circuits.

**Course Outcomes:**

| COs | At the end of successful completion of the course, the student will be able to | Blooms Taxonomy |
|---|---|---|
| CO1 | Understand the characteristics of various power electronics devices | Understand |
| CO2 | Understand the different firing circuits of thyristor. | Understand |
| CO3 | Analyze controlled rectifier circuits. | Analyze |
| CO4 | Study of invertors using MOSFET & IGBT. | Understand |
| CO5 | Analyze the different types of choppers. | Analyze |
| CO6 | Understand the Industrial applications of Power circuits. | Understand |

| Unit No | Content | Hours |
|---|---|---|
| Unit 1 | **Semiconductor Power Devices** | |
| | Construction and V-I Characteristics, Dynamic Characteristics during turn on, turn off, SCR Turn off methods: Class A, Class B, Class C, Class D, Class E, & Class F, dv/dt & di/dt protection circuits. Construction, working, & V-I Characteristics of Diac, Triac, GTO, Power MOSFET and IGBT. | **08 Hrs.** |
| Unit 2 | **Firing Circuits of SCR** | |
| | Turn On methods of SCR, UJT triggering circuits with design, PUT, Diac and Triac triggering circuits, Cosine based firing for bridge-controlled converter. Need of Isolation. Pulse transformer & Optocoupler based isolation techniques | **06 Hrs.** |
| Unit 3 | **Controlled Rectifiers** | |
| | Controlled Rectifiers Single Phase Half wave, Full wave, Half controlled and Full controlled converters with R & RL Load, effect of Freewheeling Diode. Calculations of performance parameters and Numerical expected. | **07 Hrs.** |
| Unit 4 | **Inverters using MOSFET/IGBT's** | |
| | Principle and operation of Single-phase half bridge and full bridge inverters. Harmonic reduction techniques of inverter: Quasi square wave, Multiple PWM and sine wave PWM. (Analytical treatment not expected) | **06 Hrs.** |
| Unit 5 | **Choppers and its Applications** | |
| | Basic principles of choppers, time ratio control and current limit control techniques, voltage commutated chopper circuit, Jones chopper, Morgan's chopper, step-up chopper and AC chopper. Speed control of DC series motors using chopper, speed control of DC shunt motor using phase-controlled rectifiers. | **07 Hrs.** |
| Unit 6 | **Industrial Applications** | |
| | Static circuit breakers, over voltage protectors, zero voltage switch, integral cycle triggering, time delay method, soft start method. Non drive applications using induction heating and Dielectric heating, switched mode power supply (SMPS), Uninterrupted power supply (UPS), Battery charger, light dimmer using triac and diac, A.C. voltage stabilizer –Relay type, Servo type | **08 Hrs.** |

**References:**

| Reference Books | |
|---|---|
| 1 | Ned Mohan: Power Electronics; Wiley Pub |
| 2 | M. H. Rashid, “Power Electronics”, Pearson. |
| 3 | V. R. Moorthi, “Power Electronics: Devices, Circuits and Industrial Applications”, Oxford University Press |

**Text Books:**

| Text Books | |
|---|---|
| 1 | P. S. Bhimbra, “Power Electronics”, Khanna Publication |
| 2 | P. C. Sen, “Power Electronics”, MGH publication. |
| 3 | M. D. Singh & Khan Chandani, “Power Electronics”, McGraw Hill publication, |

**PYTHON PROGRAMMING**

| | | | | |
|---|---|---|---|---|
| **Lectures** | **:** | **3 Hrs. / Week** | **Evaluation Scheme** | |
| **Credit** | **:** | **3** | **MSE** | **:** 30 Marks |
| **Practical** | **:** | | **ISE/CA** | **:** 10 Marks |
| | | | **ESE** | **:** 60 Marks |

**Course Objectives:** The objective of the course is to

1. To define the structure and components of a Python program.
2. To learn how to write loops and decision statements in Python.
3. To learn how to write functions and pass arguments in Python.
4. To learn how to build and package Python modules for reusability.

**Course Outcomes:**

| COs | At the end of successful completion of the course, the student will be able to | Blooms Taxonomy |
|---|---|---|
| CO1 | To Learn Basic Syntax of Python Programming | Understand |
| CO2 | To understand and implement concepts of object-oriented methodology using Python. | Understand |
| CO3 | To learn collections in Python | Understand |
| CO4 | To develop problem solving skills and their implementation through Python. | Analyze |
| CO5 | Understand and apply the concept of mutable and immutable data structures in Python, including Lists, Tuples, Sets, and Dictionaries. | Understand |
| CO6 | Understand the concept of Python modules and how they help in organizing and reusing code. | Understand |

| Unit No | Content | Hours |
|---|---|---|
| Unit 1 | **Introduction to Python:** | |
| | an interpreted high-level language, interactive mode and script mode. Variables, Expressions and Statements, Variables and Types-mutable and Immutable variable and Keywords. | **06 Hrs.** |
| Unit 2 | **Operators and Operands in Python.** | |
| | Arithmetic, relational and logical operators, Operator precedence. Expressions and Statements (Assignment statement); Taking input (using raw input () and input ()) and displaying output - print statement, Comments in Python. Conditional and Looping Construct if - else statement and nested if – else while, for, use of range function infor, Nested loops, break, continue. | **08 Hrs.** |
| Unit 3 | **Functions:** | |
| | Built-In Function, invoking built in functions, Functions from math, random, time & date, User Define Function. | **06 Hrs.** |
| Unit 4 | **Strings:** | |
| | Creating, initializing and accessing the elements; String operators: +, *, in, not in, range, slice [n:m], String built in functions & methods, Strings constants defined in string module, Regular Expression and Pattern Matching. | **07 Hrs.** |
| Unit 5 | **Lists:** | |
| | Concept of mutable lists, creating, initializing and accessing the elements of list, List operations. Tuples: Immutable concept, creating, initializing and accessing the elements in a tuple; Tuple functions: cmp (), len (), max (), min (), tuple (). Sets: Concept of Sets, creating, initializing and accessing the elements of Sets operation (Membership, union, intersection, difference, and symmetric difference. Dictionaries: Concept of key-value pair, creating, initializing and accessing the elements in a dictionary, Traversing, Dictionary functions & Methods. | **08 Hrs.** |
| Unit 6 | **Modules:** | |
| | Executing modules as scripts, The Module Search Path, “Compiled” Python files Standard Modules, the dir () Function, Packages Importing * From a Package. | **07 Hrs.** |

**Textbooks:**

| **Text Books** | |
|---|---|
| 1 | Learning Python By Mark Lutz,O’Reilly Publication |
| 2 | Programming with python, A users Book, Michael Dawson, Cengage Learning |
| 3 | Python Essential Reference, David Beazley, Third Edition 5. Python Bible |

**References:**

| Reference Books | |
|---|---|
| 1 | Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf. |
| 2 | Python for Informatics: Exploring Information, Charles Severance |
| 3 | John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India |
| 4 | R. Nageswara Rao, “Core Python Programming”, Dreamtech |
| 5 | Python Learning Guide (BPB publications) |

**Microprocessor & Microcontroller (PEC 1)**

| | | | |
|---|---|---|---|
| **Lectures** | **: 3 Hrs. / Week** | **Evaluation Scheme** | |
| **Credit** | **: 3** | **MSE** | **:** 30 Marks |
| **Practical** | **:** | **ISE/CA:** | 10 Marks |
| | | **ESE** | **:** 60 Marks |

**Course Objectives:** The objective of the course is to

1. To study the concepts and basic architecture of a Microprocessor and Microcontroller.
2. To write Assembly language programs for Microprocessors and Micro controllers for various applications.
3. To know the importance of different peripheral devices and their interfacing to 8086 and 8051.
4. To build Microprocessor and Microcontroller based systems.

**Course Outcomes:**

| COs | At the end of successful completion of the course, the student will be able to | Blooms Taxonomy |
|---|---|---|
| CO1 | Explain 16-bit Microprocessor architectures and fundamental concepts of Microcontrollers. | Understand |
| CO2 | To develop programming skills for Microprocessors and Microcontrollers. | Apply |
| CO3 | To interface various devices in Microprocessor and Microcontroller systems. | Analyze |
| CO4 | To design and implement Microprocessor and Microcontroller based systems. | Apply |

| Unit No | Content | Hours |
|---|---|---|
| Unit 1 | **The 8086 Microprocessor** | |
| | 8086 Architecture, Memory Segmentation, 8086 pin description, Interrupts and Interrupt service routines, Dedicated interrupts, Software interrupts | **07 Hrs.** |
| Unit 2 | **8086 programming** | |
| | Addressing modes, Instruction Set and Assembler Directives, Assembly language programming | **07 Hrs.** |
| Unit 3 | **8086 Interfacing –Part I** | |

| | | |
|---|---|---|
| | Generating the 8086 System Clock and Reset Signals using 8284 clock generator, 8086 Minimum and Maximum Mode CPU Modules, Minimum and Maximum Mode Timing Diagrams, Memory interfacing. | **07 Hrs.** |
| **Unit 4** | **8086 Interfacing –Part II** | |
| | 8255-PPI: Functional Block Diagram and description, Operating Modes, 8259- PIC: Functional Block Diagram and description, Cascaded mode of operation, System design (including Memory and I/O) | **07 Hrs.** |
| **Unit 5** | **The 8051 Microcontroller** | |
| | Differences between a Microprocessor and Microcontroller, Architecture of 8051 Memory Organization of the 8051, Addressing modes, Instruction set, Assembly language programming. | **07 Hrs.** |
| **Unit 6** | **8051 Interfacing** | |
| | I/O port programming, Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, Stepper Motor and DC motor Interfacing | **07 Hrs.** |

**References**:

| **Text Books** | |
|---|---|
| 1 | 8086/8088 family: Design Programming and Interfacing: By John Uffenbeck (Pearson Education) |
| 2 | Microprocessor and Interfacing: By Douglas Hall (TMH Publication) |
| 3 | The 8051 Microcontroller and Embedded Systems Using Assembly and C: By M. A. Mazidi, J. C. Mazidi, Rolin D. McKinlay, Pearson Education, 2ndEdition. |
| 4 | The 8051 Microcontroller: ByKenneth J. Ayala, Cengage Learning India Pvt. Ltd, 3rdEdition |

**Text Books:**

| **Reference Books** | |
|---|---|
| 1 | Microcomputer Systems: 8086/8088 family Architecture, Programming and Design: By Liu & Gibson (PHI Publication). |
| 2 | The INTEL Microprocessors, Architecture, Programming and Interfacing: By Barry B. Brey (PearsonPublishers, 8th Edition) |
| 3 | Microcontrollers: Architecture, Programming, Interfacing and System Design: By RajKamal, Pearson Education, 2005. |
| 4 | The 8051 Microcontroller Based Embedded Systems: By Manish K Patel, McGraw Hill, 2014. |
| 5 | Microcontroller Theory And Applications:By Ajay V Deshmukh, Tata Mcgraw Hill |

**Multi-disciplinary Minor–03 Fundamentals of Robotics and Drone Technology**

**Theory: 3 Hrs./Week**

**Theory** : 3 Hrs./Week

**Credit** : 3

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA** : 10 Marks

**ESE** : 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | • Basic Engineering Mathematics<br>• Basic Programming (C/C++/Python)<br>• Fundamentals of Electronics and Control Systems | | |
| Course Objectives | 1 | Understand the fundamentals of robotics and autonomous systems. | |
| | 2 | Explain ROS architecture and communication. | |
| | 3 | Develop robot models and simulate robots using Gazebo. | |
| | 4 | Understand sensors, localization, mapping and navigation. | |
| | 5 | Learn fundamentals of quadcopter drones. | |
| | 6 | Design robotic and drone applications using ROS and Gazebo | |
| Course Outcomes | **After competition of this course Students will be able to** | | |
| | CO 1 | Explain fundamentals of robotics. | Understand |
| | CO 2 | Develop ROS applications. | Implement |
| | CO 3 | Model and simulate robots in Gazebo. | Implement |
| | CO 4 | Analyze perception and navigation. | Analyze |
| | CO 5 | Explain UAV architecture and simulate drones. | Understand |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | Introduction to Robotics | |
| | Introduction to Robotics: history, components, DOF, coordinate frames, applications. | 04 Hrs. |
| | ROS | |

| | | |
|---|---|---|
| **Unit 2** | ROS: architecture, nodes, topics, services, RViz, packages. | **04 Hrs.** |
| **Unit 3** | Robot Modelling | |
| | URDF/Xacro, robot modeling, Gazebo simulation, sensors | **06 Hrs.** |
| **Unit 4** | Robot Navigation | |
| | Localization, SLAM, navigation, LiDAR, camera, IMU. | **04 Hrs.** |
| **Unit 5** | Drone technology | |
| | Drone technology: UAVs, Pixhawk, MAVLink, PX4, applications. | **04 Hrs.** |
| **Unit 6** | Drone simulation | **06 Hrs.** |
| | Drone simulation using PX4 SITL, MAVROS, Gazebo, autonomous missions. | |

**Textbooks**

| Sr. No. | Title | Author | Edition/Publication |
|---|---|---|---|
| 01 | Mastering ROS for Robotics Programming | Lentin Joseph | |
| 02 | Programming Robots with ROS | Morgan Quigley et al. | |

**Reference Books**

| Sr. No. | Title | Author | Edition/Publication |
|---|---|---|---|
| 01 | • Robot Modeling and Control | Spong | |
| 02 | • Introduction to Robotics | John J. Craig | |
| 03 | • Robotics, Vision and Control | Peter Corke | |
| 04 | • Modern Robotics | Lynch & Park | |

**Power Electronics Lab**

| | | | |
|---|---|---|---|
| **Theory** | **:** NA | **Evaluation Scheme** | |
| **Credit** | **:** 1 | **ISE/CA** | **:** 25 Marks |
| | | **ESE** | **:** **25** Marks |

| **Course Objectives:** The objective of the course is to |
|---|
| 1. Make students aware of semiconductor power devices with its firing circuits.<br>2. Prepare students to design and simulate Controlled rectifier circuits.<br>3. Make students aware to the Utilization of Choppers and Inverters<br>4. Explain Industrial applications of Power Electronics Circuits. |
| |

**Course Outcomes:**

| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Understand and explain the characteristics of semiconductor power devices and their firing circuits. | Understand |
| CO2 | Design and simulate controlled rectifier circuits used in power electronics applications. | Analyze |
| CO3 | Analyze and apply the operation of choppers and inverters in power conversion systems. | Analyze |
| CO4 | Explain and evaluate the industrial applications of power electronics circuits. | Understand |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. Experiment on V-I Characteristics of SCR TRIAC, DIAC.
2. Study of V-I Characteristics of MOSFET/IGBT/GTO
3. Study of Firing circuits using UJT as relaxation oscillator/RAMP- Pedestal Circuit
4. Study of Firing circuits using TRIAC, DIAC
5. Study of Half controlled Bridge rectifier
6. Study of Fully controlled Bridge rectifier
7. Study of AC voltage Regulator
8. Study of Jones chopper and Morgan's chopper
9. Study of Single-phase Inverter
10. Study of SMPS/UPS
11. Study of Light dimmer using Diac/Triac
12. Study of A.C. Voltage stabilizer

Note: These experiments can be performed on virtual lab also

**PYTHON PROGRAMMING LAB**

| | | | |
|---|---|---|---|
| **Theory** | **:** | NA | **Evaluation Scheme** |
| **Credit** | **:** | 1 | **ISE/CA:** 25 Marks |
| | | | **ESE : NA** |

| **Course Objectives:** The objective of the course is to |
|---|
| 1. To define the structure and components of a Python program.<br>2. To learn how to write loops and decision statements in Python.<br>3. To learn how to write functions and pass arguments in Python.<br>4. To learn how to build and package Python modules for reusability. |

| **Course Outcomes:** | |
|---|---|
| At the end of successful completion of the course, the student will be able to | **Blooms Taxonomy** |
| Understand and explain the basic structure and components of a Python program. | Understand |
| Apply decision making and looping constructs to develop Python programs for problem solving. | Analyze |
| Develop modular programs using functions and argument passing in Python. | Apply |
| Create and use Python modules and packages to build reusable and organized programs. | Apply |

**List of Experiment**

1. Installation of Python Shell.
2. Built in functions in Python.
3. Study about operators in Python.
4. Write a Python program to take user input using input () and display the output using print ().
5. Write a Python program to demonstrate conditional constructs: if, if-else, and nested if-else.
6. Write a program to demonstrate loops (for, while) and range () function. Implement programs using break and continue statements.
7. Use built-in functions from math, random, and time modules.
8. Write Python programs to define and call user-defined functions.
9. String Operations Write a program to demonstrate string slicing, concatenation, repetition, and membership operators (in and not in). Implement a program to use string methods like split (), join (), find (), replace (), etc.
10. Write Python programs to match patterns using the re module
11. Write programs to create, access, and manipulate lists. Implement list operations like sorting, reversing, and list comprehensions. Demonstrate tuple creation, access, and use of tuple functions like len (), max (), min (), etc.
12. Write programs to create and manipulate sets and dictionary in python.

## PEC-1 Lab (Microprocessor and Microcontroller)

| | | | |
|---|---|---|---|
| **Theory** | **:** NA | **Evaluation Scheme** | |
| **Credit** | **:** 1 | **ISE/CA** | **:** 25 Marks |
| **Course Code** | **: ECS0259** | **ESE** | **: NA** |

| **Course Objectives:** The objective of the course is to | | |
|---|---|---|
| To provide hands-on exposure to 8086 microprocessor and 8051 microcontroller programming, interfacing, and embedded system application development through practical experiments. | | |
| **Course Outcomes:** | | |
| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
| CO1 | Apply number system conversion and logic gate concepts to solve basic digital problems. | Apply |
| CO2 | Develop and execute 8086 assembly language programs using data transfer, arithmetic, logical, and branching instructions | Apply |
| CO3 | Implement 8086 programs for memory manipulation, array processing, sorting, and arithmetic operations. . | Apply |
| CO4 | Interface and control peripheral devices using the 8051 microcontrollers for embedded system applications. | Analyze |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. To convert different number from decimal to binary, octal to hexadecimal & vice versa &also study of logic gates.
2. Perform hands on experiment using 8086 kits.
3. Storing and displaying the content stored at different registers and memory location.
4. Implementation of 8086 programs involving data transfer and arithmetic instruction set.
5. Implementation of 8086 programs involving logical and bit manipulation instruction set.
6. Implementation of 8086 programs involving branch instruction and machine control instruction set.
7. Data transfer. - block move, exchange, sorting, finding largest element in an array.
8. Arithmetic instructions - addition/subtraction, multiplication, square & cube. (16 bits arithmetic operations)
9. Boolean & logical instructions (bit manipulations)
10. Programs to generate delay using serial port and on-chip timer / counter.
11. Simple calculator using six-digit seven segment display and hex keyboard interface to 8051.
12. Stepper and dc motor control interface to 8051

Parking or Environmental Monitoring.

**MDM 03 Lab**

| | | | |
|---|---|---|---|
| **Theory** | **:** NA | **Evaluation Scheme** | |
| **Credit** | **:** 2 | **ISE/CA** | **:** 50 Marks |
| **Practical:** | **: 02 Hrs./Week** | **ESE** | **: NA** |

| **Course Objectives:** The objective of the course is to |
|---|
| To provide hands-on experience in robot programming, simulation, and autonomous drone applications using the Robot Operating System (ROS), Gazebo, and PX4 simulation environment. |
| |

**Course Outcomes:**

| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
|---|---|---|
| CO1 | install, configure, and use the ROS and Gazebo environment for robot and drone application development. | Apply |
| CO2 | Develop ROS-based applications by creating nodes, publishers, subscribers, services, and robot models using URDF/Xacro. | Create |
| CO3 | Simulate and analyze mobile robot perception, localization, mapping, and autonomous navigation using Gazebo and RViz. | Analyze |
| CO4 | Design and simulate autonomous drone missions using PX4, MAVROS, and Gazebo by integrating sensors and waypoint-based navigation for real-world applications. | Create |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. Install Ubuntu, ROS and Gazebo
2. Create ROS workspace
3. Publisher–Subscriber
4. URDF robot model
5. Mobile robot in Gazebo
6. RViz visualization
7. LiDAR/Camera simulation
8. SLAM with TurtleBot
9. Navigation stack
10. PX4 drone simulation
11. Waypoint navigation
12. Mini project

**Mini Project I**

| | | | |
|---|---|---|---|
| **Lectures** | **:** | **NA** | **Evaluation Scheme** |
| **Credit** | **:** | **1** | |
| **Practical** | **:** | **2 Hrs./Week** | **ISE/CA:** 25 Marks |

**Course Objectives:**

1. Provide students for knowledge of Electronics Components and soldering techniques and its package information for electronics circuit design
2. Provide students for knowledge of the assembling of electronics circuit with components on PCB (Printed Circuit Board) of circuit design.
3. Design and development of Small electronic project based on hardware and software for Electronics systems.

**Course Outcomes:**

After successful completion of the course students will be able to:
CO1: Practice acquired knowledge within the chosen area of technology for project development.
CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO3: Reproduce, improve and refine technical aspects for engineering projects.
CO4:. Work as an individual or in a team in development of technical projects
CO5: Communicate and report effectively project related activities and finding

**Mini project work should consist of following steps.**

The Mini Project topic should be based on the any one subject concept that students have studied for their Academic Year.
1. Students should propose project ideas & finalize the project idea in consultation with guide.
2. Students should submit implementation plan in the form of PERT/CPM chart, which will cover weekly activity of project report.
3. Problem definition and specification development in the form of synopsis.
4. Design of circuit with calculation & should include
a) Analog part
b) digital part
c) Power supply
d) Test strategy if firmware is required produce flow chart.

**Note**:- 1. Project report should include report of all above steps and conclusion.
2. Project group should demonstrate and deliver seminar on project.
3. A mini project should not exceed three students per group.

**Project synopsis Format**: Project synopsis should be of 08 to 10 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed.
1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Point. Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman

9. Headings: Times New Roman, 14 Point, Bold Face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director
11. Index of synopsis:
a. Title Sheet
b. Certificate
c. Acknowledgement
d. Table of Contents.
e. List of Figures
f. List of Tables
12. References

**Digital Signal Processing**

| | | | | | |
|---|---|---|---|---|---|
| **Lectures** | **:** | 3 Hrs./Week | **Evaluation Scheme** | | |
| **Tutorial** | **:** | NA | **MSE** | **:** | 30 Marks |
| **Credit** | **:** | 3 | **ISE/CA** | **:** | 10 Marks |
| | | | **ESE** | **:** | 60 Marks |

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Signal System | | |
| Course Objective | 1 | To understand Fast Fourier Transform and Fast Convolution | |
| | 2 | To understand design of digital FIR filters using various methods | |
| | 3 | To understand design of digital IIR filters using various methods | |
| | 4 | To understand the key architectural features of DSP Processor | |
| | 5 | To understand the basic concept of Multirate digital signal processing | |
| | 6 | To understand the basic concept of wavelet transform | |
| Course Outcomes | After competition of this course Students will be able to | | Blooms Taxonomy |
| | CO1 | Make use of FFT algorithm for filtering of long duration sequences | Apply |
| | CO2 | Design digital FIR filters | Analyze |
| | CO3 | Design digital IIR filters | Analyze |
| | CO4 | Implement FIR and IIR filters using DSP Processor | Analyze |
| | CO5 | Apply the basic concept of Multirate digital signal processing | Apply |
| | CO6 | Apply the basic concept of wavelet transform | Apply |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | **Discrete Fourier Transform & FFT Algorithms** | |
| | Computational Complexity of DFT, Fast Fourier transform algorithms – Radix -2 DIT and DIF for DFT and IDFT computations, Circular convolution, Fast Convolution: Overlap-Add and Overlap-save algorithm. (Numerical) | **07 Hrs.** |
| Unit 2 | **FIR Filter Design** | |
| | Characteristic of FIR filter, properties of FIR filter, type of FIR filter Fourier series method, frequency sampling, Fourier series & windowing method. | **07 Hrs.** |
| Unit 3 | **IIR Filter Design** | |
| | Analog filters approximations, mapping of S-plane to Z-plane, Design of IIR using Impulse Invariance Method, Bilinear Transformation method, Frequency Transformation, Filter design methods: Butterworth filters, Chebyshev filters and its conversion to digital filter. | **07 Hrs.** |
| Unit 4 | **Realization of Digital filters** | |
| | FIR and IIR filter realization in cascade form and parallel form Effect of finite word length on realization. Introduction to DSP processors: TMS320C67XX, Architecture, Functional Units, pipelining, Registers, Addressing modes. | **08 Hrs.** |
| Unit 5 | **Multirate digital signal processing** | |
| | Need of Multirate digital signal processing, decimation by factor D, two stage decimator, interpolation by factor I, two stage Interpolator, sampling rate conversion by rational factor I/D, applications of multirate signal processing | **07 Hrs.** |
| Unit 6 | **Wavelet Transform** | |
| | Fourier Transform and its limitations, short time Fourier transform, continuous wavelet Transform, Discretization of the continuous wavelet Transform, Multiresolution Approximations; mother wavelet and Scaling functions, Haar wavelets and Daubechies wavelets, Applications of wavelet transform | **06 Hrs.** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Digital Signal Processing Principles, Algorithms and Application | John G Prokis, Manolakis | Pearson Education publication |
| 02 | Digital Signal Processing | Salivahanam, A Vallavaraj, C. Guanapriya | Tata McGraw Hill Publication |
| 03 | Digital Signal Processing | A. Anand Kumar | PHI Publications |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Digital Signal Processing | P. Ramesh Babu | SciTech Publication |
| 02 | Digital Signal Processing | Sanjeet Mitra | Tata McGraw Hill Publication |
| 03 | Digital Signal Processing | Alan Oppenheim, Schafer | PHI Publication |

**Software Engineering**

**Lecture :** 3 Hrs/Week

Tutorial : 01 Hr./Week

**Credit : 4**

**Evaluation Scheme**

**MSE : 30 Marks**

**ISE/CA : 10 Marks**

**ESE : 60 Marks**

| | | | |
|---|---|---|---|
| Course Pre-Requisite | C++, Python programming, Data structure | | |
| Course Objective | 1. | To expose the students to basic concepts & principles of software engineering. | |
| | 2. | To make the student aware of the importance of SDLC in their project development work. | |
| | 3. | To expose the students to software testing techniques and software quality management. | |
| Course Outcomes | After competition of this course Students will be able to | | Blooms Taxonomy |
| | CO1 | Comprehend systematic methodologies of SDLC (Software Development Life Cycle). | Understand |
| | CO2 | Discriminate competing and feasible system requirements indicating correct real world problem scope and prepare stepwise system conceptual model using stakeholder analysis and requirement validation. | Analyze |
| | CO3 | Prepare SRS document for a project. | Analyze |
| | CO4 | Apply software design and development techniques. | Apply |
| | CO5 | Develop a quality software project through effective team-building, planning, scheduling and risk. | Apply |
| | CO6 | Understand testing methods at each phase of SDLC. | Understand |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | **The software Problem** | |
| | Cost, Schedule & Quality, Scale and Change, Software Lectures Processes: Process & Project, Component Software Processes, Software Development process Models, Project Management Process. | **07 Hrs.** |
| Unit 2 | **Software Requirements Analysis & specification** | |
| | Value of Good SRS, Requirement Process, Requirements Specification, Other Approaches for Analysis, Validation | **07 Hrs.** |
| Unit 3 | **Software Planning & Scheduling** | |
| | Responsibilities of Software Project Manager, Project Planning, Project Scheduling, Project Staffing, People CMM, Risk Management | **07 Hrs.** |
| Unit 4 | **Design** | |
| | Design Concepts, Function Oriented Design, Object Oriented Design, Detail Design, Verification, Metrics | **07 Hrs.** |
| Unit 5 | **Coding & Testing** | |
| | Coding & Code Review, Testing, Unit Testing, Black Box, Testing, White Box Testing, Program Analysis Tools, Integration Testing, 7 System Testing | **07 Hrs.** |
| Unit 6 | **Software Reliability &Quality Management** | |
| | Reliability, Software Quality, Software Quality Management System, ISO 9000, SEI capability Maturity Model, Six Sigma, Agile Software Development & Extreme Programming, Agile Project Management | **07 Hrs.** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Software Engineering: A precise Approach | Pankaj Jalote | Wiley India |
| 02 | Fundamentals of Software Engineering | Rajib Mall | 3rd Edition, PHI |
| 03 | Software Engineering | Jan Sommerville | 9th Edition Pearson |
| 04 | Software Engineering Principles & Practices | Rohit Khurana ITLESL | 2nd Edition Vikas Publishing House Pvt. Ltd. |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Software Engineering – Concepts & Practices | Ugrasen Suman | Cenage Learning |
| 02 | Software Engineering Fundamentals | Behforooz & Hudson | Oxford: Indian Edition1st |

**Artificial Intelligence**

**Lectures** : 3 Hrs/Week

**Credit** : 3

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA** : 10 Marks

**ESE** : 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Data structure algorithm, Discrete Mathematics | | |
| Course Objective | 1. | To impart artificial intelligence principles, techniques, and its history. | |
| | 2. | To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems | |
| | 3. | To develop intelligent systems by assembling solutions to concrete computational problems. | |
| Course Outcomes | After competition of this course Students will be able to | | Blooms Taxonomy |
| | CO1 | Evaluate Artificial Intelligence (AI) methods and describe their foundations. | Remember |
| | CO2 | Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning. | Analyze |
| | CO3 | Demonstrate knowledge of reasoning and knowledge representation for solving real world problems. | Understand |
| | CO4 | Analyze and illustrate how search algorithms play vital role in problem solving. | Analyze |
| | CO5 | Illustrate the construction of learning and expert system. | Analyze |
| | CO6 | Discuss current scope and limitations of AI and societal implications. | Understand |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | **Artificial Intelligence and Its Issues:** | |
| | Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems | **07 Hrs.** |
| Unit 2 | **Overview to Problem Solving & Heuristic Search** | |
| | Problem solving by Search, Problem space - State space, Blind Search - Types, Performance measurement. Types, Game playing mini-max algorithm, Alpha-Beta Pruning | **07 Hrs.** |
| Unit 3 | **Probabilistic Reasoning & Markov Decision process** | |
| | Probability, conditional probability, Bayes Rule, Bayesian Networks-representation, construction and inference, temporal model, hidden Markov model. MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs. | **07 Hrs.** |
| Unit 4 | **Learning Systems & Expert Systems** | |
| | Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Learning Decision Trees. Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools Difficulties in Developing Expert Systems - Applications of Expert Systems. | **07 Hrs.** |
| Unit 5 | **Reinforcement Learning** | |
| | Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning. | **07 Hrs.** |
| Unit 6 | **AI with Python:** | |
| | Study of important inbuilt libraries of Python like NumPy, SciPy, matplotlib, nltk, Simple AI. Installing Python. Setting up PATH. Running Python. Study of real time applications of AI with Python, Case Studies: AI Platforms-Azure ML, Google AI, Swift AI, Tensor flow. | **07 Hrs.** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Artificial Intelligence: A Modern Approach | Stuart Russell and Peter Norvig | Pearson 4th Edition |
| 02 | Artificial Intelligence | Elaine Rich and Kevin Knight | Tata McGraw Hill 3rd Edition |
| 03 | Artificial Intelligence: Structures and Strategies for Complex Problem Solving | George F. Luger | Pearson, 6th Edition |

| **Reference Books** | | | |
|---|---|---|---|
| **Sr. No.** | **Title** | **Author** | **Edition/Publication** |
| 01 | Artificial Intelligence: A Guide to Intelligent Systems Author | Michael Negnevitsky | Pearson Education Second Edition |
| 02 | Machine Learning | Tom M. Mitchell | McGraw-Hill, 1st Edition |
| 03 | Artificial Intelligence with Python | Prateek Joshi | Packt Publishing, 2nd Edition |

**PLC & Automation (PEC II)**

**Lectures** : 3 Hrs./Week

**Credit** : 3

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA:** 10 Marks

**ESE:** 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Sensor & applications, Instrumentation | | |
| Course Objective | 1. | 1. Discuss importance, purpose, functions and operations of the PLC in industrial application.<br>2. The ladder diagrams for industrial control applications.<br>3. Aware how to select the essential elements and practices needed to develop and implement the engineering automation using PLC. | |
| Course Outcomes | After competition of this course Students will be able to | | Blooms Taxonomy |
| | CO1 | Apply concepts of PLC, its uses for industrial applications. | Apply |
| | CO2 | Demonstrate Relay logic instructions & PLC ladder programs for industrial applications. | Apply |
| | CO3 | Demonstrate timer, counter arithmetic, comparison functions & PLC ladder programs for industrial applications. | Apply |
| | CO4 | Make use of knowledge of Installation, troubleshooting & maintenance of PLC to provide solution for industrial automation problems. | Understand |
| | CO5 | Describe fundamentals of process control, SCADA & HMI | Understand |
| | CO6 | Select appropriate interfacing technique & communication protocol to establish communication with field devices, HMI & SCADA. | Analyze |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | **PLC Overview** | |
| | Definition & History of PLC, Basic structure & Components of PLC, Principle of Operation, Selection of PLC, Why Use PLC, PLC I/O Modules, Memory & How it is used, PLC advantages &Disadvantages, PLC vs Computers, Overview of Micro PLCs. Conventional ladders vs PLC Ladder logic, What is Logic? Overview of Logic functions, Number systems & Codes, Hardwired Logic vs Programmed logic, Programming word level logic instructions, Relation of digital gate logic to contact/coil logic | **07 Hrs.** |
| Unit 2 | **Basics of PLC Programming –I** | |
| | Processor memory organization, PLC Programming languages, Ladder diagrams, Relays, contactors, switches, sensors, output control devices, latching relays, ladder diagram elements. Instructions: Relay type instructions, Instruction addressing, Branch Instructions, Internal Relay Instructions, Programming. Develop a PLC ladder logic diagram for given situation: A railway station has 3 platforms A, B and C. A train is coming into the station. It has to be given entry to platform A if A is empty. If both A and B are occupied then it has to be given entry to platform C. If all the platforms are full then the train has to wait. | **07 Hrs.** |
| Unit 3 | **Basics of PLC Programming –II** | |
| | Basic Functions: PLC Timer & Counter functions, Timer & Counter Industrial applications, Arithmetic functions, Comparison functions, Jump functions, Data handling functions, Digital Bit functions, PLC matrix Functions, Advanced PLC Functions: Analog PLC operation, PID control of Continuous processes. Develop PLC program for following statement: Motor 1 (M1) starts as soon as start switch is ON; after 10 Seconds M1 goes off and Motor 2 (M2) starts. After 5 seconds M2 goes OFF and M3 starts. After 10 Seconds M3 goes off, M1 Starts. and the cycle is repeated. When stop switch is ON, all Motors are stop. | **07 Hrs.** |

| | | |
|---|---|---|
| **Unit 4** | **PLC Installation, Troubleshooting & Maintenance** | |
| | Installation: Consideration of operating environment, receiving test, check & assembly, Electrical Noise, Leaky inputs & outputs, Grounding, voltage variations & surges, Circuit protections & wiring, Program Editing& Commissioning. Troubleshooting: Processor module, Input & Output malfunctions, Ladder logic program. PLC Maintenance. | **07 Hrs.** |
| **Unit 5** | **Process control, HMI & SCADA** | |
| | Types of processes, structure of control systems, on/off control, PID Control, Motion control, SCADA (Supervisory control and data acquisition): Block diagram, RTU (Remote terminal unit), Functions of RTU, MTU (Main terminal unit), functions of MTU, operating interfaces& applications, HMI (Human Machine Interface, Interfacing technique of PLC with HMI. | **07 Hrs.** |
| **Unit 6** | **PLC Networking** | |
| | Types of communication interface, Types of networking channels, Advantages of standard industrial network, Data Communications, Serial communication, Industrial network: CAN (Controller area network), Device Net, ControlNet, Ether Net/IP, Modbus, Fieldbus, Profibus-PA/DP | **07 Hrs.** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Programmable Logic Controllers. | Frank D. Petruzella | McGraw-Hill Education, Fourth Edition. |

| **Reference Books** | | | |
|---|---|---|---|
| **Sr. No.** | **Title** | **Author** | **Edition/Publication** |
| 01 | Programmable logic controllers & Industrial Automation | Madhuchandra Mitra, Samarjeet Sen Gupta Penram International Pvt. Ltd. | Fourth reprint, 2012 |
| 02 | Programmable Logic Controllers | W. Bolton, Elsevier | Fourth Edition,2015 |
| 03 | Programmable Logic Controllers, Principles & Applications | John W. Wobb, Ronald, A. Rais. | PHI publishing, Fifth Edition |

**Internet of Things (PEC III)**

**Theory** : 3 Hrs./Week

**Credit** : 3

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA** : 10 Marks

**ESE** : 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Sensors and applications | | |
| Course Objectives | 1 | To learn Internet of Things Technology | |
| | 2 | To know the basics of RFID, Sensor technologies. | |
| | 3 | To know the basics of IoT systems like Raspberry Pi, Arduino, and Banana Pi. | |
| | 4 | To aware students about wireless communication technologies and IoT applications. | |
| Course Outcomes | **After competition of this course Students will be able to** | | |
| | CO 1 | Understand the fundamental concepts of Internet of Things including IoT architecture, framework, identification technologies, and the role of the internet in IoT systems. | Understand |
| | CO 2 | Analyze IoT mechanisms such as object identification, communication capabilities, scalability, interoperability, security, privacy, and device power management. | Analyze |
| | CO 3 | Understand the working principles and components of Radio Frequency Identification systems, including tags, readers, middleware, and sensor nodes. | Understand |
| | CO 4 | Develop basic IoT systems using Raspberry Pi by understanding its hardware, I/O interfacing, operating system, and programming using C/C++ and Python. | Apply |
| | CO 5 | Evaluate various IoT communication technologies such as Bluetooth, Zigbee, WLAN, NFC, and cellular networks for different IoT applications. | Understand |
| | CO6 | Apply IoT concepts to real-world applications including smart metering, Smart City solutions, e-health systems, environmental monitoring, home automation, and industrial control systems. | Apply |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | **Introduction:** | |
| | IoT, Objects / Things, IoT definitions, IoT frame work, Identification technologies, Internet in IoTs. | **06 Hrs.** |
| Unit 2 | **Fundamental of IoT mechanisms:** | |
| | Identification of IoT objects and services, Traffic characteristics, scalability and interoperability, security and privacy, Communication capabilities, Mobility support and device power, Sensor technology, RFID technology and satellite technology. | **06 Hrs.** |
| Unit 3 | **Radio Frequency Identification Technology** | |
| | RFID, IoT objects and services, principles of RFID, Components of an RFID system, RFID reader, Tags, middleware, Sensor nodes, connecting nodes, networking nodes. | **06 Hrs.** |
| Unit 4 | **IoT systems** | |
| | Hardware and Software: Introduction to Raspberry Pi, Familiar with Raspberry Pi hardware, study of I/O ports, Programming with Raspberry Pi: Study of operating system, simple programs in C / C++, Introduction with Python programming. | **06 Hrs.** |
| Unit 5 | **Communication Technologies** | |
| | WPAN Technologies: Introduction to IEEE 802.15.4 standard, Bluetooth, Zigbee, IEEE 802.15.6; WBANS, NFC, IEEE 802.11 WLAN, Cellular and mobile technologies. | **06 Hrs.** |
| Unit 6 | **IoT Application Examples** | **06 Hrs.** |
| | Smart Metering, advanced metering infrastructure, e-health / Body Area Network, City Automation (Smart City), Automotive Application, Environmental Applications, Home Automation, Control Applications | |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | The Internet of Things - Connecting objects to the web | Hakima Chaouchi | Wiley Publications |
| 02 | Building the Internet of Things | Daniel Minoli | Wiley Publications |
| 03 | Introduction to Wireless Telecommunications systems and Networks | Gary J. Mulett. | Cengage Learning (India Edition) |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Raspberry Pi for Dummies | Sean McManus, Mike Cook | A Wiley Brand |
| 02 | Architecting the Internet of Things | Bernd Scholz, Reiter | Springer |

**Multi-disciplinary Minor–04 Embedded C Programming**

**Theory** : 2 Hrs./Week

**Credit** : 2

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA** : 10 Marks

**ESE** : 60 Marks

| | | |
|---|---|---|
| Course Pre-Requisite | Basic knowledge of C Programming, Digital Electronics, and Microcontroller Fundamentals. | |
| Course Objectives | 1 | Understand Embedded C and embedded systems. |
| | 2 | Develop Embedded C programs using AVR. |
| | 3 | Explain I/O, timers, interrupts and serial communication. |
| | 4 | Interface peripherals and sensors. |
| | 5 | Analyze embedded applications. |
| | 6 | Design simple embedded applications |
| Course Outcomes | **After competition of this course Students will be able to** | |
| | CO 1 | Explain the architecture of embedded systems and AVR microcontrollers. |
| | CO 2 | Develop Embedded C programs for digital input/output, timers, and interrupts. |
| | CO 3 | Interface serial communication protocols and peripheral devices using Embedded C. |
| | CO 4 | Analyze embedded applications using ADC, PWM, and communication peripherals. |
| | CO 5 | Design simple real-time embedded system applications using Embedded C. |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | **Introduction to Embedded Systems** | |
| | **Introduction to Embedded Systems:** Embedded systems, applications, characteristics, Embedded hardware and software, AVR architecture, development tools, Embedded C fundamentals. | **04 Hrs.** |
| Unit 2 | **Embedded C Programming:** | |
| | **Embedded C Programming:** Data types, variables, operators, functions, pointers, memory organization, preprocessor directives, modular programming. | **04 Hrs.** |
| Unit 3 | **Digital I/O and Interrupt Programming:** | |
| | **Digital I/O and Interrupt Programming:** GPIO programming, LEDs, switches, LCD interfacing, timers, counters, interrupt programming, watchdog timer. | **06 Hrs.** |
| Unit 4 | **Serial Communication:** | |
| | **Serial Communication:** UART, SPI, I²C communication protocols, serial data transmission, EEPROM interfacing, communication examples. | **04 Hrs.** |
| Unit 5 | **Analog Interfacing:** | |
| | **Analog Interfacing:** ADC programming, PWM generation, sensor interfacing, motor control, analog signal acquisition. | **04 Hrs.** |
| Unit 6 | **Embedded System Applications:** | **06 Hrs.** |
| | **Embedded System Applications:** Real-time embedded programming concepts, debugging techniques, low-power programming, embedded application **development, case studies.** | |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Embedded C Programming and the Atmel AVR | Richard H. Barnett, Sarah Cox & Larry O'Cull | Delmar Cengage Learning |
| 02 | Programming Embedded Systems in C and C++ | Michael Barr & Anthony Massa | O'Reilly Media |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | The 8051 Microcontroller and Embedded Systems | Muhammad Ali Mazidi | Pearson |
| 02 | Embedded Systems: Introduction to ARM Cortex-M Microcontrollers | Jonathan W. Valvano | Cengage Learning |
| 03 | Embedded Systems Design | Frank Vahid & Tony Givargis | Wiley |
| 04 | Embedded Systems Architecture | Tammy Noergaard | Elsevier |

**PLC and Automation - Lab (PEC-II Lab)**

| | | | |
|---|---|---|---|
| **Lectures** | **:** NA | **Evaluation Scheme** | |
| **Practicals** | : 02 Hrs. / Week | **MSE** | **:** NA |
| **Credit** | **:** 1 | **ISE/CA** | **:** 50 Marks |
| | | **ESE** | **:** 25 Marks |

| | | | |
|---|---|---|---|
| Course Outcomes | After competition of this course Students will be able to | | Blooms Taxonomy |
| | CO1 | Understand the fundamental concepts and techniques of artificial intelligence. | Understand |
| | CO2 | Apply AI search algorithms, knowledge representation, and reasoning techniques to solve problems | Analyze |
| | CO3 | Analyze problems and select appropriate AI techniques like fuzzy logic, Bayesian networks, reinforcement learning, neural networks and genetic algorithms to achieve the solution. | Analyze |
| | CO4 | Evaluate AI algorithms and develop integrated AI solutions for real world problems by integrating multiple concepts learnt in the course. | Analyze |

**List of Experiments: (Minimum 08 experiment should be performed.)**

1. To study PLC installation, troubleshooting and maintenance of PLC.
2. Study hardware and software used in PLC.
3. Implementation Logic Gates.
4. To develop an application using On-Delay timer.
5. To develop an application using Off-Delay timer.
6. To Develop an application using UP counter.
7. To Develop an application using DOWN counter.
8. Write and implement ladder logic program to on-off the DC motor using PLC.
9. Develop a ladder program for starting an electrical motor.
10. To study of SCADA system.
11. To study different types of communication interface.
12. To study about conveyor control system using PLC.

**Artificial Intelligence Lab**

| | | | |
|---|---|---|---|
| **Lectures** | **:** NA | **Evaluation Scheme** | |
| **Practicals** | : 02 Hrs. / Week | **MSE** | **:** NA |
| **Credit** | **:** 1 | **ISE/CA** | **:** 50 Marks |
| | | **ESE** | **:** 25 Marks |

| | | | |
|---|---|---|---|
| Course Outcomes | After competition of this course Students will be able to | | Blooms Taxonomy |
| | CO1 | Understand the fundamental concepts and techniques of artificial intelligence. | Understand |
| | CO2 | Apply AI search algorithms, knowledge representation, and reasoning techniques to solve problems | Analyze |
| | CO3 | Analyze problems and select appropriate AI techniques like fuzzy logic, Bayesian networks, reinforcement learning, neural networks and genetic algorithms to achieve the solution. | Analyze |
| | CO4 | Evaluate AI algorithms and develop integrated AI solutions for real world problems by integrating multiple concepts learnt in the course. | Analyze |

**List of Experiments: (Minimum 08 experiment should be performed.)**

1. Write a python program to implement breadth first search (BFS) traversal on input tray.
2. Write a python program to solve water jug problem by using breadth first search (BFS).
3. Write a python program to solve 8 puzzle problem using the A* algorithm.
4. Write a python program to create tic-tac-toe game using the minimax algorithm.
5. Write a python program to create a simple three-layer neural network for implementation of binary function.
6. Write a python program to implement Bayesian network to model probabilistic reasoning for burglary alarm system.
7. Write a python program to implement Q-value iteration algorithm for solving the Markov Decision Process (MDP) problem in the farmer example.
8. Write a python program to implement Alpha-Beta pruning for game search.
9. Write a Python program to implement Decision Tree learning.
10. Write a Python program using NumPy/Matplotlib for AI data analysis.

**Mini Project II**

| | | | |
|---|---|---|---|
| **Lectures** | **:** | **NA** | **Evaluation Scheme** |
| **Credit** | **:** | **2** | |
| **Practical** | **:** | **4 Hrs./Week** | **ISE/CA :** 50 Marks |

**Course Objectives:**

1. Provide students for knowledge of Electronics Components and soldering techniques and its package information for electronics circuit design
2. Provide students for knowledge of the assembling of electronics circuit with components on PCB (Printed Circuit Board) of circuit design.
3. Design and development of Small electronic project based on hardware and software for Electronics systems.

**Course Outcomes:**

After successful completion of the course students will be able to:
CO1: Practice acquired knowledge within the chosen area of technology for project development.
CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO3: Reproduce, improve and refine technical aspects for engineering projects.
CO4:. Work as an individual or in a team in development of technical projects
CO5: Communicate and report effectively project related activities and finding

**Mini project work should consist of following steps.**

The Mini Project topic should be based on the any one subject concept that students have studied for their Academic Year.
1. Students should propose project ideas & finalize the project idea in consultation with guide.
2. Students should submit implementation plan in the form of PERT/CPM chart, which will cover weekly activity of project report.
3. Problem definition and specification development in the form of synopsis.
4. Design of circuit with calculation & should include
a) Analog part
b) digital part
c) Power supply
d) Test strategy if firmware is required produce flow chart.
5. Simulation of design using tools like OrCAD, Matlab, etc.
6. Design of enclosure & PCB.
7. Fabrication & assembly of PCB & enclosure.
8. Testing & calibration.
9. Measurement of specifications.

**Note**: - 1. Project report should include report of all above steps and conclusion.
2. Project group should demonstrate and deliver seminar on project.

3. A mini project should not exceed three students per group.

**Project Report Format**: Project report should be of 15 to 20 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Point. Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
9. Headings: Times New Roman, 14 Point, Bold Face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director
11. Index of Report:

a. Title Sheet
b. Certificate
c. Acknowledgement
d. Table of Contents.
e. List of Figures
f. List of Tables

12. References

**PEC I (Microprocessor & Microcontroller)**

**Lectures : 3 Hrs. / Week**

**Credit : 3**

**Evaluation Scheme**

**MSE : 30 Marks**

**ISE/CA: 10 Marks**

**ESE : 60 Marks**

| | | |
|---|---|---|
| Course Pre-Requisite | Basic knowledge of Digital Electronics, Computer Organization, Number Systems, Logic Gates, and C Programming fundamentals. | |
| Course Objectives | 1 | To study the concepts and basic architecture of a Microprocessor and Microcontroller. |
| | 2 | To write Assembly language programs for Microprocessors and Micro controllers for various applications. |
| | 3 | To know the importance of different peripheral devices and their interfacing to 8086 and 8051. . |
| | 4 | To build Microprocessor and Microcontroller based systems. |
| Course Outcomes | **After competition of this course Students will be able to** | |
| | CO 1 | Explain 16-bit Microprocessor architectures and fundamental concepts of Microcontrollers. |
| | CO 2 | To develop programming skills for Microprocessors and Microcontrollers |
| | CO 3 | To interface various devices in Microprocessor and Microcontroller systems. |
| | CO 4 | To design and implement Microprocessor and Microcontroller based systems. |

| Unit No | Content | Hours |
|---|---|---|
| Unit 1 | **The 8086 Microprocessor** | |
| | 8086 Architecture, Memory Segmentation, 8086 pin description, Interrupts and Interrupt service routines, Dedicated interrupts, Software interrupts | **07 Hrs.** |
| Unit 2 | **8086 programming** | |
| | Addressing modes, Instruction Set and Assembler Directives, Assembly language programming | **07 Hrs.** |
| **Unit 3** | **8086 Interfacing –Part I** | |
| | Generating the 8086 System Clock and Reset Signals using 8284 clock generator, 8086 Minimum and Maximum Mode CPU Modules, Minimum and Maximum Mode Timing Diagrams, Memory interfacing. | **07 Hrs.** |
| | **8086 Interfacing –Part II** | |

| | | |
|---|---|---|
| **Unit 4** | 8255-PPI: Functional Block Diagram and description, Operating Modes, 8259-PIC: Functional Block Diagram and description, Cascaded mode of operation, System design (including Memory and I/O) | **07 Hrs.** |
| **Unit 5** | **The 8051 Microcontroller** | |
| | Differences between a Microprocessor and Microcontroller, Architecture of 8051 Memory Organization of the 8051, Addressing modes, Instruction set, Assembly language programming. | **07 Hrs.** |
| **Unit 6** | **8051 Interfacing** | |
| | I/O port programming, Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, Stepper Motor and DC motor Interfacing | **07 Hrs.** |

**References**:

| **Text Books** | |
|---|---|
| 1 | 8086/8088 family: Design Programming and Interfacing: By John Uffenbeck (Pearson Education) |
| 2 | Microprocessor and Interfacing: By Douglas Hall (TMH Publication) |
| 3 | The 8051 Microcontroller and Embedded Systems Using Assembly and C: By M. A. Mazidi, J. C. Mazidi, Rolin D. McKinlay, Pearson Education, 2ndEdition. |
| 4 | The 8051 Microcontroller: ByKenneth J. Ayala, Cengage Learning India Pvt. Ltd, 3rdEdition |

**Text Books:**

| **Reference Books** | |
|---|---|
| 1 | Microcomputer Systems: 8086/8088 family Architecture, Programming and Design: By Liu & Gibson (PHI Publication). |
| 2 | The INTEL Microprocessors, Architecture, Programming and Interfacing: By Barry B. Brey (Pearson Publishers, 8th Edition) |
| 3 | Microcontrollers: Architecture, Programming, Interfacing and System Design: By RajKamal, Pearson Education, 2005. |
| 4 | The 8051 Microcontroller Based Embedded Systems: By Manish K Patel, McGraw Hill, 2014. |
| 5 | Microcontroller Theory and Applications: By Ajay V Deshmukh, Tata McGraw Hill |

## PEC-I Lab (Microprocessor and Microcontroller)

| | | | | | |
|---|---|---|---|---|---|
| **Theory** | **:** | NA | **Evaluation Scheme** | | |
| **Credit** | **:** | 1 | **ISE/CA** | **:** | 25 Marks |
| | | | **ESE** | **:** | **NA** |

| **Course Objectives:** The objective of the course is to | | |
|---|---|---|
| To provide hands-on exposure to 8086 microprocessor and 8051 microcontroller programming, interfacing, and embedded system application development through practical experiments. | | |
| **Course Outcomes:** | | |
| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
| CO1 | Apply number system conversion and logic gate concepts to solve basic digital problems. | Apply |
| CO2 | Develop and execute 8086 assembly language programs using data transfer, arithmetic, logical, and branching instructions | Apply |
| CO3 | Implement 8086 programs for memory manipulation, array processing, sorting, and arithmetic operations. | Apply |
| CO4 | Interface and control peripheral devices using the 8051 microcontrollers for embedded system applications. | Analyze |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. To convert different number from decimal to binary, octal to hexadecimal & vice versa &also study of logic gates.
2. Perform hands on experiment using 8086 kits.
3. Storing and displaying the content stored at different registers and memory location.
4. Implementation of 8086 programs involving data transfer and arithmetic instruction set.
5. Implementation of 8086 programs involving logical and bit manipulation instruction set.
6. Implementation of 8086 programs involving branch instruction and machine control instruction set.
7. Data transfer. - block move, exchange, sorting, finding largest element in an array.
8. Arithmetic instructions - addition/subtraction, multiplication, square & cube. (16 bits arithmetic operations)
9. Boolean & logical instructions (bit manipulations)
10. Programs to generate delay using serial port and on-chip timer / counter.
11. Simple calculator using six-digit seven segment display and hex keyboard interface to 8051.
12. Stepper and dc motor control interface to 8051

Parking or Environmental Monitoring.

**PEC-II (Network Analysis)**

**Theory** : 3 Hrs./Week

**Credit** : 3

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA** : 10 Marks

**ESE** : 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Basic knowledge of Computer Networks, Embedded Systems, and Programming fundamentals. | | |
| Course Objectives | 1 | Understand basic electrical network concepts and circuit laws. | |
| | 2 | Apply network theorems to analyze electrical circuits. | |
| | 3 | Analyze DC and AC electrical networks. | |
| | 4 | Evaluate transient responses of electrical circuits. | |
| | 5 | Understand two-port network parameters and network functions. | |
| | 6 | Apply network analysis techniques to solve engineering problems. | |
| Course Outcomes | **After competition of this course Students will be able to** | | |
| | CO 1 | Apply basic circuit laws to analyze electrical networks. | Apply |
| | CO 2 | Solve circuits using network theorems and analysis methods. | Apply |
| | CO 3 | Analyze AC circuits using phasor techniques. | Analyze |
| | CO 4 | Evaluate transient responses of RL, RC, and RLC circuits. | Evaluate |
| | CO 5 | Determine two-port network parameters and transfer functions. | Analyze |
| | CO 6 | Apply network analysis concepts to practical engineering problems. | Apply |

| Unit No. | Content | Hours |
|---|---|---|
| Unit 1 | **Basic Circuit Concepts and Laws** | |
| | Introduction to electrical networks; Circuit variables and elements (R, L, C); Independent and dependent sources; Ohm's law; Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL); Series–parallel circuits; Voltage and current division; Source transformation; Basic circuit analysis problems. | **07 Hrs.** |
| **Unit 2** | **Network Theorems and Circuit Analysis** | |

| | | |
|---|---|---|
| | Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum Power Transfer theorem; Reciprocity theorem; Millman's theorem; Compensation theorem; Applications of network theorems to DC circuits. | **07 Hrs.** |
| **Unit 3** | **Systematic Network Analysis** | |
| | Mesh (Loop) analysis; Nodal analysis; Supermesh and Supernode techniques; Star–Delta (Y–Δ) and Delta–Star (Δ–Y) transformations; Network topology concepts; Graphs, Trees, Twigs, Links, Tie-sets and Cut-sets; Introduction to duality. | **07 Hrs.** |
| **Unit 4** | **Sinusoidal Steady-State Analysis** | |
| | Sinusoidal waveforms and phasors; Complex numbers in circuit analysis; Impedance and admittance; Analysis of RL, RC and RLC circuits; Series and parallel resonance; Active, reactive and apparent power; Power factor and power factor improvement. | **07 Hrs.** |
| **Unit 5** | **Transient Analysis and Laplace Transform** | |
| | Initial and final conditions; Transient response of RL and RC circuits; Time constant; Natural, forced and complete responses; Introduction to second-order RLC circuits; Laplace transform; Network analysis using Laplace transform; Initial and final value theorems. | **07 Hrs.** |
| **Unit 6** | **Two-Port Networks and Network Functions** | **07 Hrs.** |
| | Two-port network parameters (Z, Y, h and ABCD parameters); Interconnection of two-port networks; Driving-point and transfer functions; Poles and zeros; Network functions; Frequency response; Introduction to filters and practical applications. | |
| | **Total** | **42 Hrs** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Engineering Circuit Analysis | William H. Hayt Jr., Jack E. Kemmerly, and Steven M. Durbin | McGraw-Hill Education, 9th Edition |
| 02 | Network Analysis | M. E. Van Valkenburg | Pearson Education India, 3rd Edition |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Network Analysis | A. Sudhakar and Shyammohan S. Palli | McGraw-Hill Education, 2015. |
| 02 | Network Analysis and Synthesis | Franklin F. Kuo | Wiley |
| 03 | Theory and Problems of Electric Circuits | Joseph A. Edminister | McGraw-Hill Education. |

**PEC-II Lab (Network Analysis)**

| | | | | | |
|---|---|---|---|---|---|
| **Theory** | **:** | Network Analysis | **Evaluation Scheme** | | |
| **Credit** | **:** | 1 | **ISE/CA** | **:** | 25 Marks |
| | | | **ESE** | **:** | **25** Marks |

| **Course Objectives:** The objective of the course is to | | |
|---|---|---|
| 1. The objective of the course is to provide hands-on exposure to IoT hardware, communication protocols, cloud platforms, and application development through practical experiments. | | |
| **Course Outcomes:** | | |
| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
| CO1 | Understand basic electrical network concepts and circuit laws. | Understand |
| CO2 | Apply network theorems to analyze electrical circuits. | Apply |
| CO3 | Analyze DC and AC electrical networks. | Analyze |
| CO4 | Evaluate transient responses of electrical circuits. | Evaluate |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1) Verification of Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL).
2) Verification of Superposition Theorem in DC circuits.
3) Verification of Thevenin's and Norton's Theorems.
4) Verification of Maximum Power Transfer Theorem.
5) Analysis of electrical networks using Mesh and Nodal Analysis.
6) Study of Series and Parallel Resonance in RLC circuits.
7) Measurement of Active, Reactive, and Apparent Power and Power Factor in AC circuits.
8) Study of Transient Response of RC and RL circuits.
9) Determination of Two-Port Network Parameters (Z, Y, h, and ABCD parameters).
10) Simulation of DC and AC Network Analysis using MATLAB/Simulink, PSpice, or Multisim.

**PEC-III (Biomedical Instrumentation)**

| | | | |
|---|---|---|---|
| **Theory** | **:** | 3 Hrs./Week | **Evaluation Scheme** |
| | | | **MSE :** 30 Marks |
| **Credit** | **:** | 3 | **ISE/CA :** 10 Marks |
| | | | **ESE :** 60 Marks |

| | | |
|---|---|---|
| Course Pre-Requisite | Basic knowledge of human anatomy and physiology, electrical and electronic circuits, sensors, and signal processing is essential for understanding Biomedical Instrumentation. | |
| Course Objectives | 1 | To introduce a fundamental of transducers as applicable to physiology |
| | 2 | To explore the human body parameter measurements setups |
| | 3 | To make the students understand the basic concepts of forensic techniques |
| | 4 | To give basic ideas about how multimedia evidences are useful in crime investigation. |
| Course Outcomes | **After competition of this course Students will be able to** | |
| | CO1 | Understand the physiology of biomedical system |
| | CO2 | Measure biomedical and physiological information |
| | CO3 | Discuss the application of Electronics in diagnostics and therapeutic area |

| Unit No. | Content | Hours |
|---|---|---|
| **Unit 1** | **Human Physiology and Biomedical Transducers** | |
| | Cell and its structure, Resting and Action Potential, Nervous system: Functional organization of the nervous system, Structure of nervous system, neurons, synapse, transmitters and neural communication, Cardiovascular system, respiratory system, Basic components of a biomedical system, Transducers, selection criteria, Piezo-electric, ultrasonic transducers, Temperature, measurements - Fiber optic temperature sensors. | **07 Hrs.** |
| **Unit 2** | **Biomedical Electrodes and Physiological Signal Acquisition** | **07 Hrs.** |
| | Electrodes: Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier. ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms. | |
| | **Biomedical Measurements and Patient Safety** | |

| | | |
|---|---|---|
| **Unit 3** | Electrical safety in medical environment: Shock hazards, Leakage current, Instruments for checking safety parameters of biomedical equipment. Measurement of Blood Pressure, Cardiac Output, Heart Rate, Heart Sounds, Pulmonary Function Measurements, Spirometer, Photo Plethysmography, Body Plethysmography. | **07 Hrs.** |
| **Unit 4** | **Clinical Laboratory Instrumentation and Medical Standards** | |
| | Blood Gas Analyzers: pH of blood, Measurement of blood $pCO_2$ and $pO_2$, Finger-tip Oximeter, ESR measurement, GSR measurement, Introduction to HL7 standards and medical data communication. | **07 Hrs.** |
| **Unit 5** | **Medical Imaging and Patient Monitoring Systems** | |
| | Radiographic and Fluoroscopic Techniques, X-rays, Computed Tomography (CT), Mammography, Magnetic Resonance Imaging (MRI), Functional MRI (fMRI), Ultrasonography, Endoscopy, Thermography, Biotelemetry systems, Patient Monitoring Systems. | **07 Hrs.** |
| **Unit 6** | **Biomedical Therapeutic and Assisting Equipment** | **07 Hrs.** |
| | Pacemakers, Defibrillators, Ventilators, Nerve and Muscle Stimulators, Diathermy, Heart-Lung Machine, Audiometers, Dialyzers, Lithotripsy. | |
| | | **Total – 42 Hrs** |

**Textbooks**

| Sr. No. | Title | Author | Edition/Publication |
|---|---|---|---|
| 01 | Hand Book of Bio-Medical instrumentation | R.S.Khandpur | Tata McGraw Hill Publishing Co Ltd., 2003 |
| 02 | Bio-Medical Instrumentation and Measurements | Leslie Cromwell, FredJ.Weibell, Erich, A.Pfeiffer | II edition, Pearson Education, 2002 / PHI. |

**Reference Books**

| Sr. No. | Title | Author | Edition/Publication |
|---|---|---|---|
| 01 | Medical Instrumentation | J.Webster | John Wiley & Sons, 1995 |
| 02 | Principles of Applied Bio-Medical Instrumentation | L.A. Geddes and L.E.Baker | John Wiley & Sons, 1975. |

## PEC-I (Communication Systems)

**Theory** : **3** Hrs./Week

**Credit** : **3**

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA** : 10 Marks

**ESE** : 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Basic knowledge of Signals and Systems, Electronic Devices and Circuits, and analog communication concepts is recommended for studying Communication Systems. | | |
| Course Objectives | 1 | Describe various modulation, demodulation and multiplexing schemes. | |
| | 2 | Recognize the importance of different modulation and spread spectrum techniques. | |
| | 3 | Apply the properties of basic Modulation techniques to analyze various Communication systems | |
| Course Outcomes | **After competition of this course Students will be able to** | | |
| | CO1 | Describe fundamental concepts and various components of communication systems | Understand |
| | CO2 | Analyze analog modulation techniques | Analyze |
| | CO3 | Describe digital pulse modulation schemes | Understand |
| | CO4 | Explain spread spectrum technology and its applications | Understand |

| Unit No. | Content | Hours |
|---|---|---|
| **Unit 1** | **Introduction To Electronic Communication** | |
| | Importance of communication, Basic blocks in a communication system, types of modulation, Electromagnetic spectrum (different bands and their frequencies, Bandwidth-concept of transmission bandwidth), noise and its types, Signal to Noise ratio (SNR), Noise Figure, Noise Temperature | **07 Hrs.** |
| **Unit 2** | **Amplitude Modulation** | **07 Hrs.** |
| | Generation of Amplitude Modulation (AM-DSB-FC), Double Sideband Suppressed Carrier (DSB-SC), Single Sideband Suppressed Carrier (SSB-SC), and Vestigial Sideband (VSB) signals; analysis of AM types in time and frequency domains; and understanding of receiver architectures, including Tuned Radio Frequency (TRF) and Super heterodyne Receivers. | |
| **Unit 3** | **Angle Modulation** | |
| | Frequency Modulation (FM) and Phase Modulation (PM), including narrow-band and wide-band FM; Mathematical analysis of FM signal, Carson's rule; FM generation using direct and indirect methods; FM demodulation techniques such as Foster-Seeley discriminator, phase discrimination, and PLL methods; concepts of pre-emphasis and de-emphasis; receiver characteristics, including sensitivity, selectivity, and fidelity. | **07 Hrs.** |
| | **Pulse Modulation** | |

| | | |
|---|---|---|
| **Unit 4** | Sampling Process, sampling theorem, aliasing effect, types of pulse modulation- Generation and Detection of Pulse Amplitude Modulation (PAM), Pulse width Modulation (PWM), pulse position modulation (PPM) signals, Quantization types, Companding principle: A law and μ law | **07 Hrs.** |
| **Unit 5** | **Introduction to Digital Communication System** | |
| | PCM generation and reconstruction, signal-to-quantization noise ratio analysis, delta modulation and adaptive delta modulation, differential pulse code modulation, trade-offs between bandwidth and noise, multiplexing techniques. | **07 Hrs.** |
| **Unit 6** | **Spread spectrum Techniques** | |
| | Introduction, Pseudo noise sequences, PRBS generator, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum | **Hrs.** |
| | | **Total – 42 Hrs** |

**Textbooks**

| Sr. No. | Title | Author | Edition/Publication |
|---|---|---|---|
| 01 | Digital Communication Systems | John Wiley & Sons, 4th Edition, 2006. | John Wiley & Sons, 4th Edition, 2006. |
| 02 | Principles of Communication System, 4th Edition | Taub, Schilling | McGraw Hill,2007. |
| 03 | Communication Systems: Analog and Digital- 2nd edition | R. P. Singh , S. Sapre | McGraw Hill, 2009 |

**Reference Books**

| Sr. No. | Title | Author | Edition/Publication |
|---|---|---|---|
| 01 | Digital Communications – 5th Edition | John G. Proakis | McGraw- Hill, 2008. |
| 02 | Digital and Analog Communication Systems – 3rd edition | Sam Shanmugam | John Wiley, 2005 |
| 03 | Electronic Communications systems- 5th Edition | George Kennedy | McGraw Hill, 2008. |
| 04 | Modern Digital and Analog Communication Systems | B. P. Lathi and Z. Ding | Oxford, 4/e, 2011. |

## PEC-I LAB (Communication Systems Lab)

| | | | | | |
|---|---|---|---|---|---|
| **Theory** | **:** | NA | **Evaluation Scheme** | | |
| **Credit** | **:** | 1 | **ISE/CA** | **:** | 25 Marks |
| | | | **ESE** | **:** | **25** Marks |

| **Course Objectives:** The objective of the course is to | | |
|---|---|---|
| Develop practical skills in analyzing, simulating, and implementing analog and digital communication systems using modulation, demodulation, multiplexing techniques, and MATLAB/SIMULINK. | | |
| **Course Outcomes:** | | |
| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
| CO1 | Implement and analyze modulation and demodulation techniques like AM, DSB-SC, SSB-SC, FM, and pulse modulation. | Apply |
| CO2 | Apply digital communication concepts and multiplexing schemes in signal generation, detection, reconstruction, and analysis. | Apply |
| CO3 | Use MATLAB and SIMULINK to simulate and analyze modulation techniques and communication | Apply |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. Experiment on practical implementation of Amplitude Modulation (AM) and demodulation.
2. Experiment on practical implementation of calculation of modulation index using: AM signal Trapezoidal pattern
3. Experiment on practical implementation of generation and detection of Double Sideband Suppressed Carrier (DSB-SC) modulation.
4. Experiment on practical implementation of generation and detection of Single Sideband Suppressed Carrier (SSB-SC) modulation.
5. Experiment on practical implementation of Frequency Modulation (FM), its detection, and calculation of modulation index.
6. Experiment on practical implementation of generation of Frequency Modulation (FM) and demodulation using PLL.
7. Experiment on practical implementation of Sampling and Reconstruction.
8. Experiment on practical implementation of generation and detection of PAM signal.
9. Experiment on practical implementation of generation and detection of PWM signal.

10. Experiment on practical implementation of generation and detection of PPM signal.
11. Experiment on practical implementation of generation and detection of PCM.
12. Experiment on practical implementation of generation and detection of Delta Modulation (DM).
13. Experiment on practical implementation of generation and detection of Adaptive Delta Modulation (ADM).
14. Experiment on practical implementation of multiplexing:
15. PAM-TDM
16. PCM-TDM
17. Experiment on practical implementation of generation of Pseudo Random Binary Sequence (PRBS) using IC and breadboard.

## PEC-II (Antenna and Wave Propagation)

**Theory** : **3** Hrs./Week

**Credit** : **3**

**Evaluation Scheme**

**MSE** : 30 Marks

**ISE/CA** : 10 Marks

**ESE** : 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Basic knowledge of electromagnetic field theory, transmission lines, wave propagation, engineering mathematics, and communication systems is essential for understanding Antenna and Wave Propagation. | | |
| Course Objectives | 1 | Basic parameters of antennas and their principle of operation | |
| | 2 | Different Antenna types to know their applications in various domains. | |
| | 3 | Different types of wave propagation Techniques | |
| Course Outcomes | **After competition of this course Students will be able to** | | |
| | CO1 | Realize the importance of basics of antenna systems to differentiate the applicability of each type of antenna | Understand |
| | CO2 | Analyze the utilization of Antenna systems in wide areas like wireless communication, fixed line communication, computer communication etc. | Analyze |
| | CO3 | Discuss radio wave propagation | Understand |

| Unit No. | Content | Hours |
|---|---|---|
| **Unit 1** | **Fundamentals of Antenna** | |
| | Basic Antenna parameters, pattern , beam area, radiation intensity, beam efficiency, directivity, gain and resolution, antenna aperture, effective height, radio communication link, field from oscillating dipole, field zones. Linear, Elliptical and Circular polarization, Front to back ratio, Antenna impedance. | **07 Hrs.** |
| **Unit 2** | **Antenna array and Frequency independent antenna** | **07 Hrs.** |
| | Array of two isotropic point sources, non-isotropic but similar point source and the principle of pattern multiplication, examples of pattern synthesis by pattern multiplication, non-isotropic and dissimilar point sources, linear array of isotropic point source of equal amplitude and spacing. Broadband basics, frequency independent concept: Rumsey‟s principle, the frequency independent planner log-spiral antenna, frequency independent conical-spiral antenna, the log periodic antenna, the composite yagi-uda corner-log periodic array | |
| **Unit 3** | **Antenna Measurement and Microstrip Antenna** | |
| | Antenna measurement: Antenna ranges, Radiation pattern, Gain measurements, Directivity measurements Microstrip Antenna: Introduction, Basic characteristics, Feeding methods, Rectangular patch, Circular patch | **07** |

| | | |
|---|---|---|
| | | **Hrs.** |
| **Unit 4** | **Ground Wave Propagation** | |
| | Potential Functions and the Electromagnetic Field, Potential Functions for sinusoidal oscillations, Plane earth reflection, space wave and the surface wave, elevated dipole antennas above a plane earth, wave tilt of the surface wave, spherical earth propagation,<br>troposphere wave | **07 Hrs.** |
| **Unit 5** | **Ionospheric Wave Propagation** | |
| | The ionosphere, effective permittivity and conductivity of an ionized gas, reflection and refraction of the waves by the ionosphere, regular and irregular variations of ionosphere, attenuation factor, sky wave transmission calculations, effect of earth magnetic field, wave propagation in ionosphere, Faraday rotation and measurement of total electron content, other ionosphere phenomena. | **07 Hrs.** |
| **Unit 6** | **Radar System** | **Hrs.** |
| | Fundamentals, RADAR performance factors, basic pulsed radar system, antennas and scanning, display methods, pulsed radar systems, moving target indication, radar beacons, CW Doppler radar, frequency modulated CW radar, phase array radars, planar array radars | |
| | | **Total – 42 Hrs** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Antenna for all Application | John D Kraus | Tata McGraw Hill Publication |
| 02 | Antenna Theory | Constantine A. Balanis | Wiley Publication. |
| 03 | Electromagnetic Waves and Radiation Systems | Jordan and Balmain | 2nd edition, PHI publication` |
| 04 | Electronics Communication System | Kennedy Davis | 5th edition, Tata McGraw Hill Publication |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Digital Communications – 5th Edition | G. S. N. Raju | Pearson publication |
| 02 | Digital and Analog Communication Systems – 3rd edition | Sam Shanmugam | Satya prakashan |

## PEC-II LAB (Antenna and Wave Propagation)

| | | | | | |
|---|---|---|---|---|---|
| **Theory** | **:** | NA | **Evaluation Scheme** | | |
| **Credit** | **:** | 1 | **ISE/CA** | **:** | 25 Marks |
| | | | **ESE** | **:** | **25** Marks |

| **Course Objectives:** The objective of the course is to | | |
|---|---|---|
| Develop practical skills in analyzing, simulating, and implementing analog and digital communication systems using modulation, demodulation, multiplexing techniques, and MATLAB/SIMULINK. | | |
| **Course Outcomes:** | | |
| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
| CO1 | Implement and analyze modulation and demodulation techniques like AM, DSB-SC, SSB-SC, FM, and pulse modulation. | Apply |
| CO2 | Apply digital communication concepts and multiplexing schemes in signal generation, detection, reconstruction, and analysis. | Apply |
| CO3 | Use MATLAB and SIMULINK to simulate and analyze modulation techniques and communication | Apply |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. Study of different types of Antenna systems
2. Study of Antenna simulation tools
3. Microstrip patch antenna design using MATLAB
4. Dipole antenna design using MATLAB
5. FDTD analysis of Microstrip patch using MATLAB
6. Demonstration of inset and line feeding using MATLAB
7. Impedance matching using quarter wave transformer using MATLAB
8. Design of Array of two antennas using MATLAB
9. Calculation of beam width, front to back ratio & gain of simple dipole antenna using MATLAB
10. Calculation of beam width, front to back ratio & gain of Yagi-Uda antenna.
11. Calculation of beam width, front to back ratio & gain of log periodic antenna

**PEC–III (Fundamental of Electromagnetics)**

**Theory** : 3 Hrs./Week

**Credit** : 3

**Evaluation Scheme**

**MSE :** 30 Marks

**ISE/CA :** 10 Marks

**ESE :** 60 Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Basic knowledge of Engineering Mathematics (vector calculus), Engineering Physics (electricity and magnetism), and Electric Circuit Theory. | | |
| Course Objectives | 1 | To understand concepts of vectors for engineering electromagnetic. | |
| | 2 | To understand the static electric and magnetic field | |
| | 3 | To understand and analyze the time-varying fields, Maxwell's equations, and electromagnetic wave propagation in different media. | |
| Course Outcomes | **After competition of this course Students will be able to** | | **Blooms Taxonomy** |
| | CO 1 | Understand the basic mathematical concepts related to electromagnetic vector fields. | Understand |
| | CO 2 | Analyze the static electric and magnetic fields, their behavior in different media, associated laws, boundary conditions and electromagnetic potentials | Analyze |
| | CO 3 | Apply integral and point form of Maxwell`s equations for solving the problems of electromagnetic field theory. | Apply |
| | CO 4 | Analyze time varying fields, propagation of electromagnetic waves in different media, pointing theorem, their sources & effects | Analyze |

| Unit No. | Content | Hours |
|---|---|---|
| **Unit 1** | **Vector Analysis:** | |
| | Introduction to Co-ordinate Systems – Rectangular, Cylindrical and Spherical Co- ordinate Systems – Co-ordinate transformation; Gradient of a Scalar field, Divergence of a Vector field and Curl of a Vector field- their physical interpretation. | **07 Hrs.** |
| **Unit 2** | **Electrostatics:** | **07 Hrs.** |
| | Coulomb's law, Electric field intensity due to point Charge, infinite line charge, and infinite surface charge distribution. Electric flux density, Gauss's law and Divergence theorem, Energy, potential energy and work done, potential gradient, Electric dipole and its electric field, dipole movement, energy density in electrostatic field | |
| **Unit 3** | **Conductor, Dielectrics and Capacitance:** | |
| | Current and current density, Continuity equation of current, properties of conductors, boundary conditions, Energy stored in capacitors, Poisson's and | **07 Hrs.** |

| | | |
|---|---|---|
| | Laplace's equations, Capacitance between parallel plates and co-axial cable using Laplace's equation | |
| **Unit 4** | **Steady Magnetic Field:** | |
| | Biot Savert's law, Magnetic field due to infinitely long current carrying conductor, Magnetic Field due to infinite sheet of charge, Ampere's circuital law, Application to co-axial cable. Curl operator, Magnetic flux density, Stoke's theorem. Scalar and vector magnetic potential, Lorentz's force equation. Energy stored in magnetic field, boundary conditions. | **07 Hrs.** |
| **Unit 5** | **Time varying fields and Maxwell's Equations:** | |
| | Faraday's law, General case of Induction, Displacement Current, Modified Amper's Law, Maxwell's equations (Differential, Integral, Phasor forms) for time varying field. | **07 Hrs.** |
| **Unit 6** | **Electromagnetic Waves** | **07 Hrs.** |
| | Uniform plane wave, wave equation for free space, wave equation for lossy media, wave propagation in good conductor and good dielectric, Poynting vector and power flow | |
| | | Total-42Hrs |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Principles of Electromagnetics, | Matthew N.O. Sadiku | Oxford University Press, 6th Edition |
| 02 | Engineering Electromagnetics | Hayt W. H. and J. A. Buck | McGraw-Hill, 8th Edition |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Electromagnetics, | Joseph A. Edminister | Schaum's Outline Series, Tata McGrawHill, Revised 2nd Edition. |
| 02 | Electromagnetics with Applications | John Kraus and Daniel Fleisch | McGraw-Hill, 5th edition |
| 03 | Fundamentals of Engineering Electromagnetics | Cheng D K | Addison-Wesley. |
| 04 | Electromagnetic Field Theory Fundamentals | Guru B. S. and H. R.Hizroglu | PWS Publication Company,Boston, 1998. |

**PEC–I (Embedded Linux)**

| | | | | |
|---|---|---|---|---|
| **Theory** | **:** | 3 Hrs./Week | **Evaluation Scheme** | |
| | | | **MSE** | **:** 30 Marks |
| **Credit** | **:** | 3 | **ISE/CA** | **:** 10 Marks |
| | | | **ESE** | **:** 60 Marks |

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Basic knowledge of Embedded Systems, C Programming, Microprocessors/Microcontrollers, and Linux operating system concepts is recommended for studying Embedded Linux. | | |
| Course Objectives | 1 | Introduce fundamentals of Embedded Linux and its role in embedded systems. | |
| | 2 | Provide understanding of Linux architecture and kernel concepts. | |
| | 3 | Enable students to develop and deploy applications on embedded Linux platforms. | |
| | 4 | Familiarize students with system programming and device driver basics. | |
| | 5 | Develop skills for configuring, building, and booting embedded Linux systems. | |
| | 6 | Prepare students for industrial applications involving embedded and IoT systems. | |
| Course Outcomes | **After competition of this course Students will be able to** | | **Blooms Taxonomy** |
| | CO1 | Understand Embedded Linux architecture and system components | Understand |
| | CO2 | Configure and build a Linux kernel for embedded platforms. | Apply |
| | CO3 | Develop Linux-based embedded applications using system calls. | Apply |
| | CO4 | Explain booting process and file system management. | Understand |
| | CO5 | Understand basics of device drivers and hardware interfacing. | Understand |
| | CO6 | Apply Embedded Linux concepts to real-world embedded and IoT applications | Apply |

| Unit No. | Content | Hours |
|---|---|---|
| **Unit 1** | **Introduction to Embedded Linux** | |
| | Overview of embedded systems and operating systems Need for Embedded Linux<br>Advantages and limitations of Embedded Linux Embedded Linux architecture<br>Comparison with RTOS | **07 Hrs.** |
| **Unit 2** | **Linux System Architecture** | **07 Hrs.** |
| | Linux kernel architecture User<br>space and kernel space Linux<br>file system structure<br>Process management and scheduling Memory management concepts | |
| **Unit 3** | **Embedded Linux Development Environment** | |
| | Cross-compilation concepts<br>Toolchains and build systems<br>Introduction to BusyBox Root<br>file system creation<br>Introduction to Yocto and Buildroot (overview) | **07 Hrs.** |
| **Unit 4** | **Booting and File Systems** | |
| | Bootloader concepts (U-Boot overview) Linux<br>booting sequence<br>Flash file systems (JFFS2, YAFFS, EXT) Mounting and managing file system | **07 Hrs.** |
| **Unit 5** | **Linux System Programming** | |
| | System calls and kernel interface Process<br>creation and management<br>Inter-process communication (pipes, signals, shared memory) Thread<br>programming basics<br>File I/O operations | **07 Hrs.** |
| **Unit 6** | **Device Drivers and Embedded Applications** | **Hrs.** |
| | Introduction to Linux device drivers<br>Character device drivers (conceptual)<br>GPIO and peripheral interfacing<br>Embedded Linux applications in IoT<br>Case studies and industry applications | |
| | | **Total – 42 Hrs** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Embedded Linux Systems | Karim Yaghmour | O'Reilly Media |
| 02 | Embedded Linux Primer | Frank Vasquez and Chris Simmonds | Pearson |
| 03 | Embedded Linux Primer | Christopher Hallinan | Pearson |

| **Reference Books** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Linux Kernel Development | Robert Love | Pearson |
| 02 | Understanding the Linux Kernel | Daniel P. Bovet and Marco Cesati | O'Reilly Media |
| 03 | Linux Kernel Programming | Steve Bird | Packt |
| 04 | Linux Foundation Training Material. | | |

## PEC-1 LAB (Embedded Linux)

| | | | | | |
|---|---|---|---|---|---|
| **Theory** | **:** | NA | **Evaluation Scheme** | | |
| **Credit** | **:** | 1 | **ISE/CA** | **:** | 25 Marks |
| | | | **ESE** | **:** | **25** Marks |

| **Course Objectives:** The objective of the course is to | | |
|---|---|---|
| Develop practical skills in Embedded Linux by learning Linux command-line operations, cross-compilation, kernel configuration, bootloader, file systems, process management, IPC, device drivers, and embedded application development. | | |
| **Course Outcomes:** | | |
| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
| CO1 | Apply Linux command-line operations, cross-compilation, kernel configuration, bootloader, and root file system concepts for Embedded Linux development. | Understand and apply |
| CO2 | Develop and demonstrate Embedded Linux applications using process and thread programming, IPC mechanisms, file I/O, and basic device driver programming | Develop and demonstrate |
| CO3 | Design and implement Embedded Linux–based mini project by integrating system programming concepts and embedded software development techniques. | Design and implement |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. Study of Linux command-line practice.
2. Study of cross-compiling simple applications.
3. Study of kernel configuration exercise.
4. Study of root file system creation.
5. Study of bootloader.
6. Study of process and thread programming.
7. Study of IPC (Inter-Process Communication) mechanisms.
8. Study of file I/O programming.
9. Study of device driver demonstration.
10. Mini project / case study.

**PEC-II (Mobile Technology)**

| | | | | |
|---|---|---|---|---|
| **Theory** | **:** | 3 Hrs./Week | **Evaluation Scheme** | |
| | | | **MSE** | **:** 30 Marks |
| **Credit** | **:** | 3 | **ISE/CA** | **:** 10 Marks |
| | | | **ESE** | **:** 60 Marks |

| | | |
|---|---|---|
| Course Pre-Requisite | Basic knowledge of Computer Networks, Digital Communication, and Wireless Communication concepts is recommended for studying Mobile Technology. | |
| Course Objectives | 1 | Realize importance of cellular concepts and its propagation mechanism |
| | 2 | Nurture students with knowledge of traffic engineering in cellular networks. |
| | 3 | Understand the importance of services and Channels in GSM. |
| | 4 | Understand architecture of GSM, 4G and 5G. |
| Course Outcomes | **After competition of this course Students will be able to** | |
| | CO1 | Apply multiple access techniques to mobile communication |
| | CO2 | Explore the architecture of GSM. |
| | CO3 | Apply and make use of GSM Services. |
| | CO4 | Differentiate thoroughly the routing protocols and generations of mobile technologies |

| Unit No. | Content | Hours |
|---|---|---|
| **Unit 1** | **Introduction to Mobile Communication & Multiple Access Technique** | |
| | Mobile and Personal Communication, mobile and wireless devices, Specialized packet and mobile radio networks, circuit switched data services on cellular networks, packet switched data services on cellular networks, Multiple Access Technique- FDMA, TDMA, SDMA, and CDMA. | **07 Hrs.** |
| **Unit 2** | **Cellular Concept** | **07 Hrs.** |
| | Introduction to cellular telephone system:<br>Expansion of mobile system capacity through frequency reuse, Cell geometry, Selection of cluster size, Cell splitting and sectoring, Coverage and capacity in cellular system and Handoff strategies.<br>Propagation Mechanism:<br>Free space and two ray propagation model, Basic propagation mechanism.<br>Hata outdoor propagation model. Small Scale Fading and Multipath: Types of | |

| | | |
|---|---|---|
| | Small-scale fading, Small scale multipath propagation, Impulse response model of multipath channel and Small-scale multipath measurements. | |
| **Unit 3** | **Introduction to GSM** | |
| | Introduction, Architecture of GSM, characteristics of GSM standards, services, Radio transmission parameters in GSM System. | **07 Hrs.** |
| **Unit 4** | **GSM Services and Channels** | |
| | Traffic and Logical Channels in GSM, GSM time hierarchy, Description of call setup procedure, Handover mechanism in GSM, Security in GSM. Data transmission in GSM: Data Services, SMS, HSCSD, GPRS, EDGE | **07 Hrs.** |
| **Unit 5** | **Routing Protocols** | |
| | Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm. | **07 Hrs.** |
| **Unit 6** | **Evolution of Mobile Technologies** | **07 Hrs.** |
| | Evolution of Mobile Generation and its comparison (GSM & CDMA) LTE basics, LTE frame structure, LTE Design parameters with Standardization and Architecture of LTE. Overview of 5 G Networks, Comparison of 4G and 5G technology, Opportunities and requirements in 5G network, Open Wireless Architecture of 5G network. | |
| | | **Total – 42 Hrs** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | Mobile Communications | Jachen Schiller | Pearson Education |
| 02 | Wireless Communications Principles and Practice | Theodore Rappaport | Pearson Education |
| 03 | Advanced Wireless Networks | Savo Glisic | Wily India |

**PEC-III (Ethical Hacking)**

**Theory : 3** Hrs./Week

**Credit : 3**

**Evaluation Scheme**

**MSE : 30** Marks

**ISE/CA : 10** Marks

**ESE : 60** Marks

| | | | |
|---|---|---|---|
| Course Pre-Requisite | Computer Networks, Data Communications, Operating Systems | | |
| Course Objectives | 1 | To develop foundational knowledge of information security concepts | |
| | 2 | To understand ethical hacking methodologies and penetration-testing phases | |
| | 3 | To equip students with hands-on skills in security assessment | |
| | 4 | To analyze weaknesses in computer networks, systems, web applications, and wireless security | |
| | 5 | To encourage ethical and legal consciousness in cybersecurity practice | |
| | 6 | To prepare students for real-world cybersecurity roles, certifications | |
| Course Outcomes | **After competition of this course Students will be able to** | | **Blooms Taxonomy** |
| | CO 1 | Explain security principles, cyber threats, vulnerabilities, and legal/ethical issues related to hacking | Understand |
| | CO 2 | Apply information gathering and reconnaissance using open-source intelligence and basic scanning techniques. | Apply |
| | CO 3 | Analyze network services and system weaknesses through enumeration and vulnerability assessment. | Analyze |
| | CO 4 | Demonstrate password-cracking, exploitation, and post-exploitation procedures in a controlled environment. | Apply |
| | CO 5 | Analyze and evaluate security weaknesses in web and wireless networks and propose suitable defensive measures. | Evaluate |
| | CO 6 | Prepare security assessment documentation and penetration-testing reports. | Create |

| Unit No. | Content | Hours |
|---|---|---|
| **Unit 1** | **Principles of Hacking & Legal Parameters** | |
| | Introduction of Ethical Hacking, Need of Ethical hacking, Principles of Ethical hacking, Types of Hacking, Phases of Ethical Hacking, Types of hackers, Hacking Technique, Types of Attacks on a System, Introduction to Malware, Viruses ,Worms & Trojan Concepts | **07 Hrs.** |
| | **System Hacking and & Exploitation** | |

| | | |
|---|---|---|
| **Unit 2** | Introduction to Footprinting & Reconnaissance, Types of Footprinting, Footprinting through Web Services, Password Attacks<br>Enumeration: Techniques for Enumeration, Information Gathering Using Groups, Forums and Biogs. Network Scanning Concepts. | **07 Hrs.** |
| **Unit 3** | **Sniffing And Social Engineering** | |
| | What is Sniffing , MAC Spoofing & Flooding, Active Scanning Techniques, DHCP Flooding, Types of Sniffing, Setup DHCP Rouge (MITM Attack), Protocols Vulnerable to Sniffing, Sniffing with Wireshark Social Engineering Concepts :Social Engineering Techniques | **07 Hrs.** |
| **Unit 4** | **Network & Wireless Security** | |
| | Packet Sniffing, Wireless Hacking, Attacks on Voice over IP systems such as eavesdropping, call hijacking, and denial of service attacks.<br>Firewall & Examples ,What is IDS & examples | **07 Hrs.** |
| **Unit 5** | **Mobile & Wireless Networks Hacking** | |
| | Introduction to the Mobile architecture ,Working principle for mobile OS, Security of the application used in Mobiles ,Hacking Methodology for mobile with Metasploit Introduction to Wireless Terminology, Networks, Standards Types of Wireless Authentication and Encryption | **07 Hrs.** |
| **Unit 6** | **IoT and Cloud Attacks** | **07 Hrs.** |
| | IOT Concept and Attacks, Technology and Protocols, Challenges, Opportunity in IOT, OWASP Top 10 IOT Vulnerabilities and Obstacles, Hacking IOT Devices, Cloud Computing Overview , Introduction to Cloud & Virtualization | |
| | | **Total – 42 Hrs** |

| **Textbooks** | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | CEH VlO: EC-Council Certified Ethical Hacker Complete Training Guide by IPSpecialist | Ric Messier | CEH vll Wiley |
| 02 | The Complete Ethical Hacking Book | Thirumalesh | 1st Edition |
| 03 | Hands-On Ethical Hacking and Network Defense | Michael T. Simpson, Nicholas D. Antill &Robert S. Wilson | 4th Edition |

| Reference Books | | | |
|---|---|---|---|
| Sr. No. | Title | Author | Edition/Publication |
| 01 | CEH vl0 Certified Ethical Hacker Study Guide | Ric Messier | Wiley |
| 02 | Gray Hat Hacking: The Ethical Hacker's Handbook | Allen Harper, Daniel Regalado, et al. | 6th Edition McGraw-Hill |
| 03 | Ethical Hacking: Techniques, Tools, and Countermeasures | Michael G. Solomon & Sean-Philip Oriyano | 4th Edition |

**PEC-III LAB (Ethical Hacking Lab)**

| | | | | | |
|---|---|---|---|---|---|
| **Theory** | **:** | NA | **Evaluation Scheme** | | |
| **Credit** | **:** | 1 | **ISE/CA** | **:** | 25 Marks |
| | | | **ESE** | **:** | **25** Marks |

| **Course Objectives:** The objective of the course is to | | |
|---|---|---|
| To equip students with the knowledge and practical skills to perform ethical penetration testing by applying information gathering, vulnerability assessment, controlled exploitation, web application security analysis, and professional reporting while adhering to legal and ethical standards. | | |
| **Course Outcomes:** | | |
| **COs** | **At the end of successful completion of the course, the student will be able to** | **Blooms Taxonomy** |
| CO1 | Apply ethical hacking methodologies to perform reconnaissance, foot printing, scanning, and enumeration on target systems using industry-standard security tools. | Apply |
| CO2 | Analyze and perform penetration testing to identify and exploit vulnerabilities in operating systems, networks, and web applications. | Apply |
| CO3 | Evaluate system security by conducting password attacks, privilege escalation, malware analysis, and assessing associated security risks. | Apply |
| CO4 | Develop professional penetration testing reports and recommend appropriate security controls and countermeasures to mitigate identified cyber threats and vulnerabilities. | Apply |

**List of Experiment: (Minimum 08 Experiments are to be performed.)**

1. To learn about hacking tools and skills.
2. To understand ethical hacking principles and explore Kali Linux.
3. To study Foot printing and Reconnaissance.
4. To discover live hosts, open ports, and services.
5. To study Fingerprinting.
6. To identify vulnerabilities in a target system.
7. To understand password security and cracking methods.
8. To learn and study Sniffing and its tools.
9. To demonstrate SQL Injection vulnerability.
10. To study and exploit Cross-Site Scripting (XSS) vulnerabilities in a web application and understand the risks posed by client-side attacks.
11. To study Wireless Hacking.
12. To prepare a professional penetration testing report.