**Department of**
**Electronics and Communication Engineering**

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**FACULTY OF ENGINEERING AND TECHNOLOGY**

**B.TECH. - ELECTRONICS AND COMMUNICATION ENGINEERING**

**REGULATION 2021, REVISION (1)**

(Applicable for the students admitted in the Academic year 2021 onwards)

**FOUR YEAR FULL TIME**

**CURRICULUM AND SYLLABUS**

**I – VIII SEMESTERS**

| APPROVAL | |
|---|---|
| **BOS** | **42nd ACM** |
| 16.06.2023 | 08.07.2023 |

| | |
|---|---|
| **INSTITUTE VISION** | To be a University of global dynamism with excellence in knowledge and innovation ensuring social responsibility for creating an egalitarian society. |

| | | |
|---|---|---|
| **INSTITUTE MISSION** | **UM1** | Offering well balanced programmes with scholarly faculty and state-of-art facilities to impart high level of knowledge. |
| | **UM2** | Providing student - centered education and foster their growth in critical thinking, creativity, entrepreneurship, problem solving and collaborative work. |
| | **UM3** | Involving progressive and meaningful research with concern for sustainable development. |
| | **UM4** | Enabling the students to acquire the skills for global competencies. |
| | **UM5** | Inculcating Universal values, Self respect, Gender equality, Dignity and Ethics. |

**CORE VALUES**

- Student – centric vocation
- Academic excellence
- Social Justice, equity, equality, diversity, empowerment, sustainability
- Skills and use of technology for global competency.
- Continual improvement
- Leadership qualities.
- Societal needs
- Learning, a life – long process
- Team work
- Entrepreneurship for men and women
- Rural development
- Basic societal, and applied research on Energy, Environment, and Empowerment.

| | |
|---|---|
| **DEPARTMENT VISION** | To be an innovative leading department in the domain of Electronics and Communication Engineering in promoting academic growth by offering UG, PG and Ph.D Programmes to augment the industrial and societal needs through cutting edge research activities |

| | | |
|---|---|---|
| **DEPARTMENT MISSION** | **DM1** | To offer UG, PG and Ph.D programmes in Electronics and Communication Engineering through State-of-art facilities and Technology Enabled Teaching Methodologies. |
| | **DM2** | To produce Exemplary Electronics and Communication Engineers to meet the contemporary requirements of the industries and institutions. |
| | **DM3** | To excel in research and development activities along with establishingcollaborative research ventures and linkages with leading organizations. |
| | **DM4** | To cultivate entrepreneurial skill and concern for society among students. |

**Table: 1 Mapping of University Mission (UM) and Department Mission (DM)**

| | **UM1** | **UM2** | **UM3** | **UM4** | **UM5** |
|---|---|---|---|---|---|
| **DM1** | 3 | 2 | | 1 | 1 |
| **DM2** | 1 | 2 | 1 | 3 | 1 |
| **DM3** | 1 | 1 | 3 | 3 | |
| **DM4** | | 1 | 1 | 1 | 3 |
| **Total** | **5** | **6** | **4** | **8** | **5** |

**1-Low 2- Medium 3 – High**

## PROGRAMME EDUCATIONAL OBJECTIVES

| | |
|---|---|
| PEO1 | Graduates will be successful Electronics and Communication Engineering Professionals in industries, higher education and research. |
| PEO2 | Graduates will be technically competent in identifying, analyzing and creating appropriate Electronics and Communication Engineering solutions to become an entrepreneur. |
| PEO3 | Graduates will work as a member and lead following ethical practices. |
| PEO4 | Graduates will strive to develop their knowledge and skills throughout their career for the benefit of the society. |

**Table: 2 Mapping of Program Educational Objectives (PEOs) withDepartment Mission (DM)**

| PEO / DM | DM1 | DM 2 | DM 3 | DM4 |
|---|---|---|---|---|
| **PEO 1** | 3 | 2 | 1 | 1 |
| **PEO 2** | 2 | 3 | 1 | 1 |
| **PEO 3** | | 2 | 2 | 2 |
| **PEO 4** | | 1 | 1 | 3 |
| | **5** | **8** | **5** | **7** |

***1- Low 2 – Medium 3-High***

## GRADUATE ATTRIBUTES

1. **Knowledge base for Engineering:** Demonstrate competence in mathematics, natural sciences, engineering fundamentals and specialized engineering knowledge appropriate to the program.
2. **Problem Analysis:** Identify, formulate, analyze and solve diverse engineering problems.
3. **Design:** Solution for complicated open–ended engineering problems and design the components with appropriate standards to meet specified needs with proper attention to public health, safety, environment and society.
4. **Experimental Investigation:** Technical skills to conduct investigation, interpretation of observed data and provide solution for multifaceted problems.
5. **Modern Engineering tools usage**: Acquire, select, manipulate relevant techniques, resources and advanced engineering ICT tools to operate simple to complex engineering activities.
6. **Impact of engineering on society:** Provide a product / project for use by the public towards their health, welfare, safety and legal issues to serve the society effectively.
7. **Environment and Sustainability:** Design eco-friendly and sustainable products in demonstrating the technology development to meet present and future needs.
8. **High Ethical Standards:** Practice ethical codes and standards endorsed by professional engineers.
9. **Leadership and team work:** Perform as an individual and as a leader in diverse teams and in multi-disciplinary scenarios.
10. **Communication Skills:** Professional communication with the society to comprehend and formulate reports, documentation, effective delivery of presentation and responsible to clear instructions.
11. P**roject management and Finance:** Appropriate in incorporating finance and business practices including project, risk and change management in the practice of engineering by understanding their limitations.
12. **Life-long learners:** Update the technical needs in a challenging world in equipping themselves to maintain their competence.

## PROGRAM OUTCOMES (POs)

1. Able to apply the knowledge of Mathematics, Science, Engineering and Technology inthe field of Electronics and Communication Engineering
2. Capable to identify and analyse the Electronics and Communication engineering problems.
3. Proficient to provide solutions to meet the specific needs of the public health, safety, environment and society.
4. Competent to conduct experiments, interpret the data and compare the performance and provide solutions for complex problems.
5. Adept to handle modern Electronics and Communication Engineering tools, equipments and software.
6. Skillful to design Electronics and Communication products and validate by analysis and test for the benefit of the society towards safety and legal issues.
7. Efficient to develop aElectronics and Communication system or process to meet the economical growth, eco friendly environment and sustainability.
8. Instill to integrate professional, ethical and social responsibility in all walks of life.
9. Masterful to lead the group activities or as a team member for best outputs.
10. Effective to comprehend and formulate reports, deliver presentations and respond to the queries with clear ideas.
11. Capable to incorporate business practices and project management for the economical growth of the nation.
12. Able to update technical knowhow and engage in lifelong learning to meet the challenges of the modern world.

**PROGRAMME SPECIFIC OUTCOMES (PSOS)**

13. (PSO1) Able to apply the knowledge in Networking technologies
14. (PSO2) Able to apply the knowledge in Wireless Communications

**Table: 3Mapping of Program Outcomes (POs) with Graduate Attributes (GAs)**

| PO/GA | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO1** | 3 | 1 | | | 1 | | | | | | | |
| **PO2** | 1 | 3 | 1 | 1 | 1 | | | | | | | |
| **PO3** | 1 | 1 | 3 | 1 | 1 | | | | | | | |
| **PO4** | 1 | 1 | 1 | 3 | 1 | | | | | | | |
| **PO5** | 1 | 1 | 1 | 1 | 3 | | | | | | | |
| **PO6** | 1 | 1 | 1 | 1 | 1 | 3 | | | | | | |
| **PO7** | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | | | | |
| **PO8** | | | | | | 1 | 1 | 3 | 1 | | | |
| **PO 9** | | | | | | | | | 3 | 1 | | |
| **PO10** | | | | | | | | | 1 | 3 | 1 | |
| **PO11** | 1 | 1 | 1 | | 1 | | | | | | 3 | |
| **PO12** | 1 | 1 | 1 | 1 | 1 | | | | | | | 3 |
| **PSO1** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | 2 |
| **PSO2** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | 2 |

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

**Table:4 Mapping of Program Outcomes (POs) with Program Educational Objectives(PEOs)**

| PEO / PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PEO 1** | 3 | 3 | 2 | 3 | 3 | 2 | 1 | | | 1 | 2 | | 2 | 2 |
| **PEO 2** | 2 | 3 | 2 | 3 | 3 | 2 | 2 | | 1 | 3 | 2 | 3 | 2 | 2 |
| **PEO 3** | | | 1 | | | 1 | 2 | 1 | 3 | | 3 | 3 | 2 | 2 |
| **PEO 4** | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 1 | 1 | 3 | | 2 | 2 |

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

**Curriculum and Syllabus**

**Regulation 2021**

**Revision -1**

## SEMESTER I

| S. No | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | L | T | P | Hours |
| 1 | XMA101 | BSC | Calculus and Linear Algebra | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 2 | XBE102 | ESC | Electrical and Electronics Engineering Systems | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 3 | XAP103 | BSC | Applied Physics for Engineers | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 4 | XEC104 | EFC | Fundamentals of computers | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 5 | XGS105 | HSMC | Speech Communication | 0 | 1 | 2 | 3 | 0 | 1 | 4 | 5 |
| 6 | XUM106 *# | MC | Constitution of India | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| 7 | XBE107 | ESC | Electrical and Electronics Engineering Systems Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 8 | XAP108 | BSC | Applied Physics for Engineers Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| | **Total** | | | 12 | 4 | 4 | 20 | 15 | 4 | 8 | 27 |

**Total Credits – 20 Total Hours- 27**

## SEMESTER II

| S. No | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | L | T | P | Hours |
| 1 | XMA201 | BSC | Calculus, Ordinary Differential Equations and Complex Variable | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 2 | XCP202 | ESC | Programming for Problem Solving | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 3 | XAC203 | BSC | Applied Chemistry for Engineers | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 4 | XGS204 | HSMC | Technical Communication | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 |
| 5 | XWP205 | ESC | Workshop Practices | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 5 |
| 6 | XEM206 | ESC | Engineering Mechanics | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 7 | XCP207 | ESC | Programming for Problem Solving Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 8 | XAC208 | BSC | Applied Chemistry for Engineers Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| | **Total** | | | 15 | 2 | 4 | 21 | 15 | 2 | 8 | 25 |

**Total Credits – 21 Total Hours- 25**

## SEMESTER III

| S. No | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | L | T | P | Hours |
| 1 | XMA301 | BSC | Transforms and Partial Differential Equations | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 2 | XEC302 | PCC | Electronic devices | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 3 | XEC303 | PCC | Digital System Design | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 4 | XEC304 | PCC | Network Theory | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 5 | XEC305 | PCC | Electromagnetic Theory and Transmission Lines | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 6 | XUM306 | HSMC | Entrepreneurship Development | 2 | 0 | 0 | 2 | 2 | 0 | 0 | SS - 13 |
| 7 | XUM307 | MC (HSMC) | Universal Human Values 2: Understanding Harmony | 2 | 1 | 0 | 3 | 2 | 1 | 0 | 3 |
| 8 | XEC308 | PCC | Electronic Devices and Networks Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 9 | XEC309 | PCC | Digital System Design Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 10 | XEC310 | PROJ | In-plant Training - I | - | - | 1 | 1 | - | - | - | - |
| | **Total** | | | 19 | 3 | 3 | 25 | 19 | 3 | 4 | 27 |

**Total Credits -25 Total Hours- 27**

## SEMESTER IV

| S. No. | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | L | T | P | Hours |
| 1. | XEC401 | BSC | Probability Theory and Stochastic Processes | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 2. | XEC402 | PCC | Electronic Circuits | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 3. | XEC403 | PCC | Signals and Systems | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 4. | XEC404 | PCC | Analog Integrated Circuits | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 5. | XUM009 | HSMC | Economics for Engineers | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 6 | XUM003 *# | MC | Disaster Management | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| 7 | XEC407 | PCC | Electronic Circuits Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 8 | XEC408 | PCC | Analog Integrated Circuits Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 9 | XEC409 | PCC | Signals and Systems Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| | | | **Total** | 15 | 3 | 3 | 21 | 18 | 3 | 6 | 27 |

**Total Credits – 21 Total Hours- 27**

## SEMESTER V

| S. No. | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | L | T | P | Hours |
| 1 | XEC501 | PCC | Microprocessors and Microcontrollers | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 2 | XEC502 | PCC | Digital Signal Processing | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 3 | XEC503 | PCC | Antennas and Wave Propagation | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 4 | XEC504 | PCC | Communication Theory | 3 | 1 | 0 | 4 | 3 | 1 | 0 | 4 |
| 5 | PEC-I* | PEC | Professional Elective-1 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 6 | OE I** | OE | Open Elective-1 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 7 | XEC507 | PCC | Microprocessors and Microcontrollers Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 8 | XEC508 | PCC | Digital Signal Processing Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 9 | XEC509 | PROJ | In-plant Training - II | - | - | 1 | 1 | - | - | - | - |
| | | | **Total** | 18 | 2 | 3 | 23 | 18 | 2 | 4 | 24 |

**Total Credits – 23 Total Hours- 24**

## SEMESTER VI

| S. No. | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | L | T | P | Hours |
| 1 | XEC601 | PCC | Digital Communication | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 2 | XEC602 | PCC | Microwave Engineering and Fiber Optic Communication | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 3 | PEC-II* | PEC | Professional Elective-2 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 4 | OE II** | OE | Open Elective-2 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 5 | XGS605 | HSMC | Professional Skills | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 5 |
| 6 | XUM005 *# | MC | Cyber Security | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| 7 | XEC607 | PCC | Analog and Digital Communication Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 8 | XEC608 | PCC | Microwave Engineering and Fiber Optic Communication Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| | | | **Total** | **13** | **0** | **4** | **17** | **16** | **0** | **8** | **24** |

**Total Credits – 17 Total Hours- 24**

## SEMESTER VII

| S. No. | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | L | T | P | Hours |
| 1 | XEC701 | PCC | VLSI Design and Embedded Systems | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 2 | XEC702 | PCC | Modern Control Systems | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 3 | PEC-III* | PEC | Professional Elective-3 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 4 | OE III** | OE | Open Elective-3 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 5 | XUM008*# | MC | Environmental Sciences | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| 6 | XEC706 | PCC | VLSI Design and Embedded Systems Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 7 | XEC707 | PCC | Modern Control Systems Laboratory | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| 8 | XEC708 | PROJ | Project Work (Phase-I) | 0 | 0 | 2 | 2 | 0 | 0 | 4 | 4 |
| 9 | XEC709 | PROJ | In-plant Training - III | - | - | 2 | 2 | - | - | - | - |
| | | | **Total** | 12 | 0 | 6 | 18 | 15 | 0 | 8 | 23 |

**Total Credits – 18 Total Hours- 23**

## SEMESTER VIII

| S. No. | Course Code | Category | Name of the Course | Credits | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | L | T | P | Hours |
| 1 | PEC-IV* | PEC | Professional Elective-4 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 3 | OE IV** | OE | Open Elective -4 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 4 | OE V** | OE | Open Elective-5 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 |
| 5 | XEC804 | PROJ | Project Work (Phase-II) | 0 | 0 | 9 | 9 | 0 | 0 | 18 | 18 |
| | | | **Total** | 9 | 0 | 9 | 18 | 9 | 0 | 18 | 27 |

**Total Credits – 18 Total Hours- 27**

*** Professional Elective** **** Open Elective** ***# Non-credit Course**

**Grant Total Credits: 163**

**In Plant Training of 30 days in the vacation periods is mandatory to complete the graduation.**

## LIST OF ELECTIVES

| Program Elective PE | Course Code. | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| PE1 505* | XEC505A | Computer Organization and Architecture | 3 | 0 | 0 | 3 |
| | XEC505B | Introduction to Artificial Intelligence | 3 | 0 | 0 | 3 |
| | XEC505C | Radio Frequency Electronics | 3 | 0 | 0 | 3 |
| | XEC505D | Radar Technologies | 3 | 0 | 0 | 3 |
| PE2 603* | XEC603A | Introduction to Data Structure | 3 | 0 | 0 | 3 |
| | XEC603B | Applied Machine Learning | 3 | 0 | 0 | 3 |
| | XEC603C | Wireless Communications | 3 | 0 | 0 | 3 |
| | XEC603D | Avionics Systems | 3 | 0 | 0 | 3 |
| PE3 703* | XEC703A | Introduction to Operating Systems | 3 | 0 | 0 | 3 |
| | XEC703B | Artificial Intelligence for Robotics | 3 | 0 | 0 | 3 |
| | XEC703C | Wireless Networks | 3 | 0 | 0 | 3 |
| | XEC703D | Satellite Communication | 3 | 0 | 0 | 3 |
| PE4 801* | XEC801A | Fundamentals of Kotlin Programming | 3 | 0 | 0 | 3 |
| | XEC801B | Internet of Things | 3 | 0 | 0 | 3 |
| | XEC801C | Fundamentals of 5G Technology | 3 | 0 | 0 | 3 |
| | XEC801D | Remote Sensing | 3 | 0 | 0 | 3 |

## LIST OF OPEN ELECTIVES

| Open Elective OE | Course code. | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| OE** | XECOE1 | Display Systems | 3 | 0 | 0 | 3 |
| OE** | XECOE2 | Human Assist Devices | 3 | 0 | 0 | 3 |

## SPECIALIZATION COURSE

### a) Robotics and Industrial Automation

| S.No | Course Code | Semester | Name of the Course | Credit | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | L | T | P | H |
| 1 | XECHR1 | III | Service Robotics with Drives and Sensors | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 5 |
| 2 | XECHR2 | IV | Industrial Robotics and Automation | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 5 |
| 3 | XECHR3 | V | Fundamentals of ROS and Embedded in Robotics | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 5 |
| 4 | XECHR4 | V | Artificial Intelligence and Computer Vision for Robotics | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 5 |
| 5 | XECHR5 | VI | Deep Learning for Robotics | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 5 |
| 6 | XECHR6 | VII | Mini Project | 0 | 0 | 5 | 5 | 0 | 0 | 5 | 5 |
| | | | **Total** | **5** | **0** | **15** | **20** | **5** | **0** | **20** | **35** |

### b) Artificial Intelligence and Machine Learning

| S. No | Course Code | Semester | Course Title | Credit | | | | Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | L | T | P | H |
| 1 | XCSHA1 | III | Introduction to Artificial Intelligence | 1 | 0 | 2 | 3 | 5 | 0 | 2 | 5 |
| 2 | XCSHA2 | IV | Image Processing and Vision Techniques | 1 | 0 | 2 | 3 | 5 | 0 | 2 | 5 |
| 3 | XCSHA3 | V | Introduction to Machine Learning | 1 | 0 | 2 | 3 | 5 | 0 | 2 | 5 |
| 4 | XCSHA4 | VI | Deep Learning for Robotics | 1 | 0 | 2 | 3 | 5 | 0 | 2 | 5 |
| 5 | XCSHA5 | VI | Internet of Things | 1 | 0 | 2 | 3 | 5 | 0 | 2 | 5 |
| 6 | XCSHA6 | VII | Mini Project | 0 | 0 | 5 | 5 | 10 | 0 | 5 | 10 |
| | | | **Total** | **5** | **0** | **15** | **20** | **35** | **0** | **15** | **35** |

**SYLLABUS**

| COURSE CODE | | | XMA101 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | CALCULUS AND LINEAR ALGEBRA | 3 | 1 | 0 | 4 |
| C | P | A | | L | T | P | H |
| 3 | 0.5 | 0.5 | | 3 | 1 | 0 | 4 |

**PREREQUISITE:** Differentiation and Integration

| Course Outcomes | | Domain | Level |
|---|---|---|---|
| CO1 | ***Apply*** orthogonal transformation to reduce quadratic form to canonical forms. | Cognitive | Remembering<br>Applying |
| CO2 | ***Apply*** power series to tests the convergence of the sequences and series. Half range Fourier sine and cosine series. | Cognitive<br>Psychomotor | Applying<br>Remembering<br>Guided Response |
| CO3 | ***Find***the derivative of composite functions and implicit functions. Euler's theorem and Jacobin | Cognitive<br>Psychomotor | Remembering<br>Guided Response |
| CO4 | ***Explain*** the functions of two variables by Taylor'sexpansion, by finding maxima and minima with and without constraints using Lagrangian Method.<br>Directional derivatives, Gradient, Curl and Divergence. | Cognitive<br>Affective | Remembering<br>Understanding<br>Receiving |
| CO5 | ***Apply*** Differential and Integral calculus to notions curvature and to improper integrals. | Cognitive | Applying |

| **UNITI –MATRICES** | **12 Hours** |
|---|---|
| Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors - Cayley-Hamilton Theorem – Diagonalisation of Matrices – Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only). | |
| **UNITII -SEQUENCES AND SERIES** | **12 Hours** |
| Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem. | |
| **UNIT III -MULTIVARIABLE CALCULUS: PARTIAL DIFFERENTIATION** | **12 Hours** |
| Limits and continuity –Partial differentiation – Total Derivative – Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian. | |
| **UNIT IV - MULTIVARIABLE CALCULUS: MAXIMA AND MINIMA AND VECTOR CALCULUS** | **12 Hours** |
| Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers – Directional Derivatives - Gradient, Divergence and Curl. | |
| **UNIT V - DIFFERENTIAL AND INTEGRAL CALCULUS** | **12 Hours** |

| |
|---|
| Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. |

| LECTURE | TUTORIAL | TOTAL |
|---|---|---|
| 45 | 15 | 60 |

**TEXT BOOKS**


1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2015.
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2014.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2010.


**REFERENCE BOOKS**


1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.


**Table 1: Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | | | 2 | | | | | 1 | | 2 |
| **CO 2** | 3 | 1 | | | | | | | | 1 | | 1 |
| **CO 3** | 3 | 1 | | | | | | | | 1 | | 1 |
| **CO 4** | 3 | 2 | | | | | | | | 1 | | 1 |
| **CO 5** | 3 | 2 | | | 1 | | | | | 1 | | 2 |
| **Total** | 15 | 8 | | | 3 | | | | | 5 | | 7 |
| **Scaled Value** | 3 | 2 | | | 1 | | | | | 1 | | |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XBE102 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS | 3 | 1 | 0 | 4 |
| Prerequisites | | | Physics | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 1 | 0 | 4 |

| Course Outcomes | | Domain | Level |
|---|---|---|---|
| CO1 | ***Define*** and ***Relate***the fundamentals of electrical parameters and build and explain AC, DC circuits by Using measuring devices | Cognitive | Understanding |
| CO2 | ***Define*** and ***Explain***the operation of DC and AC machines. | Cognitive | Understanding |
| CO3 | ***Recall*** and ***Illustrate***various semiconductor devices and their applications and displays the input output characteristics of basic semiconductor devices. | Cognitive | Understanding |
| CO4 | ***Relate*** and ***Explain*** the number systems and logic gates. Construct the different digital circuit. | Cognitive | Understanding |
| CO5 | ***Label*** and ***Outline*** the different types of microprocessors and their applications. | Cognitive | Understanding |

**UNIT I -FUNDAMENTALS OF DC AND AC CIRCUITS, MEASUREMENTS** **9+3**

Fundamentals of DC– Ohm's Law – Kirchhoff's Laws - Sources - Voltage and Current Relations –Star/Delta Transformation - Fundamentals of AC – Average Value, RMS Value, Form Factor - AC power and Power Factor, Phasor Representation of sinusoidal quantities, Simple Series, Parallel, Series Parallel Circuit - Operating Principles of Moving coil and Moving Iron Instruments (Ammeter, Voltmeter) and Dynamometer type meters (Watt meter and Energy meter).

**UNIT II -ELECTRICAL MACHINES** **9+3**

Construction, Principle of Operation, Basic Equations, Types and Application of DC Generators, DC motors - Basics of Single-Phase Induction Motor and Three Phase Induction Motor-Construction, Principle of Operation of Single-Phase Transformer, Three phase transformers, Auto transformer.

**UNIT III - SEMICONDUCTOR DEVICES** **9+3**

Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications

**UNIT IV -DIGITAL ELECTRONICS** **9+3**

Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subtractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.

**UNIT V - MICROPROCESSORS** **9+3**

Architecture, 8085, pin diagram of 8085, ALU timing and control unit, registers, data and address bus, timing and control signals, Instruction types, classification of instructions, addressing modes, Interfacing Basics: Data transfer concepts – Simple Programming concepts.

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| HOURS | 45 | 15 | 60 |

| | | | |
|---|---|---|---|
| **TEXT BOOKS:** | | | |
| 1. Metha V.K, Rohit Mehta, 2020. Principles of Electronics,12th ed, S Chand Publishing.<br>2. Albert Malvino, David J.Bates., 2017. Electronics Principles. 7th ed, Tata McGraw-Hill. NewDelhi.<br>3. Rajakamal, 2014. Digital System-Principle & Design. 2nd ed. Pearson education.<br>4. Morris Mano, 2015. Digital Design. Prentice Hall of India.<br>5. Ramesh, S. Gaonkar, 2013, Microprocessor Architecture, Programming and its Applications with the 8085, 6th ed , India: Penram International Publications. | | | |
| **REFERENCE BOOKS:** | | | |
| 1. Cotton, H.,2005 Electrical Technology. CBS Publishers & Distributors Pvt Ltd.<br>2. Syed, A. Nasar, 1998, Electrical Circuits. Schaum Series.<br>3. Jacob Millman and Christos, C. Halkias, 1967, Electronics Devices, New Delhi: Tata McGraw-Hill.<br>4. Millman, J. and Halkias, C. C., 1972. Integrated Electronics: Analog and Digital Circuits and Systems, Tokyo: McGraw-Hill, Kogakusha Ltd.<br>5. Mohammed Rafiquzzaman, 1999. Microprocessors - Theory and Applications: Intel and Motorola. Prentice Hall International. | | | |
| **E-REFERENCES:** | | | |
| 1. NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De, Prof. T. K. Bhattacharya and Prof. G.D. Roy, IIT Kharagpur.<br>2. Prof.L.Umanand, http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#, IISc Bangalore.<br>3. http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura, IIT Madras.<br>4. Dr.L.Umanand, http://www.nptelvideos.in/2012/11/basic-electrical-technology.html, IISC Bangalore. | | | |

**Table 1:Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | |
| **CO 2** | 3 | 3 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | |
| **CO 3** | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | |
| **CO 4** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| **CO 5** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| **Total** | 12 | 12 | 6 | 5 | 6 | 6 | 3 | 3 | 5 | 5 | 5 | |
| **Scaled** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | |

1-5 → 1, 6-10 → 2, 11-15 → 3
1 – Low Relation, 2 – Medium Relation, 3 – High Relation

| COURSE CODE | | | XAP103 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | APPLIED PHYSICS FOR ENGINEERS | 3 | 1 | 0 | 4 |
| PREREQUISITE | | | Basic Physics in HSC level | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 2.8 | 0.8 | 0.4 | | | | | |

| COURSE OUTCOMES | | Domain | Level |
|---|---|---|---|
| CO1 | ***Identify*** the basics of mechanics, ***explain*** the principles of elasticity and ***determine*** its significance in engineering systems and technological advances. | Cognitive<br>Psychomotor | Remembering, Understanding<br>Mechanism |
| CO2 | ***Illustrate*** the laws of electrostatics, magneto-statics and electromagnetic induction; ***use*** and ***locate***basic applications of electromagnetic induction to technology. | Cognitive<br>Psychomotor<br>Affective | Remembering, Analyzing,<br>Mechanism<br>Respond |
| CO3 | ***Understand*** the fundamental phenomena in optics by measurement and ***describe*** the working principle and application of various lasers and fibre optics. | Cognitive<br>Psychomotor<br>Affective | Understanding, Applying<br>Mechanism<br>Receiving |
| CO4 | ***Analyse***energy bands in solids, ***discuss*** and ***use*** physics principles of latest technology using semiconductor devices. | Cognitive<br>Psychomotor<br>Affective | Understanding, Analyzing<br>Mechanism<br>Receiving |
| CO5 | ***Develop*** Knowledge on particle duality and ***solve***Schrodinger equation for simple potential. | Cognitive | Understanding, Applying |

**UNIT I -MECHANICS OF SOLIDS** **9+3**

**Mechanics:** Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.

**Elasticity:**Stress - Strain - Hooke's law - Stress strain diagram - Classification of elastic modulus - Moment, couple and torque - Torsion pendulum - Applications of torsion pendulum - Bending of beams - Experimental determination of Young's modulus: Uniform bending and non-uniform bending.

**UNIT II -ELECTROMAGNETIC THEORY** **9+3**

Laws of electrostatics - Electrostatic field and potential of a dipole; DielectricPolarisation, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.

**UNIT III -OPTICS, LASERS AND FIBRE OPTICS** **9+3**

**Optics:** Dispersion- Optical instrument: Spectrometer - Determination of refractive index and dispersive power of a prism- Interference of light in thin films: air wedge - Diffraction: grating.

**LASER**: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser - $CO_2$ laser - Applications

**Fibre Optics:** Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system (Block diagram).

| UNIT IV -SEMICONDUCTOR PHYSICS | 9+3 |
|---|---|

**Semiconductors**: Energy bands in solids - Energy band diagram of good conductors, insulators and semiconductors - Concept of Fermi level - Intrinsic semiconductors - Concept of holes - doping - Extrinsic semiconductors - P type and N type semiconductors - Hall effect.

**Diodes and Transistors**: P-N junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave rectifier using P N junction diodes - PNP and NPN transistors - Three different configurations - Advantages of common emitter configuration - working of NPN transistor as an amplifier in common emitter configuration.

| UNIT V -QUANTUM PHYSICS | 9+3 |
|---|---|

Introduction to quantum physics, black body radiation, Compton effect, de Broglie hypothesis, wave – particle duality, uncertainty principle, Schrodinger wave equation (Time dependent and Time independent), particle in a box, Extension to three dimension - Degeneracy.

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| Hours | 45 | 15 | 60 |

**TEXT BOOKS**

1. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.
2. Avadhanulu M. N. "Engineering Physics" (Volume I and II), S. Chand & Company Ltd., New Delhi, 2010.

**REFERENCE BOOKS**

1. PalanisamyP. K., "Engineering Physics", Scitech Publications (India) Pvt. Ltd, Chennai.
2. Arumugam M., "Engineering Physics" (Volume I and II), Anuradha Publishers, 2010.
3. Senthil Kumar G., " Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2011.
4. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.

**E RESOURCES**

NPTEL , Engineering Physics, Prof. M. K. Srivastava, Department of Physics, IIT, Roorkee.

**Table 1: Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 1 | | | | 1 | | | 1 | 3 | 3 |
| CO2 | 3 | - | 1 | - | 1 | | | | - | | | 1 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 1 | | | | 1 | | | 1 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 1 | | | | 1 | | | 1 | 1 | 2 |
| CO5 | 3 | - | 2 | - | - | | | | - | | | 1 | 2 | 3 |
| Total | 15 | 6 | 9 | 6 | 4 | | | | 3 | | | 5 | 11 | 13 |
| **Scaled Value** | **3** | **2** | **2** | **2** | **1** | | | | **1** | | | **1** | **3** | **3** |

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

1- Low Relation, 2-Medium Relation, 3-High Relation

| COURSE CODE | | | XEC104 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | FUNDAMENTALS OF COMPUTERS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To introduce the students about basic functions of computer .
- To familiarize the concept of storage and memory devices
- To educate the student about software and applications

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the functions of various units of computer | Cognitive | Understanding |
| CO2 | ***Explain*** the operation of input and output devices | Cognitive | Understanding |
| CO3 | ***Describe*** the functions of primary memories | Cognitive | Understanding |
| CO4 | ***Describe*** the functions of secondary memories | Cognitive | Understanding |
| CO5 | ***Classify*** the various software | Cognitive | Understanding |
| CO6 | ***Explain*** the interfacing and applications of computer | Cognitive | Understanding |

| **UNIT I - INTRODUCTION** | **7 Hours** |
|---|---|
| Generations of Computer , Block Diagram of a Computer, Functions of the Different Units-input unit, Output unit, Memory unit, Central Processing Unit -Arithmetic Logic Unit- Control Unit | |
| **UNITII -INPUT & OUTPUT DEVICES** | **8 Hours** |
| Input Devices – Keyboard, Point and draw devices ,mouse, joystick, track ball, light pen , Data Scanning devices , image scanner, OCR, OMR, MICR, Bar code reader, card reader , Voice Recognition Device, Digitizers Output Devices – Monitor , Printers - Laser Printer, Dot Matrix Printers, Ink Jet Printer, Projectors | |
| **UNIT III- MEMORIES** | **8 Hours** |
| Registers [Types of Registers], Cache Memory, Primary Memory –RAM, DRAM and SRAM, ROM - Types of ROM | |
| **UNIT IV - SECONDARY MEMORIES** | **7 Hours** |
| Hard disk - structure , Data Storage . tracks , clusters, cylinders formatting of hard disk , Floppy - data storage mechanism, CD data storage mechanism, Pen drive | |
| **UNIT V – SOFTWARE** | **8 Hours** |
| System Software - Operating System, Functions of OS- Types of O/S - Program Language Translators- Assembler- complier – interpreter- Utility Programs- Communication Software - Performance Monitoring Software, Application Software , Computer Machine language, Assembly language , High level language. | |

| UNIT VI - COMPUTER INTERFACE, APPLICATIONS AND SECURITY | 7 Hours |
|---|---|
| Interaction of User and Computer , Data Communication and Network, Internet Services, Information Systems, Data base , Multimedia, Security | |

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**Text Books:**

1. Computer Fundamentals Concepts , Systems & Applications , Pradeep K. Sinha& Priti Sinha , 8th Edition, 2021, BPB Publications , ISBN:978 -81-7656-752-7.
2. Fundamentals of Computers 6th edition,ISBN:978-8120350670Prentice Hall India Learning Private Limited ,2014.

**References:**

1. Computer Fundamentals , 2010 kindle edition , ISBN- 13, 978-8131733097
2. Computer Organization and Design: P. Pal Chaudhuri , ISBN- 978-8120312548 Prentice-Hall of India Pvt.Ltd, 2021.

**Table 1: Mapping of COs with POs**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 2 | | |
| **CO 2** | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 2 | | |
| **CO 3** | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 2 | | |
| **CO 4** | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 2 | | |
| **CO 5** | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 2 | | |
| **CO6** | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 2 | | |
| **Total** | **18** | **6** | **6** | **6** | **6** | **6** | **6** | | | | | **12** | | |
| **Scaled Value** | **3** | **2** | **2** | **2** | **2** | **2** | **2** | | | | | **3** | | |

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

1- Low Relation, 2-Medium Relation, 3-High Relation

| COURSE CODE | | | XGS105 | L | T | P | SS | C |
|---|---|---|---|---|---|---|---|---|
| COURSE NAME | | | SPEECH COMMUNICATION | 0 | 1 | 2 | 0 | 3 |
| C | P | A | | L | T | P | SS | H |
| 2.6 | 0.4 | 0 | | 0 | 1 | 4 | 0 | 5 |

| COURSEOUTCOMES: | | Domain | Level |
|---|---|---|---|
| CO1 | ***Ability*** to recall the types of speeches | Cognitive | Remembering |
| CO2 | ***Apply*** the techniques in public speaking | Cognitive | Applying |
| CO3 | ***Identify***the common patterns in organizing a speech | Cognitive | Remembering |
| CO4 | ***Construct*** the nature and style of speaking | Cognitive | Creating |
| CO5 | ***Practicing***thespeaking skills | Psychomotor | Guided Response |

| | |
|---|---|
| **UNIT I – Types of Speeches** | **9** |
| 1.1 – Four types of speeches<br>1.2 – Analyzing the audience<br>1.3 - Developing ideas and supporting materials | |
| **UNIT II – Public Speaking** | **9** |
| 2.1 - Introduction to Public Speaking<br>2.2 - Competencies Needed for successful speech making<br>2.3 – Speaking about everyday life situations | |
| **UNIT III – Organization of Speech** | **9** |
| 3.1 – Developing a speech out line<br>3.2 - Organizing the speech<br>3.3 – Introduction - development – conclusion | |
| **UNIT IV – Presentation** | **9** |
| 4.1 - Tips for preparing the draft speech<br>4.2 – Presentation techniques using ICT tools<br>4.3 – Using examples from different sources | |
| **UNIT V – Activities** | **9** |
| 5.1 – Reading activities<br>5.2 – Creative presentations<br>5.3 – Media presentation techniques | |

**Suggested Readings:**

(i) Michael Swan. *Practical English Usage.*OUP. 1995
(ii) Sanjay Kumar and PushpLata.*Communication Skills*. Oxford University Press. 2011

**Table 1: Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | | 1 | | | 3 | |
| **CO2** | 3 | 3 | 1 | | 1 | 1 | 3 | |
| **CO3** | 3 | 2 | 1 | 1 | | | 2 | |
| **CO4** | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 |
| **CO5** | 3 | 2 | 1 | 2 | | 1 | 1 | 1 |
| **Total** | 14 | 11 | 4 | 5 | 2 | 3 | 11 | 2 |
| **Scaled Value** | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 1 |

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

1- Low Relation, 2 – Medium Relation, 3- High Relation

| COURSECODE | XUM106 | L | T | P | C |
|---|---|---|---|---|---|
| COURSENAME | CONSTITUTIONOFINDIA | 3 | 0 | 0 | 3 |
| PREREQUISITE: | NIL | L | T | P | H |
| C:P:A | 3:0:0 | 3 | 0 | 0 | 3 |

| COURSEOUTCOMES | | Domain | Level |
|---|---|---|---|
| CO1 | ***Study***HistoryofConstitution | Cognitive | Understanding |
| CO2 | ***Explain***theUnionExecutive | Cognitive | Remembering |
| CO3 | ***Identify***theconceptofUnionLegislature | Cognitive | Applying |
| CO4 | ***Analysis***theUnionJudiciary | Cognitive | Analyzing |
| CO5 | ***Explain***theCentreStateRelation | Cognitive | Evaluating |

| **UNITI** | **08** |
|---|---|
| ConstitutionalHistory- The Preamble-FundamentalRights-FundamentalDuties-Directiveprinciples ofStatePolicy. | |
| **UNITII** | **09** |
| The Union Executive- The President of India (powers and functions)- Vice-President of India-TheCouncil ofMinisters-PrimeMinister-Powers and Functions. | |
| **UNITIII** | **10** |
| Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of RajyaSabha-Legislative Procedure in India- Important Committes of Lok Sabha- Speaker of the LokSabha. | |
| **UNITIV** | **09** |
| The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- Appeletejurisdictions-Advisory Jurisdiction-Judicial review. | |
| **UNITV** | **09** |
| Centre State relations- Political Parties- Role of governor, powers and functions of Chief Minister-LegislativeAssembly-State Judiciary-Powers and Functionsofthe High Courts. | |

| LECTURE | TUTORIAL | PRACTICAL | TOTAL |
|---|---|---|---|
| 45 | 0 | 0 | 45 |

**REFERENCES**


1. W.H.MorrisShores- GovernmentandpoliticsofIndia,NewDelhi,B.1.Publishers,1974.
2. M.V.Pylee- Constitutional Government in India, Bombay, Asia Publishing House,1977.
3. R.Thanker-TheGovernmentandpoliticsofIndia,London:Macmillon,1995.
4. A.C.Kapur-SelectConstitutionsS,Chand&Co.,NewDelhi,1995
5. V.D.Mahajan-Select ModernGovernments,S,Chand&Co,NewDelhi,1995.
6. B.C.Rout-DemocracticConstitutionofIndia.
7. GopalK.Puri-Constitution ofIndia,India2005.


**Table1:Mapping ofCOs withPOs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | | 1 | | | | | |
| **CO2** | 2 | | | 1 | | | | | |
| **CO3** | 2 | | | 1 | | | | | 1 |
| **CO4** | 2 | | | 1 | | | | 1 | 1 |
| **CO5** | 2 | 2 | | 1 | | | | 1 | 1 |
| **Total** | 10 | 2 | | 5 | | | | 2 | 3 |
| **Scaled Values** | 2 | 1 | | 1 | | | | 1 | 1 |

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

1-LowRelation, 2-MediumRelation, 3-High Relation

| COURSE CODE | | | XBE107 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS LABORATORY | 0 | 0 | 1 | 1 |
| Prerequisite | | | Physics | L | T | P | H |
| C | P | A | | 0 | 0 | 2 | 2 |
| 0.5 | 0.25 | 0.25 | | | | | |

**COURSE OBJECTIVES:**

The course helps to

- Learn the basic concepts of electrical and electronics components.
- Understand the basic wiring methods and connection.
- Study the characteristics of diodes, Zener diodes, NPN transistors.
- Verify the working of simple logic gates, adders and subtractors.

| Course Outcomes: | | Domain | Level |
|---|---|---|---|
| CO1 | ***Apply*** the fundamental electrical concepts and ***differentiate*** the various electronic components. | Cognitive Psychomotor Affective | Understanding Set Valuing |
| CO2 | ***Implement*** and ***execute*** the different types of wiring connections. | Cognitive Psychomotor Affective | Understanding Set Valuing |
| CO3 | ***Demonstrate*** the Fluorescent lamp connection with choke. | Cognitive Psychomotor Affective | Understanding Set Valuing |
| CO4 | ***Characterize*** and **display** the basic knowledge on the working of PN junction and Zener diode. | Cognitive Psychomotor Affective | Understanding Set Valuing |
| CO5 | ***Implement*** and **execute** the various digital electronic circuits such as Adders and Subtractors. | Cognitive Psychomotor Affective | Understanding Set Valuing |

**List of Experiments:**

1. Study of Electrical Symbols, Tools and Safety Precautions, Power Supplies.
2. Study of Active and Passive elements – Resistors, Inductors and Capacitors, Bread Board.
3. Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.
4. Fluorescent lamp connection with choke.
5. Staircase Wiring
6. Forward and Reverse bias characteristics of PN junction diode.
7. Forward and Reverse bias characteristics of zener diode.
8. Input and Output Characteristics of NPN transistor.
9. Construction and verification of simple logic gates.
10. Construction and verification of adders and subtractors.

| | PRACTICAL | TOTAL |
|---|---|---|
| | 30 | 30 |

**Table 1: Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | |
| **CO 2** | 3 | 3 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | |
| **CO 3** | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | |
| **CO 4** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| **CO 5** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| **Total** | 12 | 12 | 6 | 5 | 6 | 6 | 3 | 3 | 5 | 5 | 5 | |
| **Scaled Value** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | |

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3
1 – Low Relation, 2 – Medium Relation, 3 – High Relation

| COURSE CODE | | | XAP108 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | APPLIED PHYSICS FOR ENGINEERS LAB | 0 | 0 | 1 | 1 |
| PREREQUISITE: | | | Basic Physics in HSC level | L | T | P | H |
| C | P | A | | 0 | 0 | 2 | 2 |
| 0 | 0.75 | 0.25 | | | | | |

| COURSE OUTCOMES | | Domain | Level |
|---|---|---|---|
| CO1 | ***Determine*** the significance of elasticity in engineering systems and technological advances. | Psychomotor | Mechanism |
| CO2 | ***use*** and ***locate***basic applications of electromagnetic induction to technology. | Psychomotor<br>Affective | Mechanism<br>Responding |
| CO3 | ***Describe*** the working principle and application of various lasers and fibre optics. | Psychomotor | Mechanism |
| CO4 | ***use*** physics principles of latest technology using semiconductor devices. | Psychomotor | Mechanism |

**LABORATORY**

| | |
|---|---|
| 1. | Torsional Pendulum - determination of moment of inertia and rigidity modulus of the given material of the wire. |
| 2. | Uniform Bending - Determination of the Young's Modulus of the material of the beam. |
| 3. | Non-Uniform Bending - Determination of the Young's Modulus of the material of the beam. |
| 4. | Meter Bridge - Determination of specific resistance of the material of the wire. |
| 5. | Spectrometer - Determination of dispersive power of the give prism. |
| 6. | Spectrometer - Determination of wavelength of various colours in Hg source using grating. |
| 7. | Air wedge - Determination of thickness of a given thin wire. |
| 8. | Laser - Determination of wavelength of given laser source and size of the given micro particle using Laser grating. |
| 9. | Post office Box - Determination of band gap of a given semiconductor. |
| 10. | PN Junction Diode - Determination of V-I characteristics of the given diode. |

**REFERENCE BOOKS**


1. Samir Kumar Ghosh, "A text book of Advanced Practical Physics", New Central Agency (P) Ltd, 2008.
2. Arora C.L., "Practical Physics", S. Chand & Company Ltd., New Delhi, 2013.
3. UmayalSundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.


| | PRACTICAL | TOTAL HOURS |
|---|---|---|
| Total Hours | 30 | 30 |

**Table 1: Mapping of COs with POs**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO 11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | 1 | 3 | 2 |
| **CO2** | 3 | - | 1 | - | 1 | - | - | - | - | - | - | 1 | 2 | 3 |
| **CO3** | 3 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | 1 | 3 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | 1 | 2 | 3 |
| **Total** | **12** | **6** | **7** | **6** | **4** | **-** | **-** | **-** | **3** | **-** | **-** | **5** | **10** | **10** |
| **Scaled Value** | **3** | **2** | **2** | **2** | **1** | | | | **1** | | | **1** | **2** | **2** |

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

1 – Low Relation, 2 – Medium Relation, 3 – High Relation

| COURSE CODE | | | XMA201 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE | 3 | 1 | 0 | 4 |
| C | P | A | | L | T | P | H |
| 3 | 0.5 | 0.5 | | 3 | 1 | 0 | 4 |

**PREREQUISITE:Mathematics I (Calculus and Linear Algebra)**

| Course Outcomes | | Domain | Level |
|---|---|---|---|
| CO1 | ***Find*** double and triple integrals and to find line, surface and volume of an integral by ***Applying*** Greens, Gauss divergence and Stokes theorem. | Cognitive | Applying<br>Remembering |
| CO2 | ***Solve*** first order differential equations of different types which are solvable for p, y, x and Clairaut's type. | Cognitive | Applying |
| CO3 | ***Solve*** Second order ordinary differential equations with variable coefficients using various methods. | Cognitive | Applying |
| CO4 | ***Use*** CR equations to verify analytic functions and to find harmonic functions and harmonic conjugate. Conformal mapping of translation and rotation. Mobius transformation. | Cognitive | Remembering<br>Applying<br>Guided Response |
| CO5 | ***Apply***Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouvilles theorem. Taylor's series, zeros of analytic functions, singularities, Laurent's series. | Cognitive<br>Affective | Applying<br>Receiving |

| **UNIT I - MULTIVARIABLE CALCULUS (Integration)** | **12** |
|---|---|
| Multiple Integration: Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Triple integrals (Cartesian), Scalar line integrals - vector line integrals - scalar surface integrals - vector surface integrals - Theorems of Green, Gauss and Stokes. | |
| **UNIT II -FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** | **12** |
| Exact - linear and Bernoulli's equations - Euler's equations - Equations not of first degree: equations solvable for p - equations solvable for y- equations solvable for x and Clairaut's type. | |
| **UNIT III - ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS** | **12** |
| Second order linear differential equations with variable coefficients- method of variation of parameters - Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties. | |
| **UNIT IV -COMPLEX VARIABLE – DIFFERENTIATION** | **12** |
| Differentiation-Cauchy-Riemann equations- analytic functions-harmonic functions-finding harmonic conjugate- elementary analytic functions (exponential, trigonometric, logarithm) and their properties- Conformal mappings- Mobius transformations and their properties. | |

| **UNIT V -COMPLEX VARIABLE - INTEGRATION** | **12** |
|---|---|
| Contour integrals - Cauchy-Goursat theorem (without proof) - Cauchy Integral formula (without proof)-Liouville's theorem (without proof)- Taylor's series- zeros of analytic functions- | |

singularities- Laurent's series – Residues- Cauchy Residue theorem (without proof)- Evaluation of definite integral involving sine and cosine- Evaluation of certain improper integrals using the Bromwich contour.

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 15 | 60 |

**TEXT BOOK**

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th$^{th}$ Edition, 2008.

**REFERENCE BOOKS**


1.G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9$^{th}$ Edition, Pearson,Reprint, 2002.

2. Erwin kreyszig, "Advanced Engineering Mathematics", 9$^{th}$ Edition, John Wiley & Sons, 2006.

3.W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9$^{th}$Edn. Wiley India, 2009.

4. S. L. Ross, "Differential Equations", 3$^{rd}$ Ed., Wiley India, 1984.

5.E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.

6. E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.

7.J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7$^{th}$ Ed., McGrawHill, 2004.

8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", LaxmiPublications, Reprint, 2008


**Table 1: Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | | | 2 | | | | | 1 | | 2 |
| **CO 2** | 3 | 1 | | | | | | | | 1 | | 1 |
| **CO 3** | 3 | 1 | | | | | | | | 1 | | 1 |
| **CO 4** | 3 | 2 | | | | | | | | 1 | | 1 |
| **CO 5** | 3 | 2 | | | 1 | | | | | 1 | | 2 |
| | 15 | 8 | | | 3 | | | | | 5 | | 7 |
| **Scaled Value** | 3 | 2 | | | 1 | | | | | 1 | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | XCP202 | L | T | P | C |
|---|---|---|---|---|---|
| COURSE NAME | PROGRAMMING FOR PROBLEM SOLVING | 3 | 0 | 0 | 3 |
| Prerequisite | Basic Understanding Skills | | | | |

| C | P | A | L | T | P | H |
|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 3 | 0 | 0 | 3 |

**Course Objectives**

- To learn programming language basics and syntax
- To ignite logical thinking
- To understand structured programming approach
- To deal with user defined data types
- To know about data storage in secondary memory

| *Course Outcome: After the completion of the course, students will be able to* | | Domain | Level |
|---|---|---|---|
| CO1 | ***Define*** programming fundamentals and ***Solve*** simple programs using I/O statements | Cognitive | Remembering Understanding Applying |
| CO2 | ***Define*** syntax and ***write simple programs*** using control structures and arrays | Cognitive | Remembering Understanding Applying |
| CO3 | ***Explain*** and ***write simple programs*** using functions and pointers | Cognitive | Remembering Understanding Applying |
| CO4 | ***Explain*** and ***write simple programs*** using structures and unions | Cognitive | Remembering Understanding Applying |
| CO5 | ***Explain*** and ***write simple programs*** using files and ***Build*** simple projects | Cognitive | Remembering Understanding Applying |

**COURSE CONTENT**

**UNIT I - PROGRAMMING FUNDAMENTALS AND I/O STATEMENTS** **9**

Introduction to components of a computer system, Program – Flowchart – Pseudo code – Software – Introduction to C language – Character set – Tokens: Identifiers, Keywords, Constants, and Operators – sample program structure -Header files – Data Types- Variables - Output statements – Input statements.

**UNIT II - CONTROL STRUCTURE AND ARRAYS** **9**

Control Structures – Conditional Control statements: Branching, Looping - Unconditional control structures: switch, break, continue, goto statements – Arrays: One Dimensional Array – Declaration – Initialization – Accessing Array Elements – Searching – Sorting – Two Dimensional arrays - Declaration – Initialization – Matrix Operations – Multi Dimensional Arrays - Declaration – Initialization. Storage classes: auto – extern – static. Strings: Basic operations on strings.

**UNIT III -FUNCTIONS AND POINTERS** **9**

| | |
|---|---|
| Functions: Built in functions – User Defined Functions - Parameter passing methods - Passing arrays to functions – Recursion - Programs using arrays and functions. Pointers - Pointer declaration - Address operator - Pointer expressions & pointer arithmetic - Pointers and function - Call by value - Call by Reference - Pointer to arrays - Use of Pointers in self-referential structures-Notion of linked list | |
| **UNIT IV - STRUCTURES AND UNIONS** | **9** |
| Structures and Unions - Giving values to members - Initializing structure - Functions and structures - Passing structure to elements to functions - Passing entire function to functions - Arrays of structure - Structure within a structure and Union. | |
| **UNIT V -FILES** | **9** |
| File management in C - File operation functions in C - Defining and opening a file - Closing a file - The getw and putw functions - The fprintf & fscanf functions - fseek function – Files and Structures. | |

| **Total Hours** | | **L** | **T** | **P** | **Total** |
|---|---|---|---|---|---|
| | | **45** | **0** | **0** | **45** |

**TEXT BOOKS**

1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMH publications, 2010
2. Yeshwant Kanethker, “Let us C”, BPB Publications, 2008

**REFERENCE BOOKS**

1. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill, 7th edition 2017.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education Inc. 2005
3. Johnson baugh R. and Kalin M., “Applications Programming in ANSI C”, III Edition, Pearson Education India, 2003

**E-REFERENCES**

1. https://www.indiabix.com/c-programming/questions-and-answers/
2. https://www.javatpoint.com/c-programming-language-tutorial
3. https://www.w3schools.in/c-tutorial/

**Table 1: Mapping of CO with PO’s**

| | **PO1** | **PO2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | 3 | | | | | | 2 | 3 | 2 | |
| **CO2** | 3 | 2 | | | 2 | | | | | | 2 | 3 | 2 | |
| **CO3** | 2 | 2 | 1 | 2 | 2 | | | | | | 2 | 2 | 2 | |
| **CO4** | 2 | 2 | 1 | 2 | 2 | | | | | | 2 | 2 | 2 | |
| **CO5** | 2 | 2 | 1 | | 2 | | | 1 | | 2 | 2 | 2 | 2 | |
| **Total** | 12 | 10 | 3 | 4 | 11 | | | 1 | | 2 | 10 | 12 | 10 | |
| **Scaled Value** | 3 | 2 | 1 | 1 | 3 | | | 1 | | 1 | 2 | 3 | 2 | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XAC203 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | APPLIED CHEMISTRY FOR ENGINEERS | 3 | 1 | 0 | 4 |
| PREREQUISITES | | | NIL | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 2.5 | 1 | 0.5 | | | | | |

**COURSE OBJECTIVES**

Understand the application of chemistry in engineering.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Identify***the periodic properties such as ionization energy, electron affinity, oxidation states and electro negativity. ***Describe*** the various water quality parameters like hardness and alkalinity. | Cognitive Psychomotor | Remembering Perception |
| CO2 | ***Explain*** *and* ***Measure*** microscopic chemistry in terms of atomic, molecular orbital's and intermolecular forces. | Cognitive Psychomotor | Understanding Set |
| CO3 | ***Interpret*** bulk properties and processes using thermodynamic and kinetic considerations. | Cognitive Psychomotor Affective | Applying Mechanism Receiving |
| CO4 | ***Describe, Illustrate*** *and* ***Discuss*** the chemical reactions that are used in the synthesis of molecules. | Cognitive Psychomotor Affective | Remembering Analyzing Perception Responding |
| CO5 | ***Apply, Measure*** and ***Distinguish*** the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques | Cognitive Psychomotor | Remembering, Applying Mechanism |

**UNITI - PERIODIC PROPERTIES AND WATER CHEMISTRY** **8+3**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro negativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries. **Water Chemistry**-Water quality parameters-Definition and explanation of hardness, determination of hardness by EDTA method-Introduction to alkalinity.

**UNIT II - USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA** **12+3**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion-Types, factors affecting corrosion rate and Control methods. Use of free energy considerations in metallurgy through Ellingham diagrams. Advantages of electro less plating, electroless plating of nickel and copper on Printed Circuit Board (PCB).

**UNIT III - ATOMIC AND MOLECULAR STRUCTURE** **10+3**

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles.. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

***Intermolecular forces and potential energy surfaces***

Ionic, dipolar and Vander waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of $H_3$, $H_2F$ and HCN and trajectories on these surfaces.

| **UNIT IV - SPECTROSCOPIC TECHNIQUES AND APPLICATIONS** | **7+3** |
|---|---|

Principles of spectroscopy and selection rules. Electronic spectroscopy-chromophore, auxochromes, types of electronic transition and application. Fluorescence and its applications in medicine. Vibrational spectroscopy-types of vibrations, Instrumentation and applications. Rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy-concept of chemical shift and applications-magnetic resonance imaging. Diffraction and scattering.

| **UNIT V -STEREOCHEMISTRY AND ORGANIC REACTIONS** | **8+3** |
|---|---|

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

***Organic reactions and synthesis of a drug molecule***

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization reactions and ring opening reactions. Synthesis of a commonly used drug molecule- Aspirin and paracetamol.

| **HOURS** | **LECTURE** | **TUTORIAL** | **TOTAL** |
|---|---|---|---|
| | **45** | **15** | **60** |

**TEXT BOOKS**


| | |
|---|---|
| 1. | Principles of Inorganic Chemistry Puri B.R. Sharma, L.R., Kalia K.K., (23rdedition), New Delhi, Shoban Lal Nagin Chand & Co., 1993. |
| 2. | Concise Inorganic Chemistry, Lee. J.D., UK, Black well science, 2006. |
| 3. | Physical Chemistry, Trapp. C, Cady, M. Giunta. C, Atkins's 10th Edition, Oxford publishers, 2014. |
| 4. | Elements of Physical Chemistry, Glasstone S., Lewis D., London, Mac Millan & Co. Ltd, 1983. |
| 5. | Organic Chemistry ,Morrison R.T. and Boyd R.N. (6th edition), New York, Allyn & Bacon Ltd., 1976. |
| 6. | Fundamentals of Molecular Spectroscopy,Banwell. C.N, (3th Edition), McGraw-Hill Book Company, Europe 1983. |
| 7. | Advanced Organic Chemistry, Bahl B.S. and Arun Bahl, (4th edition), S.Chand & Company Ltd. New Delhi, 1977. |
| 8. | Stereochemistry: Conformation and mechanism, P. S. Kalsi, (9th Edition), New Age International Publishers, 2017. |


**REFERENCES**


| | |
|---|---|
| 1. | Principles of Physical Chemistry,Puri B R Sharma L R and Madan S Pathania, Vishalpublishing Co., Edition 2004. |
| 2. | Engineering Chemistry, Kuriocose, J C and Rajaram, J, Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000. |


**E- REFERENCES**

| | |
|---|---|
| 1. | http://www.mooc-list.com/course/chemistry-minor-saylororg |
| 2. | https://www.canvas.net/courses/exploring-chemistry |
| 3. | http://freevideolectures.com/Course/2263/Engineering-Chemistry-I |
| 4. | http://freevideolectures.com/Course/3001/Chemistry-I |

| | |
|---|---|
| 5. | http://freevideolectures.com/Course/3167/Chemistry-II |
| 6. | http://ocw.mit.edu/courses/chemistry/ |

**Table1: Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | | | | | | | **2** | **3** | **3** | | | | |
| **CO1** | **2** | | | | | | | **1** | **2** | **2** | | | | |
| **CO1** | **3** | | | | | | | **2** | **3** | **3** | | | | |
| **CO1** | **3** | | | | | | | **3** | **3** | **3** | | | | |
| **CO1** | **3** | | | | | | | **2** | **2** | **3** | | | | |
| **Total** | **13** | | | | | | | **10** | **13** | **14** | | | | |
| **Scaled to 0,1,2 and 3** | **3** | | | | | | | **2** | **3** | **3** | | | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3
1 – Low Relation, 2 – Medium Relation, 3 – High Relation

| COURSE CODE | | | XGS204 | L | T | P | SS | C |
|---|---|---|---|---|---|---|---|---|
| COURSE NAME | | | TECHNICAL COMMUNICATION | 2 | 0 | 0 | 0 | 2 |
| PREREQUISITE | | | | L | T | P | SS | H |
| C | P | A | | 2 | 0 | 0 | 0 | 2 |
| 2 | 0 | 0 | | | | | | |

| COURSE OUTCOMES: | | Domain | Level |
|---|---|---|---|
| CO1 | ***Ability*** to understand the basic principles | Cognitive | Remembering |
| CO2 | ***Apply*** the techniques in writing | Cognitive | Applying |
| CO3 | ***Identify***communicative styles | Cognitive | Remembering |
| CO4 | ***Construct*** the nature of writing | Cognitive | Create |

| **UNIT- I BASIC PRINCIPLES** | **9** |
|---|---|
| 1.1 – Basic Principles of Technical Writing<br>1.2 – Styles used in Technical Writing<br>1.3 – Language and Tone | |
| **UNIT- II TECHNIQUES** | **9** |
| 2.1 – Special Techniques used in writing<br>2.2 – Definition & Description of mechanism<br>2.3 – Description- Classification-Interpretation | |
| **UNIT- III COMMUNICATION** | **9** |
| 3.1 – Modern development in style of writing<br>3.2 - New letter writing formats | |
| **UNIT- IV REPORT WRITING** | **9** |
| 4.1 – Types of Report writing<br>4.2 – Project writing formats | |

**SUGGESTED READINGS**

(i) John Sealy, Writing and Speaking Author; Oxford University Press, New Delhi, 2009
(ii) Williams K.S, Communicating Business. Engage Learning India Pvt Ltd, 2012

**Table1:Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | | | | | 2 | | 1 | | | | | |
| **CO2** | 2 | | | | | | 2 | | 1 | | | | | |
| **CO3** | 1 | | | | | | 1 | | 1 | | | | | |
| **CO4** | 2 | | | | | | 1 | | 1 | | | | | |
| **Total** | 7 | | | | | | 6 | | 4 | | | | | |
| **Scaled Value** | 2 | | | | | | 2 | | 1 | | | | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3
1-Low Relation,2–MediumRelation,3-HighRelation

| COURSE CODE | XWP205 | L | T | P | C |
|---|---|---|---|---|---|
| COURSE NAME | WORKSHOP PRACTICES | 1 | 0 | 2 | 3 |

| C | P | A | | L | T | P | H |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 0 | | 1 | 0 | 4 | 5 |

**PREREQUISITE:**

| Course outcomes | | Domain | Level |
|---|---|---|---|
| **CO1** | ***Summarize*** the machining methods and***practice*** machining operation. | Cognitive Psychomotor | Remembering Guided response |
| **CO2** | ***Define*** metal casting process,moulding methods and **relate**Casting and Smithy applications. | Cognitive Psychomotor | Remembering Guided response |
| **CO3** | ***Plan*** basic carpentry operations and***practice*** carpentry operations. | Cognitive Psychomotor | Remembering Guided response |
| **CO4** | ***Plan*** basic fitting operations and***practice***fitting operations. | Cognitive Psychomotor | Remembering Guided response |
| **CO5** | ***Summarize*** metal joining operation and***practice*** welding operation. | Cognitive Psychomotor | Remembering Guided response |
| **CO6** | ***Illustrate*** the basics of sheet metal work and***make*** appropriate models**.** | Cognitive Psychomotor | Remembering Guided response |

**COURSE CONTENT**

| EXP. NO | TITLE | CO RELATION |
|---|---|---|
| 1 | Introduction to machining process | **CO1** |
| 2 | Plain turning using lathe operation | **CO1** |
| 3 | Introduction to CNC | **CO1** |
| 4 | Demonstration of plain turning using CNC | **CO1** |
| 5 | Study of metal casting operation | **CO2** |
| 6 | Demonstration of moulding process | **CO2** |
| 7 | Study of smithy operation | **CO2** |
| 8 | Study of carpentry tools | **CO3** |
| 9 | Half lap joint – Carpentry | **CO3** |
| 10 | Mortise and Tenon joint – Carpentry | **CO3** |
| 11 | Study of fitting tools | **CO4** |
| 12 | Square fitting | **CO4** |
| 13 | Triangular fitting | **CO4** |
| 14 | Study of welding tools | **CO5** |
| 15 | Square butt joint – welding | **CO5** |
| 16 | Tee joint – Welding | **CO5** |
| 17 | Study of sheet metal working | **CO6** |
| 18 | Rectangular open type Tray - Sheet metal working | **CO6** |

| | | |
|---|---|---|
| 19 | Hollow Cylinder – Sheet metal working | **CO6** |
| 20 | Cone –– Sheet metal working | **CO6** |

**TEXT BOOKS**

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.

**REFERENCES**

1. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.
2. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
3. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
4. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

**E RESOURCES**

1. https://nptel.ac.in/courses/112107145/

**Table 1:Mapping of Cos with Pos:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | 2 | 1 | | | 1 | 1 | | 1 | 2 | 3 | |
| **CO2** | 2 | 1 | 2 | 2 | 1 | | | 1 | 1 | | 1 | 2 | 3 | |
| **CO3** | 2 | 1 | 2 | 2 | 1 | | | 1 | 1 | | 1 | 2 | 3 | |
| **CO4** | 2 | 1 | 2 | 2 | 1 | | | 1 | 1 | | 1 | 2 | 3 | |
| **CO5** | 2 | 1 | 2 | 2 | 1 | | | 1 | 1 | | 1 | 2 | 3 | |
| **CO6** | 2 | 1 | 2 | 2 | 1 | | | 1 | 1 | | 1 | 2 | 3 | |
| **Total** | **12** | **6** | **12** | **12** | **6** | | | **6** | **6** | | **6** | **12** | **18** | |
| **Scaled Value** | | | | | | | | | | | | | | |

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

1-Low Relation, 2–Medium Relation, 3-High Relation

| COURSE CODE | | | XEM206 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ENGINEERING MECHANICS | 3 | 0 | 0 | 3 |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**PREREQUISITE:**

| Course Outcome | | Domain | Level |
|---|---|---|---|
| CO1 | ***Explain*** the principles forces, laws and their applications. | Cognitive | Understanding Applying |
| CO2 | ***Apply*** the concept of friction, trusses and beams. | Cognitive | Understanding Applying |
| CO3 | ***Understand*** the conceptof Inertia and Virtual work | Cognitive | Understanding Applying |
| CO4 | ***Examine*** Dynamics in linear and curvilinear motion | Cognitive | Understanding Applying |
| CO5 | ***Apply*** dynamic principles in connected bodies | Cognitive | Understanding Applying |
| CO6 | ***Explain*** free and forced vibration | Cognitive | Remembering Understanding |

**UNIT I - INTRODUCTION TO ENGINEERING MECHANICS** 9

Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static indeterminacy.

**UNIT II - FRICTION AND BASIC STRUCTURAL ANALYSIS** **9**

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines

**UNIT III -CENTROID , CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD** **9**

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium.

**UNIT IV -REVIEW OF PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS OF RIGID BODIES** **9**

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Types of motion, D'Alembert's principle and its applications in plane

motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

| **UNIT V -MECHANICAL VIBRATIONS** | **9** |
|---|---|

Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.

| | **Lecture** | **Tutorial** | **Practical** | **Total** |
|---|---|---|---|---|
| | **45** | **0** | **0** | **45** |

**TEXT BOOKS**


1. Engineering Mechanics: Statics (14th Edition) by Russell C. Hibbeler , Best Sellers, 2015
2. D.S.Kumar "A text book of Engineering Mechanics" Publishers S.K.Kataria and Sons ,2012
3. Velusami.M.A. "Engineering Mechanics with Vector Approach": S.Chand Publishers,2012
4. J. L. Meriam, L. G. Kraige "Engineering Mechanics: Dynamics",Sixth Edition 2012
5. K L Kumar, Veenu kumar"Engineering Mechanics'McGraw Hill Education; 4th edition


**REFERENCE BOOKS**


1. Jayakumar and Kumar , Engineering Mechanics, PHI Learning Pvt Ltd, 2013
2. Chandramouli, Engineering Mechanics, PHI Learning Pvt Ltd, 2011
3. K.V.Natarajan, "Engineering Mechanics", Dhanalakshmi Publishers, Chennai, 2006.
4. Beer F.P and Johnson E.R., "Vector Mechanics for Engineers – Statics and Dynamics",Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2001.


***E-REFERENCES***

*https://archive.nptel.ac.in/courses/112/106/112106286/*

**Table1 :Mapping of COs with POs**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 1 | 3 |
| **CO2** | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 1 | 3 |
| **CO3** | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 1 | 3 |
| **CO4** | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 1 | 3 |
| **CO5** | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 1 | 3 |
| **CO6** | 2 | 2 | 2 | 1 | 3 | 1 | 1 | 3 | 3 | 3 | 1 | 3 |
| **Total** | **17** | **12** | **7** | **6** | **18** | **6** | **6** | **13** | **18** | **13** | **6** | **18** |
| Scaled Value | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1-Low Relation, 2–Medium Relation, 3-High Relation

| COURSE CODE | | | XCP207 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | PROGRAMMING FOR PROBLEM SOLVING LAB | 0 | 0 | 1 | 1 |
| PREREQUISITES | | | Basic Understanding Skills | L | T | P | H |
| C | P | A | | 0 | 0 | 2 | 2 |
| 0.5 | 0.25 | 0.25 | | | | | |

**LEARNING OBJECTIVES**

- To learn programming language basics and syntax
- To ignite logical thinking
- To understand structured programming approach
- To deal with user defined data types
- To know about data storage in secondary memory

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Solve*** simple programs using I/O statements | Cognitive Psycomotor | Applying Responding |
| CO2 | ***Solve*** programs using control structures and arrays | Cognitive Psycomotor | Applying Responding |
| CO3 | ***Solve*** programs using functions and pointers | Cognitive Psycomotor | Applying Responding |
| CO4 | ***Solve*** programs using structures | Cognitive Psycomotor | Applying Responding |
| CO5 | ***Solve*** programs using files | Cognitive Psycomotor | Applying Responding |

| S.No | List of Experiments | COs |
|---|---|---|
| 1 | Program to display a Leave Letter as per proper format | CO1 |
| 2 | i. Program for addition of two numbers<br>ii. Program to solve any mathematical formula. | CO1 |
| 3 | Program to find greatest of 3 numbers using Branching Statements | CO2 |
| 4 | Program to display divisible numbers between n1 and n2 using looping Statement | CO2 |
| 5 | Program to search an array element in an array. | CO2 |
| 6 | Program to find largest / smallest element in an array. | CO2 |
| 7 | Program to perform string operations. | CO3 |
| 8 | Program to find area of a rectangle of a given number use four function types. | CO3 |
| 9 | Programs to pass and receive array and pointers using four function types | CO3 |
| 10 | Programs using Recursion for finding factorial of a number | CO3 |
| 11 | Program to read and display student mark sheet of a student structures with variables | CO4 |
| 12 | Program to read and display student marks of a class using structures with arrays | CO4 |
| 13 | Program to create linked list using structures with pointers | CO4 |
| 14 | Program for copying contents of one file to another file. | CO5 |
| 15 | Program using files to store and display student mark list of a class using structures with array | CO5 |

| TOTAL HOURS | TUTORIAL | PRACTICAL | TOTAL |
|---|---|---|---|
| | 0 | 30 | 30 |

**Table1:Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO 11 | PSO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | | | 3 | | | | | | 2 | 3 | 2 | |
| **CO 2** | 3 | 2 | | | 2 | | | | | | 2 | 3 | 2 | |
| **CO 3** | 2 | 2 | 1 | 2 | 2 | | | | | | 2 | 2 | 2 | |
| **CO 4** | 2 | 2 | 1 | 2 | 2 | | | | | | 2 | 2 | 2 | |
| **CO 5** | 2 | 2 | 1 | | 2 | | | 1 | | 2 | 2 | 2 | 2 | |
| **Total** | 12 | 10 | 3 | 4 | 11 | | | 1 | | 2 | 10 | 12 | 10 | |
| **Scaled Value** | 3 | 2 | 1 | 1 | 3 | | | 1 | | 1 | 2 | 3 | 2 | |

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

1- Low relation 2- Medium relation 3- High relation

| COURSE CODE | | | XAC208 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | APPLIED CHEMISTRY FOR ENGINEERS LAB | 0 | 0 | 1 | 1 |
| PREREQUISITES | | | NIL | L | T | P | H |
| C | P | A | | 0 | 0 | 2 | 2 |
| 0.25 | 0.5 | 0.25 | | | | | |

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Ability*** to ***Identify*** the principles of chemistry relevant to the study of science and engineering | Cognitive Psychomotor | Remembering Perception |
| CO2 | ***Analyze*** and ***Measure*** molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, extent of hardness, chloride content of water, etc. | Cognitive Psychomotor Affective | Analyzing Perception Receiving |
| CO3 | ***Analyze*** the ***synthetic*** procedure and rate constants of reactions from concentration of reactants/products as a function of time | Cognitive | Applying |

**LIST OF EXPERIMENTS**

| Ex. No | Experiments | COs |
|---|---|---|
| 1. | Determination of chloride ion present in the water sample by Argentometric method. | CO1 |
| 2. | Determination of total, temporary and permanent hardness of water sample by EDTA method. | CO1 |
| 3. | Determination of cell constant and conductance of solutions. | CO2 |
| 4. | Potentiometry - determination of redox potentials and emfs. | CO2 |
| 5. | Determination of surface tension and viscosity. | CO3 |
| 6. | Adsorption of acetic acid by charcoal. | CO3 |
| 7. | Determination of the rate constant of a reaction. | CO4 |
| 8. | Estimation of iron by colorimetric method. | CO4 |
| 9. | Synthesis of a polymer/drug. | CO5 |
| 10. | Saponification/acid value of oil. | CO5 |

**LECURE:0 TUTORIAL: 0 PRACTICAL: 30 TOTAL:30**

**TEXT BOOKS**

| | |
|---|---|
| **1.** | Laboratory Manual "Chemistry Lab", Department of Chemistry, PMIST, Thanjavur. |

**REFERENCE BOOKS**

| | |
|---|---|
| **1.** | Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004. |
| **2.** | Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003. |

**E-RESOURCES- MOOC's**

| | |
|---|---|
| 1. | http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques |
| 2. | http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques |
| 3. | http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011 |

**Table1:Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | | 1 | 1 | 1 | | | |
| **CO2** | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO3** | 2 | 2 | 2 | 2 | 1 | 2 | 2 | | 1 | 1 | | | | |
| **CO4** | | | | | | | | | | | | | | |
| **Total** | 7 | 7 | 7 | 7 | 4 | 7 | 7 | 1 | 3 | 3 | 2 | 1 | 1 | 1 |
| **Scaled Value** | 2 | 2 | 2 | 2 | 1 | 2 | 2 | | 1 | 1 | 1 | | | |
| | | | | | | | | | | | | | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3
1-Low Relation,2–Medium Relation,3-High Relation

| COURSE CODE | | | XMA301 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS | 3 | 0 | 0 | 3 |
| C | P | A | | L | T | P | H |
| 2 | 0.5 | 0.5 | | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | Nil | | | | |

**Learning Objectives**

- Introduction of methods to solve linear partial differential equations of second order and higher order.
- Find the solutions of pde's are determined by conditions at the boundaries of the spatial domain and initial conditions at time zero.
- Provide sufficient knowledge to engineering students in the specific mathematical tools and techniques such as Fourier series, Fourier transform and Z transform.
- To enable students to use Fourier series method both in the solution of pde and other wider context.

**COURSE OUTCOMES:**

| Course outcomes: | | Domain | Level |
|---|---|---|---|
| CO1 | ***Solve*** standard types of first order and second order partial differential equations with constant coefficients. Elimination of arbitrary constants and functions. | Cognitive<br>Psychomotor | Applying<br>Imitation |
| CO2 | ***State*** Dirichlet's condition. **Explain** general Fourierseries of the curve y = f(x) in the interval (0,2π) (-π, π), (0, 2ℓ), (-ℓ,ℓ) and (0, π).<br>Perform harmonic analysis | Cognitive<br>Psychomotor | Remembering<br>Understanding<br>Imitation |
| CO3 | ***Solve*** the standard Partial Differential Equations, arising in engineeringProblems, like one dimensional Wave equation and Heat flow equation by Fourier series method in Cartesian coordinates.<br>Classify second order quasi pde. | Cognitive<br>Affective | Applying<br>Receiving |
| CO4 | ***Find***the Fourier transform and Fourier sine and cosinetransforms of simple functions using definition and its properties. | Cognitive | Remembering<br>Applying |
| CO5 | ***Apply*** the properties of Z transform to ***Find*** theZ-transform and inverse Z transform of sequence and functions, and to solve the difference equation usingthem. | Cognitive | Remembering<br>Applying |

**UNIT - I PARTIAL DIFFERENTIAL EQUATIONS** **9 Hours**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

| UNIT - II FOURIER SERIES | 9 Hours |
|---|---|
| Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series –Parseval's identity – Harmonic Analysis. | |
| **UNIT - III APPLICATIONS OF BOUNDARY VALUE PROBLEMS** | **9 Hours** |
| Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates**.** | |
| **UNIT - IV FOURIER TRANSFORM** | **9 Hours** |
| Fourier integral theorem (without proof) – Fourier transform pairs – Fourier Sine and Cosine transforms – properties – Transforms of simple functions – Convolution theorem – Parseval's identity | |
| **UNIT - V Z TRANSFORM AND DIFFERENCE EQUATIONS** | **9 Hours** |
| Z-transform – Elementary properties – Inverse Z – transform – Convolution theorem – Initial and Final value theorems - Formation of difference equations – Solution of difference equations. using Z-transform. | |

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**TEXT BOOKS**


**1.** Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi (2015).

2.Veerarajan. T., "Engineering Mathematics Volume III", Second reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.


**REFERENCES**


1. Churchill, R.V. and Brown, J.W., "Fourier Series and Boundary Value Problems", Fourth Edition, McGraw Hill Book Co., Singapore (1987).
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics Volume III", S. Chand & Company Ltd., New Delhi (1996).
3. Bali N.P. and Manish Goyal, "A Text Book of Engineering Mathematics" 7th Edition Lakshmi Publications (P) Limited, New Delhi (2007).
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Narayanan, S., ManicavachagomPillay, T.K. and Ramaniah, G., "Advanced Mathematics for Engineering Students", Volume: II and III, S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai (2002).


**E-REFERENCES**

1. **nptel**: Advanced Engineering Mathematics, Prof. Jitendra Kumar, Department of Mathematics, Indian Institute of Technology, Kharagpur, India.

**Table1:Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | | | | | | | | | 1 | | 1 |
| **CO 2** | 3 | | | | | | | | | 1 | | 1 |
| **CO 3** | 3 | 2 | | | | | | | | 1 | 1 | 2 |
| **CO 4** | 3 | 2 | | | 1 | | | | | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | | | 1 | | | | | 1 | 1 | 1 |
| | 15 | 6 | | | 2 | | | | | 5 | 3 | 6 |
| **Scaled Value** | 3 | 2 | | | 2 | | | | | 1 | 1 | 2 |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC302 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ELECTRONIC DEVICES | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To familiarize the operation and characteristics of semiconductor diodes and their applications.
- To impart knowledge on the characteristics of BJT and FET
- To make the students understand the operation of power electronic devices and special diodes
- To outline the operation of Special Semiconductor devices

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the operation of junction diodes and their applications. | Cognitive | Understanding |
| CO2 | ***Illustrate*** the input and output characteristics of bi-polar junction transistors under different configurations. | Cognitive | Understanding |
| CO3 | ***Illustrate*** the drain and transfer Characteristics of FET and MOSFET | Cognitive | Understanding |
| CO4 | ***Outline*** the operation and characteristics of power electronic devices. | Cognitive | Understanding |
| CO5 | ***Explain*** the operation of special diodes. | Cognitive | Understanding |
| CO6 | ***Compare*** the construction and luminescence characteristics optoelectronic devices. | Cognitive | Understanding |

**UNIT I -SEMICONDUCTOR DIODES** **8 Hours**

Semiconductors, Energy band structures, PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown Diodes, Rectifiers and Voltage regulators.

**UNIT II - BIPOLAR JUNCTION TRANSISTORS** **8 Hours**

Transistor Operations--Early effect-Current equations – Input and Output characteristics of CE, CB, CC configurations - Hybrid -π model - h-parameter model, Ebers Moll Model.

**UNIT III -FIELD EFFECT TRANSISTORS** **8 Hours**

JFETs - Drain and Transfer characteristics-Current equations-Pinch off voltage and its significance- MOSFET – Characteristics- DMOSFET, E-MOSFET- Characteristics - Comparison.

**UNIT IV - POWER ELECTRONIC DEVICES** **7 Hours**

Uni Junction Transistor, Silicon Controlled Rectifier, DIAC, TRIAC, Power BJT- Power MOSFET – DMOS – VMOS.

| | |
|---|---|
| **UNIT V -SPECIAL SEMICONDUCTOR DIODES** | **7 Hours** |
| Metal-Semiconductor Junction- Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device. | |
| **UNIT VI - OPTO ELECTRONIC DEVICES** | **7 Hours** |
| Photo diode, Photo transistor, LASER diode, LDR. LED, LCD, Opto Coupler, Solar cell, CCD. | |

| **HOURS** | **LECTURE** | **TOTAL** |
|---|---|---|
| | **45** | **45** |

**Text Books:**


1.Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHill Inc. 2012.

2.Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2008.


**References:**


1.Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Prentice Hall, 10th edition, July 2008.

2.David A. Bell ,"Electronic devices and circuits", Prentice Hall of India, 2004.

3.Millman and Christos C.Halkias, "Electronic Devices and Circuits" 3rd Edition, Tata McGraw Hill,New Delhi, 2010.

4.G.Streetman,andS.K.Banerjee,"SolidStateElectronicDevices,"7thedition,Pearson,2014.


**Table 1 : Mapping of COs with POs**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 3** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 4** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO6** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| Total | 18 | 12 | 12 | 12 | 6 | 6 | 6 | 6 | | | | 12 | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC303 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | DIGITAL SYSTEM DESIGN | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To introduce basic postulates of Boolean Algebra, methods for simplification of Boolean expression and Code conversion.
- To outline the design of combinational logic circuits.
- To understand the design of sequential logic circuits.
- To introduce the function of logic families and Programmable Logic Devices.
- To implement logic gates, combinational and sequential circuits using VHDL.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the fundamental concepts of Boolean Algebra, Karnaugh map techniques and Binary Code converters | Cognitive | Understanding |
| CO2 | ***Construc***t the various of combinational logic circuits | Cognitive | Applying |
| CO3 | ***Build*** various Sequential logic circuits | Cognitive | Applying |
| CO4 | ***Explain*** the operation of various Logic Families | Cognitive | Understanding |
| CO5 | ***Classify*** the various types of Memories and Programmable Logic Devices | Cognitive | Understanding |
| CO6 | ***Develop*** the VHDL to simulate combinational and sequential logic circuits. | Cognitive | Applying |

| UNIT I -LOGIC SIMPLIFICATION | 8 Hours |
|---|---|

Boolean Algebra and DeMorgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps, Logic gates ,Binary codes, Code Conversion.

| UNIT II -COMBINATIONAL LOGIC CIRCUITS | 8 Hours |
|---|---|

Comparator,Multiplexer, Demultiplexer,Encoder,Decoder,Driver&MultiplexedDisplay,Half and Full Adders , Half and Full Subtractors, Serial and Parallel Adders, BCD Adder .

| UNIT III - SEQUENTIAL LOGIC CIRCUITS DESIGN | 8 Hours |
|---|---|

SR,JK , D and T type Flip lops, Ripple Counter and Synchronous counters, Shift registers, Parity checker , Pseudo Noise Sequence generator

| UNIT IV -LOGIC FAMILIES | 7 Hours |
|---|---|

Inverter, NAND and NOR RTL, DTL, TTL, ECL, CMOS families ,Specifications,Noisemargin,Propagationdelay,fan-in,fan-out, Tristate and their interfacing,

| UNIT V- SEMICONDUCTOR MEMORIES | 7 Hours |
|---|---|

Memory elements, RAM, ROM , PAL, PLA, FPGA. Logic implementation using Programmable Devices.

| UNIT VI - VERY HIGHSPEED INTEGRATED CIRCUIT HARDWAREDESCRIPTION LANGUAGE(VHDL) | 7 Hours |
|---|---|

Basic Concepts- Data types and objects, Data flow,Behavioraland Structural Modeling, Design of Combinational and Sequential circuits using VHDL.

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**Text Books:**


1. R.P.Jain,"ModerndigitalElectronics",TataMcGrawHill,4thedition, 2009.
2. DouglasPerry,"VHDL",TataMcGrawHill,4thedition,2002.
3. W.H.Gothmann,"DigitalElectronics An introduction to theory and practice",PHI,2nd edition,2006.
4. D.V.Hall,"DigitalCircuitsandSystems",TataMcGrawHill,1989
5. CharlesRoth,"DigitalSystemDesignusingVHDL",TataMcGrawHill2nd edition 2012.


**References :**


1.M. Morris Mano, and Michael D.Ciletti "Digital Design: with an Introduction to Verilog HDL", VHDL, and SystemVerilog 6th Edition, Pearson/Prentice Hall of India Pvt. Ltd., New Delhi, 2017.

2.Thomas L. Floyd, "Digital Fundamentals, 11thEdition, Pearson Education", Inc, NewDelhi, 2014.


**Table1: Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | 2 | - | - |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | 2 | - | - |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | 2 | - | - |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | 2 | - | - |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | 2 | - | - |
| **CO6** | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 1 | - | - | - | 2 | - | - |
| **Total** | **18** | **12** | **12** | **11** | **13** | **11** | **6** | 6 | **-** | **-** | **-** | **6** | **-** | **-** |
| **Scaled Value** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | 2 | | | | **2** | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC304 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | NETWORK THEORY | 3 | 1 | 0 | 4 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 4 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To make the students to understand the basic laws and theorems of AC and DC electrical circuits.
- To familiarize the transient and steady state behaviour of networks.
- To impart the knowledge on the frequency response characteristics of RLC and filter circuits.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the concepts of nodal, mesh analysis and network topology. | Cognitive | Understanding |
| CO2 | ***Illustrate*** Network theorems. | Cognitive | Understanding |
| CO3 | ***Compare*** RL, RC and RLC networks and Analyze their characteristics | Cognitive | Understanding |
| CO4 | ***Outline*** the transient response characteristics of RL,RC,RLC | Cognitive | Understanding |
| CO5 | ***Explain*** the properties of two port network. | Cognitive | Understanding |
| CO6 | ***Interpret*** the characteristics of different types of filters | Cognitive | Understanding |

**UNIT I -BASIC CIRCUITS ANALYSIS AND NETWORK TOPOLOGY** **8 +3 Hours**

Ohm's Law – Kirchhoff's laws – Mesh current and node voltage method of analysis for D.C and A.C. circuits - Network terminology - Graph of a network - Incidence and reduced incidence matrices – Trees –Cutsets - Fundamental cutsets - Cutset matrix – Tie sets - Link currents and Tie set schedules -Twig voltages and Cutset schedules, Duality and dual networks.

**UNIT II -NETWORK THEOREMS FOR DC AND AC CIRCUITS** **8 +3 Hours**

Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem ,application of Network theorems- Network reduction: voltage and current division, source transformation – star delta conversion.

**UNIT III -RESONANCE AND COUPLED CIRCUITS** **8+3 Hours**

Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor - Selectivity. Self inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multiwinding coupled circuits - Series, Parallel connection of coupled inductors - Single tuned and double tuned coupled circuits.

**UNIT IV -TRANSIENT ANALYSIS** **7 +2 Hours**

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.

**UNIT V -TWO PORT NETWORKS** **7+2Hours**

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.

**UNIT VI -FILTERS** **7 +2Hours**

Low Pass and High Pass Filters. Band Pass and Band elimination Filters, Notch Filter - Design and Characteristics.

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 15 | 60 |

**Text Books:**


1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis" , McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.
2. Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.


**References:**


1Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Fifth Edition, McGraw Hill, 9th Reprint 2015.
2. A.Bruce Carlson, "Circuits: Engineering Concepts and Analysis of Linear Electric Circuits", Cengage Learning, India Edition 2nd Indian Reprint 2009.
3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.
4. Circuit Theory, Prof. Nageswara Rao, A.R Publications Paperback – 1st July 2017.


**Table 1 : Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 2 | 2 | - |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 2 | 2 | - |
| **CO 3** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 2 | 2 | - |
| **CO 4** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 2 | 2 | - |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 2 | 2 | - |
| **CO6** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 2 | 2 | - |
| Total | 18 | 12 | 12 | 12 | 6 | 6 | 6 | 6 | - | - | - | 12 | 12 | - |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC305 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ELECTROMAGNETIC THEORY AND TRANSMISSION LINES | 3 | 1 | 0 | 4 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 4 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To ***impart*** knowledge on the behavior of electric and magnetic fields in free space and in materials
- To provide knowledge on the relation between electric and magnetic fields, and Maxwell's equations.
- To give thorough understanding about high frequency line, power and impedance measurements
- To familiarize impedance matching using smith chart

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the Electrostatic laws and Maxwells equations. | Cognitive | Understanding |
| CO2 | ***Explain*** the Magneto static laws and Maxwells equations. | Cognitive | Understanding |
| CO3 | ***Outline*** the Propagation Characteristics of Uniform Plane Wave | Cognitive | Understanding |
| CO4 | ***Compare*** the characteristics of TE and TM waves | Cognitive | Understanding |
| CO5 | ***Relate*** the parameters of transmission lines | Cognitive | Understanding |
| CO6 | ***Interpret*** the impedance matching technique using smith chart | Cognitive | Understanding |

**UNITI - ELECTROSTATICS** **8+3 Hours**

Basics of coordinate system, Coulomb's Law ,Electric Field Intensity-Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications,ElectricPotential,RelationsBetweenEandV,Maxwell'sEquationsforElectrostaticFields,EnergyDensity, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations; Capacitance-Parallel plate, Illustrative Problems.

**UNITII - MAGNETOSTATICS** **8+3 Hours**

Biot - Savart's Law , Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductance and Magnetic Energy, Illustrative Problem. Maxwell's Equations (Time Varying Fields)- Faraday's Law and Transformer EMF, DisplacementCurrentDensity,Maxwell'sEquationsinDifferentFinalForms,Conditions data Boundary Surface: Dielectric-Dielectric, Illustrative Problems.

| UNITIII - EMWAVECHARACTERISTICS | 8+3 Hours |
|---|---|
| Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves - Definition, Relation Between E & H, Wave Propagation in Lossless and Conducting Media, Wave Propagation in Good Conductors and Good Dielectrics, Illustrative Problems. Reflection and Refraction of Plane Waves-Normal for both perfect Conductor and perfect Dielectrics, Brewster Angle ,Critical Angle and Total Internal Reflection, Surface Impedance, Pointing Vector and Pointing Theorem, Illustrative Problems. Introduction to wave guides. | |
| **UNIT IV- EMWAVE GUIDES** | **7+2 Hours** |
| General Wave behaviours along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves in Rectangular wave guides, TM and TE waves in Circular wave guides | |
| **UNIT V- TRANSMISSION LINE THEORY** | **7+2 Hours** |
| Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless transmission online, Distortion-Condition for Distortion less and Minimum Attenuation, Illustrative Problems. | |
| **UNIT VI - HIGH FREQUENCY TRANSMISSION LINE AND IMPEDANCE MATCHING** | **7+2 Hours** |
| SC and OC Lines, Input Impedance Relations, Reflection Coefficient, VSWR, λ/4, λ2, λ/8 Lines-Impedance Transformations, Smith Chart-Configuration and Applications, Single Stub Matching, Illustrative Problems | |

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 15 | 60 |

**Text Books :**


1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989.
2. John D Ryder, ―Networks, lines and fields‖, 2nd Edition, Prentice Hall India, 2015.


**References:**


1. W.H. Hayt and J.A. Buck, Engineering electrmagnetics, 7th ed., McGraw-Hill (India), 2006
2. E.C.Jordan and K.G. Balmain, -―Electromagnetic Waves and Radiating Systems Prentice Hall of India, 2006
3. Transmission Lines and Networks by Umesh Sinha, Satya Prakashan 2001, Tech India Publication New Delhi.
4. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines Pearson Education, First edition 2005.

**Table 1 : Mapping of COs with POs**

| | PO1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO 8 | PO9 | PO10 | PO 11 | P O 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 |
| **CO 3** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 |
| **CO 4** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 |
| **CO6** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 |
| Total | 18 | 12 | 12 | 12 | 6 | 6 | 6 | 6 | - | - | - | 6 | 6 | 12 |
| **Scaled Value** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | | | 2 | 2 | 3 |

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XUM306 | L | T | P | SS | C |
|---|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ENTREPRENEURSHIP DEVELOPMENT | 2 | 0 | 0 | 0 | 2 |
| PREREQUISITES | | | | L | T | P | SS | H |
| C | P | A | | 2 | 0 | 0 | 1 | 3 |
| 1.7 | 0 | 0.3 | | | | | | |

**LEARNING OBJECTIVES**

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Recognise*** and ***describe*** the role of innovation and motivation for an entrepreneur. | Cognitive | Understanding |
| CO2 | ***Self-assess*** and ***appraise*** your entrepreneurship interest with your chosen entrepreneur. | Cognitive/ Affective | Evaluate/ Verify |
| CO3 | ***Outline*** the importance of generation of new ideas for entrepreneurship and ***illustrate*** market assessment. | Cognitive | Analysing |
| CO4 | ***Explain*** the competition in business and ***sketch/demonstrate/comply*** business model for dealing with competition. | Cognitive/ Affective | Understanding, Apply/ Value, Response |
| CO5 | ***Describe*** and ***Explain*** venture creation and launching of small business and its management. | Cognitive | Remembering, Understanding |
| CO6 | ***Describe*** and ***Discuss*** various government policies and global opportunities for Entrepreneurship Development | Cognitive/ Affective | Remembering, Understanding / Integrating |

**UNIT I - INNOVATION AND ENTREPRENEURSHIP** — **5 Hours**

Definition of Innovation, Creativity and Entrepreneurship; role of innovation in entrepreneurship development (2)- Entrepreneurial motivation (1)-Competencies and traits of an entrepreneur (1)-Role of Family and Society; Entrepreneurship as a career and its role in national development (1)

**UNIT II - SELF ASSESSMENT OF ENTREPRENEURIAL INCLININATION** — **4 Hours**

Self-assessment of entrepreneurial inclination (1)-Presentation by students on their entrepreneurial inclination rating (2)-Case study of successful entrepreneurs (1)

**UNIT III - NEW IDEA GENERATION TO MARKET ASSESSMENT** — **9 Hours**

Importance of Idea generation-filtering-refinement (1)-opportunity recognition (1)- Description of chosen idea - value proposition, customer-problem-Solution statement) (1)-benefits; development status; IP ownership (1)-Market Validation- Technology/ user/decision makers/ partners (1)-market need; segmentation (1)-market TAM,SAM and SOM (1)-case study on market segmentation by popular companies (1)

**UNIT IV -CUSTOMER – COMPETITION- BUSINESS MODEL** — **9 Hours**

Customer-Target primary customer research, Decision making unit/ process-Beach head market; Cost of Customer Acquisition (2)-Competition- comparative analysis, competitive advantages-; (2)-Business model (1) -Financial planning (1)-Pitch documentation and presentation (3)

| UNIT V - VENTURE CREATION AND LAUNCHING OF SMALL BUSINESS AND ITS MANAGEMENT | 9 Hours |
|---|---|
| New enterprise creation - organizational and legal matters (1)-Operational plan (1)-Sales and distribution plan (1)-Accounting (1)-Team recruitment and management (1)-Fund raising and management (1)-Profile of a startup – case studies (2) | |
| **UNIT -VI : GOVERNMENT INITIATIVES AND GLOBAL OPPORTUNITIES** | **9 Hours** |
| Incubators and accelerators - capacity building (2)-Startup policies- Startup India (2)-Support for MSME; GeM Portal(2) Funding–national and international sources(2)-Bilateral programmes by Govt. of India -Global reach for promoting cross-cultural entrepreneurship (1) | |

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**Reference**


1. A.P.Aruna, " Lecture Notes on Entrepreneurship Development" , available as softcopy @ www.brain.net
2. Thomas W. Zimmerer, Norman M. Scarborough, "Essentials of Entrepreneurship and Small Business Management", Pearson; 3rd edition, 2001.
3. Toubia, Olivier. "Idea Generation, Creativity, and Incentives", Marketing Science. Vol. 25. pp.411-425. 10.1287/mksc.1050.0166, 2006.
4. Alexander Osterwalder and Yves Pigneur, "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers",Wiley; 1st edition, 2010.
5. Gerardus Blokdyk,"3C's model The Ultimate Step-By-Step Guide"5starcooks, 2018.


**Table 1 : Mapping of COs with POs**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | 1 | 2 | 1 | | 1 | 2 | 1 | 1 | | 3 | | | |
| **CO2** | | | | | | | | 1 | 2 | | 3 | | | |
| **CO3** | | | | | | | | 1 | 2 | | 3 | | | |
| **CO4** | | | | | | | | 1 | 2 | | 3 | | | |
| **CO5** | | | | | | | | 1 | 2 | | 3 | | | |
| **CO6** | | | | | | | | 1 | 2 | | 3 | | | |
| **Original** | | 1 | 2 | 1 | | 1 | 2 | 6 | 11 | | 18 | | | |
| **Scaled** | | 1 | 1 | 1 | | 1 | 1 | 2 | 3 | | 3 | | | |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XUM307 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 2 | 1 | 0 | 3 |
| COURSE CODE | | | UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY | | | | |
| PREREQUISITE | | | Universal Human Values 1 (desirable) | L | T | P | H |
| C | P | A | | 2 | 1 | 0 | 3 |
| 2 | 0 | 0 | | | | | |

**PREREQUISITE:** Universal Human Values 1 (desirable)

**Course Objective:**

1.Development of a holistic perspective based on self-exploration aboutthemselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

**Course Outcome:**

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

1. ***Present*** sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.
2. ***Grasp*** the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfilment. Ex.mutually enriching production system with rest of nature.
3. ***Evaluate*** the course and share with their friends. They are also able to ***suggest*** measures to make the course more effective and relevant. They are also able to ***make use of*** their understanding in the course for the happy and prosperous family and society.

**UNIT I -COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION** — **6+3**

Purpose and motivation for the course, recapitulation from Universal Human ValuesI - Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and ExperientialValidation- as the process for self-exploration - Continuous Happiness and Prosperity - A look at basic Human Aspirations - Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority - Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

**UNIT II -UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF** — **6+3**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body' -Understanding the needs of Self ('I') and 'Body' - happiness and physical facility - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Health.
Practice sessions to discuss the role others have played in making material goods available to me.

Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

| **UNIT III -UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP** | **5+3** |
|---|---|

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship - Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

| **UNIT IV -UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE** | **4+2** |
|---|---|

Understanding the harmony in the Nature 1 - Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature - Understanding Existence as Co-existence of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence. Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

| **UNIT V - IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS** | **7+3** |
|---|---|

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. - Case studies of typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations - Sum up. Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

| **LECTURE** | **TUTORIAL** | **PRACTICAL** | **TOTAL** |
|---|---|---|---|
| **28** | **14** | **0** | **42+3(SS)** |

**TEXT BOOKS:**

| | |
|---|---|
| 1. | Human Values and Professional Ethics - R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010. |

**REFERENCE BOOKS :**

| | |
|---|---|
| 1. | Jeevan Vidya Ek- Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999. |
| 2. | Human Values - A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. |
| 3. | Leonard, Annie. 2011. The Story of Stuff. New York, NY: Simon & Schuster. |

| | |
|---|---|
| 4. | The Story of My Experiments with Truth - Mohandas Karamchand Gandhi<br>AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology) |
| 5. | Small is Beautiful - E. F Schumacher. |
| 6. | Slow is Beautiful - Cecile Andrews. |
| 7. | Economy of Permanence - J C Kumarappa. |
| 8. | Bharat Mein Angreji Raj –PanditSunderlal. |
| 9. | Rediscovering India - by Dharampal. |
| 10. | Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi. |
| 11. | India Wins Freedom - Maulana Abdul Kalam Azad |
| 12. | Vivekananda - Romain Rolland (English) |
| 13. | Gandhi - Romain Rolland (English) |

**Table 1 : Mapping of COs with POs**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | 2 | 1 | | | 2 | 2 | 3 | | | | 2 | | |
| **CO2** | | | | | | 2 | 2 | 3 | | | | 2 | | |
| **CO3** | | | | | | 2 | 2 | 3 | | | | 2 | | |
| **CO4** | | | | | | 2 | 2 | 3 | | | | 2 | | |
| **CO5** | | | | | | 2 | 2 | 3 | | | | 2 | | |
| **Original** | | 2 | 1 | | | 10 | 10 | 15 | | | | 10 | | |
| **Scaled Value** | | 1 | 1 | | | 2 | 2 | 3 | | | | 2 | | |

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSECODE | | | XEC308 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ELECTRONIC DEVICES AND NETWORKS LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 0.5 | 0.25 | 0.25 | | 0 | 0 | 2 | 2 |

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Construct*** the circuit and *show* the characteristics of semiconductor diodes and their applications. | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO2 | ***Construct*** *the* Bipolar Junction Transistor circuits and *show* the characteristics. | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO3 | ***Construct*** *the circuits using FET , SCR and UJT* and showtheir characteristics. | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO4 | *Construct* and *show* the characteristics of LED and LDR | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO5 | *Construct* the networks circuits and *Experiment*the various theorems | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO6 | *Construct the* Resonance and Filter circuits and *show* the characteristics. | Cognitive Psychomotor Affective | Applying Mechanism Responding |

**LIST OF EXPERIMENTS**

1.Characteristics of Half wave and full wave rectifiers.
2.Characteristics of Bridge Rectifier (simulation using PSpice).
3.Characteristics of voltage regulators
4.Input and Output characteristics of BJT under CE and CB configuration .
5.Drain and Transfer characteristics of JFET(simulation using PSpice).
6.Characteristics of SCR and UJT.
7.Characteristics of LED and LDR
8.Verification of Thevenin's and Norton's theorems.
9.Verification of Reciprocity and Maximum Power Transfer Theorem.
10.Frequency response of series and parallel resonance circuit
11.Frequency response of low pass and high pass filter
12.Characteristics of T and π networks (simulation using PSpice).

| | PRACTICAL | TOTAL |
|---|---|---|
| HOURS | 30 | 30 |

**Table 1 : Mapping of COs with POs**

| | PO1 | PO2 | PO 3 | PO 4 | PO5 | PO 6 | PO7 | PO8 | PO 9 | PO10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **Total** | **18** | **12** | **12** | **12** | **12** | **12** | **12** | **6** | **6** | | **6** | **6** | **6** | **6** |
| **Scaled Value** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **2** | | **2** | **2** | **2** | **2** |

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC309 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | DIGITAL SYSTEM DESIGN LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 0 | 0 | 2 | 2 |
| 0.5 | 0.25 | 0.25 | | | | | |

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Construct code converter and show the output*** | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO2 | ***Construct*** Combinational logic circuits and ***show the output*** | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO3 | ***Construct*** Sequential logic circuits and ***show the output*** | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO4 | ***Build*** Counters and ***show the output*** | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO5 | ***Build*** Shift Registers and ***show the output*** | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO6 | ***Build*** digital circuits using VHDL and ***show the output*** | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |

**LIST OF EXPERIMENTS**

1. Study of logic gates.
2. Design and implementation of code converters using logic gates
3. Design and implementation of Adders using logic gates.
4. Design and implementation Subtractor using logic gates.
5. Design and implementation of Magnitude Comparators.
6. Design and implementation of encoder and decoder.
7. Design and implementation of Multiplexer and De-multiplexer.
8. Implementation of Flip- flops.
9. Construction and verification of counter . (simulation using PSpice).
10. Construction and verification of shift register. (simulation using PSpice).
11. Logic gates using VHDL.
12. Adder and subtractor using VHDL

| | PRACTICAL | TOTAL |
|---|---|---|
| HOURS | 30 | 30 |

**Table 1 : Mapping of COs with POs**

| | PO1 | PO2 | PO 3 | PO 4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 2** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO6** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **Total** | **18** | **18** | **18** | **18** | **12** | **12** | **12** | **6** | **6** | | **6** | **12** | | |
| **Scaled Value** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **2** | | **2** | **3** | | |

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC401 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | PROBABILITY THEORY AND STOCHASTIC PROCESSES | 3 | 0 | 0 | 3 |
| C | P | A | | L | T | P | H |
| 2.5 | 0.25 | 0.25 | | 3 | 0 | 0 | 3 |

**PREREQUISITE: Nil**

**Learning Objectives:**

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities and to understand the significance of linear systems with random inputs.

| Course Outcomes | | Domain | Level |
|---|---|---|---|
| CO1 | ***Describe*** sets, its operation and basics of probability by examples and **solve** problems associated. | Cognitive | Remembering Applying |
| CO2 | ***Describe*** and ***Demonstrate*** PMF, PDF, CDF of discrete and continues random variable | Cognitive | Remembering Understanding |
| CO3 | ***Describe*** Joint distributions and them to communication systems problems | Cognitive | Remembering Applying |
| CO4 | ***Describe*** random sequences and limit theorems and ***solve*** problems | Cognitive | Remembering Applying |
| CO5 | ***Describe*** stochastic and ***solve*** problems related to communication system which involves stochastic process. | Cognitive | Remembering Applying |

**UNIT – I** **9 Hours**

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models. Requirements for a random process to be stationary. Rayleigh and Rician distribution in detail. Axioms of probability -Conditional probability -Bayes rule, statistically independent Random variable -CDF - Probability density function-Statistical averages-Moments.

**UNIT - II** **9 Hours**

Discrete random variables, probability mass function, example random variables and distributions; Cumulative Distribution Function (CDF), Averages, and Expected Value of a Derived Random Variable, Variance and Standard Deviation; Continuous random variables, probability density function, probability distribution function, example distributions; Gaussian Random Variables, Delta Functions, Mixed Random Variables, Probability Models of Derived Random Variables.

**UNIT - III** **9 Hours**

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

| UNIT - IV | 9 Hours |
|---|---|
| Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem. | |
| **UNIT - V** | **9 Hours** |
| Stochastic Processes - Definitions and Examples- Types of Stochastic Processes- Random Variables from Random Processes- Independent Identically Distributed Random Sequences -The Poisson Process - Properties of the Poisson Process - The Brownian Motion Process - Expected Value and Correlation - Stationary Processes - Wide Sense Stationary Stochastic Processes -Cross-Correlation - Gaussian Processes. | |

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| HOURS | 45 | 0 | 45 |

**TEXTBOOKS**

1. Roy D. Yates and David J."Goodman, "Probability and Stochastic Processes", 3rd Edition, John Wiley & Sons, Inc., 2014.
2. H. Stark and J.W.Woods, "Probability and Random Processes with Applications to Signal Processing", Third Edition, Pearson Education, 2002.

**REFERENCES**

1. A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes", Fourth Edition, McGraw Hill., 2002
2. Scott Miller and Donald Childers, "Probability and Random Processes, : With Applications to Signal Processing and Communications', 2nd edition, Academic Pres, 2018.
3. Leon-Garcia, Alberto, "Probability, statistics, and random processes for electrical engineering", Pearson Education, Inc.,Upper Saddle River, NJ 07458, 2008

**E REFERENCE**

**1.Nptel:** Prof. Dr. S. Dharmaraja, "Stochastic Processes", Department of Mathematics, Indian Institute of Technology, Delhi, http://nptel.ac.in/courses/111102014/

**Table 1 : Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 |
| **CO 2** | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 |
| **CO 3** | 3 | 2 | 1 | 1 | | | | | 1 | 1 | | 1 |
| **CO 4** | 3 | 2 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **Total** | 15 | 10 | 5 | 3 | 2 | 2 | 1 | | 5 | 5 | 2 | 5 |
| **Scaled value** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC402 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ELECTRONIC CIRCUITS | 3 | 1 | 0 | 4 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 4 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To give a comprehensive exposure to all types of amplifiers and oscillators.
- To study about feedback amplifiers and oscillators principles.
- To understand the analysis and design of LC and RC oscillators, amplifiers, multi vibrators, power amplifiers and DC convertors.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Classify the characteristics of*** feedback amplifiers and their stability. | Cognitive | Understanding |
| CO2 | ***Compare*** the various Oscillator circuits | Cognitive | Understanding |
| CO3 | ***Illustrate*** the frequency response of tuned amplifiers | Cognitive | Understanding |
| CO4 | Outline the characteristics of wave shaping circuits and multivibrators . | Cognitive | Understanding |
| CO5 | ***Explain*** the working principle of power amplifiers | Cognitive | Understanding |
| CO6 | ***Explain*** about converters | Cognitive | Understanding |

**UNIT I -FEEDBACK AMPLIFIERS AND STABILITY** **(8+3)Hours**

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation.

**UNIT II - OSCILLATORS** **(8+3)Hours**

Barkhausen criterion for oscillation – phase shift, Wien bridge - Hartley & Colpitt‘s oscillators – Clapp oscillator-Ring oscillators and crystal oscillators – oscillator amplitude stabilization.

**UNIT III- TUNED AMPLIFIERS** **(8+3)Hours**

Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth – Stagger tuned amplifiers - Stability of tuned amplifiers – Neutralization - Hazeltine neutralization method.

**UNIT IV - WAVE SHAPING AND MULTIVIBRATOR CIRCUITS** **(7+2)Hours**

Pulse circuits – attenuators – RC integrator and differentiator circuits – diode clampers and clippers –Multivibrators - Schmitt Trigger- UJT Oscillator.

**UNIT V- POWER AMPLIFIERS** **(7+2)Hours**

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect-Class AB Power amplifier using MOSFET –

| UNIT VI - CONVERTERS | | | (7+2) Hours |
|---|---|---|---|
| Requirement for isolation in the switch-mode converters - Forward and flyback converters- Formulation of dynamic equation of buck and boost converters, Buck-Boost analysis and design | | | |
| **HOURS** | **LECTURE** | **TUTORIAL** | **TOTAL** |
| | **45** | **15** | **60** |

**TEXT BOOKS**

1.Sedra and Smith, Micro Electronic Circuits‖; Sixth Edition, Oxford University Press, 2011.

2.Jacob Millman, Microelectronics', McGraw Hill, 2nd Edition, Reprinted, 2009.

**REFERENCE BOOKS**

1. Electronic Devices and Circuit Theory‖, Robert L. Boylestad and Louis Nasheresky, 10th Edition, Pearson Education / PHI, 2008

2.David A. Bell, Electronic Devices and Circuits‖, Fifth Edition, Oxford University Press, 2008.

3.Millman J. and Taub H., Pulse Digital and Switching Waveforms‖, TMH, 2000.

4.Millman and Halkias. C., Integrated Electronics, TMH, 2007.

**Table 1 : Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO 8 | PO9 | PO10 | PO11 | PO 12 | PS O1 | PS O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **Total** | **18** | **16** | **12** | **9** | **6** | **6** | **6** | **6** | | | | **6** | **6** | **6** |
| **Scaled Value** | **3** | **3** | **3** | **2** | **2** | **2** | **2** | **2** | | | | **2** | **2** | **2** |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC403 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | SIGNALS AND SYSTEMS | 3 | 1 | 0 | 4 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 4 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | C***lassify*** various types of signals | Cognitive | Understanding |
| CO2 | C***lassify*** various types of systems | Cognitive | Understanding |
| CO3 | Explain the characteristics of continuous time system. | Cognitive | Understanding |
| CO4 | Summarize the characteristics of LTI continuous time systems | Cognitive | Understanding |
| CO5 | ***Explain*** the process of sampling and the effects of under sampling. | Cognitive | Understanding |
| CO6 | Illustrate LTI discrete time systems and realize with various structures | Cognitive | Understanding |

| **UNIT I - CLASSIFICATION OF SIGNALS** | **8 + 3 Hours** |
|---|---|

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals — Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals

| **UNIT II - CLASSIFICATION OF SYSTEMS** | **8 + 3 Hours** |
|---|---|

Classification of systems- CT systems and DT systems- — Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

| **UNIT III -ANALYSIS OF CONTINUOUS TIME SIGNALS** | **8 + 3 Hours** |
|---|---|

Fourier series for periodic signals - Fourier Transform – properties - Laplace Transforms and properties.

| **UNIT IV -LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS** | **7 + 2Hours** |
|---|---|

Impulse response - convolution integrals - Differential Equation - Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

| **UNIT V- ANALYSIS OF DISCRETE TIME SIGNALS** | **7 + 2 Hours** |
|---|---|

Baseband signal Sampling - Fourier Transform of discrete time signals (DTFT) -Properties of DTFT -Z Transform & Properties.

| **UNIT VI - LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS** | **7 + 2 Hours** |
|---|---|

Impulse response — Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 15 | 60 |

**Text Books**


1. A.V.Oppenheim,A.S.WillskyandI.T.Young,"Signals and Systems",PrenticeHall,1983.
2. R.F.Ziemer, W.H.Tranter and D.R.Fannin, "Signals and Systems-Continuous and Discrete", 4th edition, Prentice Hall,1998.

**References**

1. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
2. B.P.Lathi, "Signal Processing and Linear Systems", Oxford University Press,1998.
3. Douglas K.Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: 1999.
4. Simon Haykin and Barry Van Veen, "Signals and Systems", John Willey & Sons, Inc, second edition 2013
5. Robert A.Gabel, Richard A.Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
6. M.J.Roberts, "Signals and Systems-Analysis using Trans form methods and MATLAB", TMH, 2003.
7. Nagrath, S.N.Sharan,R.Ranjan,S.Kumar,"SignalsandSystems",TMHNewDelhi,2001.
8. Ashok Ambardar, "Analog and Digital Signal Processing", 2nd Edition, Brooks/Cole Publishing Company (An international Thomson Publishing Company), 1999.
1. **https://onlinecourses.nptel.ac.in /noc18_ee02/preview**


**Table 1: Mapping of COs with POs:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **Total** | **18** | **12** | **12** | **6** | **6** | **6** | **6** | **6** | | | | **6** | **6** | **6** |
| **Scaled Value** | **3** | **3** | **3** | **2** | **2** | **2** | **2** | **2** | | | | **2** | **2** | **2** |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC404 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ANALOG INTEGRATED CIRCUITS | 3 | 1 | 0 | 4 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 4 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To introduce the basic building blocks of linear integrated circuits
- To familiarize the linear and non-linear applications of operational amplifiers
- To impart the knowledge on the theory and applications of analog multipliers and PLL
- To disseminate the theory of ADC and DAC
- To enhance the fundamental knowledge on the concepts of waveform generation and introduce some special function ICs

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the fabrication of integrated circuits and the characteristics of differential amplifiers | Cognitive | Understanding |
| CO2 | ***Analyze*** characteristics of operational amplifiers and basic applications. | Cognitive | Analyzing |
| CO3 | ***Apply*** the principles of op-amp for various applications. | Cognitive | Applying |
| CO4 | ***Explain multivibrators*** and wave form generators | Cognitive | Understanding |
| CO5 | ***Classify the*** various types of filters and converters | Cognitive | Understanding |
| CO6 | ***Outline*** the operation of PLL and its applications. | Cognitive | Understanding |

**UNIT I - IC TECHNOLOGY AND DIFFERENTIAL AMPLIFIERS** **8+3**

Fundamentals of monolithic IC, Thick and thin film technology, Differential amplifiers: Differential amplifier configurations using BJT, Large and small signal operations, input resistance, voltage gain, CMRR, non – ideal characteristics of differential amplifiers, frequency response of differential amplifiers,.

**UNIT II - INTRODUCTION TO OPERATIONAL AMPLIFIERS** **8+3**

Block diagram, Ideal op-amp parameters, Equivalent circuit, Voltage transfer curve, Open loop op-amp configurations, Effect of finite open loop gain, Bandwidth and slew rate on circuit performance Feedback configurations, voltage series feedback, voltage shunt feedback, properties of practical op-amp

**UNIT III - OP-AMP APPLICATIONS** **8+3**

Inverting and non inverting amplifier, DC and AC amplifiers, Summing, Scaling and averaging amplifiers, Instrumentation amplifier. Voltage to current converter, Current to voltage converter, Integrator, Differentiator, Zero crossing detector, Comparators, Precision rectifiers, Log and antilog amplifier,.

**UNIT IV - MULTIVIBRATORS AND WAVE FORM GENERATORS** **7+2**

Bistable, monostable and astable multivibrators using 555 Timers Triangular and saw toothwave generators, Schmitt Trigger, RC Phase Shift, Wien bridge ,Hartley, Colpitts and Crystal oscillators

**UNIT V –FILTERS AND CONVERTERS** **7+2**

| | | | |
|---|---|---|---|
| Active filters: Advantages, First and second order low pass, Highpass, Band pass and band reject filters, Design of filters using Butterworth approximations.Data converters: A/D and D/A converters | | | |
| **UNIT VI - PLL AND APPLICATIONS** | | | **7+2** |
| PLL- basic block diagram and operation, four quadrant multipliers. Phase detector, VCO, Applications of PLL: Frequency synthesizers, AM detection, FM detection and FSK demodulation | | | |
| **HOURS** | **LECTURE** | **TUTORIAL** | **TOTAL** |
| | **45** | 15 | 60 |

**TEXT BOOKS**

1. D.Roy Choudhry, Shail Jain, - Linear Integrated Circuits‖, New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Sergio Franco, - Design with Operational Amplifiers and Analog Integrated Circuits‖, 4th Edition, Tata Mc Graw-Hill, 2016
3. Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 4/e, Tata McGraw Hill, 2015

**REFERENCES**

1. Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010
2. A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition, 2010
3. Ramakant A. Gayakwad, ―OP-AMP and Linear ICs‖, 4th Edition, Prentice Hall / Pearson Education, 2015.
4. Robert F.Coughlin, Frederick F.Driscoll, ―Operational Amplifiers and Linear Integrated Circuits‖, Sixth Edition, PHI, 2001.
5. William D.Stanley, ―Operational Amplifiers with Linear Integrated Circuits‖, Pearson Education,4th Edition,2001.

**Table 1 : Mapping of COs with Pos**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **Total** | **18** | **16** | **12** | **9** | **6** | **6** | **6** | **6** | | | | **6** | | |
| **Scaled Value** | **3** | **3** | **3** | **2** | **2** | **2** | **2** | **2** | | | | **2** | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

1

| COURSE CODE | XUM009 | L | T | P | C |
|---|---|---|---|---|---|
| COURSE NAME | ECONOMICS FOR ENGINEERS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | L | T | P | H |
| C:P:A | 2.64:0.24:0.12 | 3 | 0 | 0 | 3 |

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the concepts of economics in engineering and ***identify*** element of cost to prepare cost sheet | Cognitive Psychomotor | Understanding Perception |
| CO2 | ***Calculate and Explain*** the Break-even point and marginal costing | Cognitive Psychomotor | Understanding &Applying Perception |
| CO3 | ***Summarize*** and ***Use*** value engineering procedure for cost analysis | Cognitive Affective | Understanding Receiving |
| CO4 | ***Estimate*** replacement problem | Cognitive | Understanding |
| CO5 | ***Compute, Explain*** and ***make Use of*** different methods of depreciation | Cognitive | Understanding &Applying |

| **UNIT I -INTRODUCTION TO ECONOMICS** | **08** |
|---|---|
| Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- types of costing, element of costs, preparation of cost sheet and estimation, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost | |
| **UNIT II- BREAK-EVEN ANALYSIS&SOCIAL COST BENEFIT ANALYSIS** | **12** |
| Margin of Safety, Profit, Cost & Quantity analysis-Product Mix decisions and CVP analysis, Profit/Volume Ratio (P/V Ratio), Application of Marginal costing, Limitations<br>**Social Cost Benefit Analysis**: compare different project alternatives, Calculate direct, indirect and external effects; Monetizing effects; Result of a social cost benefit analysis. | |
| **UNIT III - VALUE ENGINEERING &COST ACCOUNTING:** | **10** |
| Value engineering – Function, aims, Value engineering procedure - Make or buy decision Business operating costs, Business overhead costs, Equipment operating costs | |
| **UNIT IV - REPLACEMENT ANALYSIS** | **07** |
| Replacement analysis –Types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset. | |
| **UNIT V- DEPRECIATION** | **08** |
| Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation. | |

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**TEXT BOOKS**


1. Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications,Faridabad, Haryana, 2012
2. S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers,Calcutta, 2012
3. PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
4. William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.

**REFERENCES**


1. Luke M Froeb / Brian T Mccann, " Managerial Economics – A problem solving approach" Thomson learning 2007
2. Truett&Truett, "Managerial economics- Analysis, problems & cases " Wiley India 8th edition 2004.
3. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
4. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002


**Table 1 : Mapping of COs with POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | 1 | | | 3 | 1 | | | 3 | |
| **CO2** | 1 | | | 1 | | | 3 | | | | 2 | |
| **CO3** | 2 | 1 | | | | | 3 | | | | 2 | |
| **CO4** | 2 | 1 | | | | | 3 | | | | 2 | |
| **CO5** | 2 | | | | | | 3 | | | 1 | 2 | |
| **Total** | 9 | 3 | 1 | 2 | | | 15 | 1 | | 1 | 11 | |
| **Scaled** | 2 | 1 | 1 | 1 | | | 3 | 1 | | 1 | 3 | |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XUM003 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | DISASTER MANAGEMENT | 0 | 0 | 0 | 0 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| | | | | | | | |

| Course Outcomes: | | Domain | Level |
|---|---|---|---|
| CO1 | Understanding the concepts of application of types of disaster preparedness | Cognitive | Application |
| CO2 | On completion of this course the students will be able to understand planning essentials of disaster. | Cognitive | Analyzing |
| CO3 | Have a good understanding of importance of seismic waves occurring globally | Cognitive | Analyzing |
| CO4 | On completion of this course, the students will be able to perform drill essential for disaster mitigation | Cognitive | Application |
| CO5 | Have a keen knowledge on essentials of risk reduction | Cognitive | Application |

| UNIT I - INTRODUCTION | 9 |
|---|---|
| Introduction – Disaster preparedness – Goals and objectives of ISDR Programme- Risk identification – Risk sharing – Disaster and development: Development plans and disaster management –Alternative to dominant approach– disaster-development linkages -Principle of risk partnership | |
| **UNIT II -APPLICATION OF TECHNOLOGY IN DISASTER RISK REDUCTION** | **9** |
| Application of various technologies: Data bases – RDBMS – Management Information systems – Decision support system and other systems – Geographic information systems – Intranets and extranets – video teleconferencing. Trigger mechanism – Remote sensing-an insight – contribution of remote sensing and GIS - Case study | |
| **UNIT III -AWARENESS OF RISK REDUCTION** | **9** |
| Trigger mechanism – constitution of trigger mechanism – risk reduction by education – disaster information network – risk reduction by public awareness | |
| **UNIT IV - DEVELOPMENT PLANNING ON DISASTER** | **9** |
| Implication of development planning – Financial arrangements – Areas of improvement – Disaster preparedness – Community based disaster management– Emergency response. | |
| **UNIT V - SEISMICITY** | **9** |
| Seismic waves – Earthquakes and faults – measures of an earthquake, magnitude and intensity – ground damage – Tsunamis and earthquakes | |

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**TEXTBOOKS**


1. Siddhartha Gautam and K Leelakrishna Rao, “Disaster Management Programmes and Policies”, Vista International Pub House, 2012,
2. Arun Kumar, “Global Disaster Management”, SBS Publishers, 2008

**REFERENCES**

1. Encyclopaedia of Disaster Management, Neha Publishers & Distributors, 2008
2. Pradeep Sahni, Madhavi Malalgoda and Ariyabandu, "Disaster risk reduction in South Asia", PHI, 2002
3. Amita Sinvhal, "Understanding earthquake disasters" TMH, 2010.
4. Pardeep Sahni, Alka Dhameja and Uma Medury, "Disaster mitigation: Experiences and reflections", PHI, 2000

**Table 1: Mapping of COs with POs**

| | PO 1 | PO 2 | PO 3 | PO4 | PO5 | PO6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | | 1 | 1 | | | | | 1 | | | 1 | 1 | 2 | 2 |
| **CO 2** | | | 2 | | 3 | | | | | | 2 | 2 | 2 | 2 |
| **CO 3** | | | | | | 2 | 2 | | | | 1 | 1 | | 1 |
| **CO 4** | | 2 | 2 | | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 1 | |
| **CO 5** | | | | | | 2 | 3 | 3 | | 2 | 1 | 1 | 2 | 2 |
| **Total** | 0 | 3 | 5 | 0 | 4 | 5 | 6 | 6 | 1 | 3 | 8 | 6 | 7 | 7 |
| **Scaled Value** | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC407 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ELECTRONIC CIRCUITS LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITES | | | | | | | |
| C | P | A | | L | T | P | H |
| 0.5 | 0.25 | 0.25 | | 0 | 0 | 2 | 2 |

**LEARNING OBJECTIVES**

- To instill the knowledge on feedback amplifiers
- To give exposure on various oscillators and tuned amplifiers
- To enhance the knowledge on Multivibrators DC to DC Converters

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | Build the series and shunt feedback amplifier circuits and show the characteristics | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO2 | Build the oscillator circuits and show the characteristics | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO3 | Build the tuned amplifier circuits and show the characteristics. | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO4 | ***Construct the*** Multivibrator circuits ***and show***the characteristics. | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO5 | ***Construct the*** power amplifier circuits ***and show*** the characteristics. | Cognitive Psychomotor Affective | Applying Mechanism Responding |
| CO6 | ***Construct the*** converter circuits ***and show*** the characteristics. | Cognitive Psychomotor Affective | Applying Mechanism Responding |

**LIST OF EXPERIMENTS**

1. Frequency response of Series feedback Amplifiers
2. Frequency response of Shunt feedback Amplifiers
3. Frequency response of RC Phase shift Oscillator
4. Frequency response of Wien Bridge Oscillator
5. Frequency response of Hartley Oscillator
6. Frequency response of Colpitts Oscillator
7. Characteristics of Single and double Tuned Amplifiers (simulation using E-sim or PSpice)
8. Study the characteristics of Integrator and Differentiator circuits
9. Study the characteristics of Astable Multivibrators

| |
|---|
| 10. Study the characteristics of Monostable Multivibrators |
| 11. Study the characteristics of Power Amplifier(simulation using E-sim or PSpice). |
| 12. Study the characteristics of DC-DC convertors(simulation using E-sim or PSpice) |

| | PRACTICAL | TOTAL |
|---|---|---|
| HOURS | 30 | 30 |

**Table 1 : Mapping of COs with Pos**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| Total | 18 | 12 | 12 | 12 | 12 | 12 | 12 | **6** | **6** | | **6** | 12 | | |
| Scaled Value | 3 | 3 | 3 | 3 | 3 | 3 | 3 | **2** | **2** | | **2** | 3 | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC408 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ANALOG INTEGRATED CIRCUITS LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITES | | | | | | | |
| C | P | A | | L | T | P | H |
| 0.5 | 0.25 | 0.25 | | 0 | 0 | 2 | 2 |

**LEARNING OBJECTIVES**

- To familiarize the basics of linear integrated circuits and available ICs
- To impart the knowledge on the characteristics of the operational amplifier.
- To teach the applications of operational amplifiers.
- To give insight into the basic knowledge of special function IC

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Construct*** and show the characteristics of Inverting , Non inverting the amplifiers, Zero Crossing detector . | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO2 | ***Construct*** and show the characteristics of Instrumentation Amplifier and Precision rectifiers | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO3 | ***Construct*** and show the characteristics of different types of oscillators | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO4 | ***Construct*** and show the characteristics of multivibrators | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO5 | ***Construct*** and show the characteristics of filters | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO6 | ***Summarize*** the characteristics of PLL | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |

**LIST OF EXPERIMENTS**

1. Inverting and Non inverting amplifiers,
2. Integrator, Differentiator and Zero Crossing Detector
3. Difference Amplifier and Instrumentation amplifier.
4. Schmitt trigger circuit using Op –Amps
5. Precision rectifiers using Op-Amp
6. RC Phase shift and Wien bridge oscillator using Op-Amp

| | | |
|---|---|---|
| 7. Colpitts and Hartley Oscillator using Op –Amps/Simulation using E-sim or PSPICE<br>8. Astable , Bistable and Monostable multivibrators using IC 555 Timer<br>9. Active second order filters using Op-Amp (LPF, HPF, BPF and BSF).<br>10. A/D converters /Simulation using E-sim or PSPICE<br>11. D/A Converters /Simulation using E-sim or PSPICE<br>12. Study of PLL IC: free running frequency lock range capture range | | |
| | **PRACTICAL** | **TOTAL** |
| | **30** | **30** |

**Table 1 : Mapping of COs with POs**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO 1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | | |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | | |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | | |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | | |
| Total | 18 | 16 | 12 | 12 | 12 | 12 | 12 | 6 | 6 | **0** | 6 | 12 | | |
| Scaled Value | 3 | 3 | 3 | 3 | 3 | 3 | 3 | **2** | **2** | | **2** | 3 | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC409 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | SIGNALS AND SYSTEMS LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITES | | | | | | | |
| C | P | A | | L | T | P | H |
| 0.5 | 0.25 | 0.25 | | 0 | 0 | 2 | 2 |

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Demonstrate*** the generation of signals | Cognitive Psychomotor | Understanding Mechanism |
| CO2 | ***Demonstrate*** the Effect of transformation of signal parameters | Cognitive Psychomotor | Understanding Mechanism |
| CO3 | ***Demonstrate*** the Convolution of signals | Cognitive | Understanding |
| CO4 | ***Demonstrate*** the Fourier Transform | Cognitive | Understanding |
| CO5 | ***Demonstrate*** the Laplace Transform | Cognitive | Understanding |
| CO6 | ***Demonstrate*** the Z Transform | Cognitive | Understanding |

**LIST OF EXPERIMENTS**

**USING SCILAB/MATLAB®**

1. Generation of Continuous Signals.
2. Generation of Discrete Signals.
3. Generation of Complex Exponentially Growing and Decaying Signals.
4. Amplitude-scaling, Time-scaling and Time-shifting
5. Addition of two Continuous Signals and two Discrete Signals
6. Convolution of two signals.
7. Calculation of the energy and power of the signals
8. Identification of Linear and non-linear systems.
9. Determination of Time variant and Time invariant systems.
10. Computation of Fourier Transform
11. Computation of Laplace transform
12. Computation of Z transform

| | PRACTICAL | TOTAL |
|---|---|---|
| HOURS | 30 | 30 |

**Table 1 : Mapping of COs with POs**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | |
| Total | 18 | 12 | 12 | 12 | 12 | 12 | 12 | 6 | 6 | | 6 | 12 | | |
| Scaled Value | 3 | 3 | 3 | 3 | 3 | 3 | 3 | **2** | **2** | | **2** | 3 | | |

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSECODE | | | XEC501 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | MICROPROCESSORS AND MICROCONTROLLERS | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**LEARNING OBJECTIVES**

- To make the students understand the Architecture of 8085 microprocessor.
- To educate the students the design aspects of I/O and Memory Interfacing circuits.
- To impart the knowledge to the students to interface microprocessors with supporting chips.
- To give insight into the Architecture of 8051 microcontroller.
- To emphasize the students to design a microcontroller based system

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the architecture and functions of8085 microprocessor and execute programs | Cognitive | Understanding |
| CO2 | ***Explain*** the architecture and functions of 8086 microprocessor and execute programs. | Cognitive | Understanding |
| CO3 | ***Outline the*** 8085 I/O interfacing techniques | Cognitive | Understanding |
| CO4 | ***Outline the applications of 8085 microprocessor*** | Cognitive | Understanding |
| CO5 | ***Illustrate*** the architecture of 8051 microcontroller | Cognitive | Understanding |
| CO6 | ***Illustrate*** 8051 microcontroller based systems | Cognitive | Understanding |

| **UNIT I -THE 8085 MICROPROCESSOR** | **8 Hours** |
|---|---|
| Introduction to 8085 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming | |

| **UNIT II - 8086 MICROPROCESSOR** | **8Hours** |
|---|---|
| Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming. | |

| **UNIT III -8085-I/O INTERFACING** | **8Hours** |
|---|---|
| Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller | |

| **UNIT IV- APPLICATIONS OF MICROPROCESSORS** | **7 Hours** |
|---|---|
| Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller | |

| **UNIT V - MICROCONTROLLER** | **7 Hours** |
|---|---|

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming. Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

| **UNIT VI - INTERFACING MICROCONTROLLER** | **7 Hours** |
|---|---|

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation -

| **HOURS** | **LECTURE** | **TUTORIAL** | **TOTAL** |
|---|---|---|---|
| | **45** | **0** | **45** |

**TEXT BOOKS**


1.Yu-Cheng Liu, Glenn A.Gibson, ―Microcomputer Systems: The 8085 / 8088 Family Architecture, Programming and Design‖, Second Edition, Prentice Hall of India, 2007.

2.Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, ―The 8051 Microcontroller and Embedded Systems: Using Assembly and C‖, Second Edition, Pearson education, 2011.

3.J.L.Antonakos, "An Introduction to the Intel Family of Microprocessors", Pearson, 1999.

4.D. V. Hall, "Micro processors and Interfacing", 2nd Edition, Tata McGrawHill, 2006.

5.Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5thEdition, Prentice Hall,2014.

6.M.A.Mazidi&J.C.Mazidi "Microcontroller and Embedded systems using Assembly & C. (2/e)",Pearson Education, 2007.

7.John H. Davies**,"** MSP430 Microcontroller Basics", Elsevier Ltd., 2008.


**REFERENCE BOOKS**


1.B.B. Brey, "The Intel Microprocessors, (7/e), Eastern Economy Edition" , 2006.

2.K.J. Ayala, "The 8051 Microcontroller ", (3/e), Thomson Delmar Learning, 2004.

3.I. S. MacKenzie and R.C.W.Phan., " The 8051 Microcontroller.(4/e)", Pearson education, 2008.

4.A.K.Ray and K.M.Bhurchandani, "Advanced Microprocessors and Peripherals",2nd Edition, TMH, 2006.

5.K.UmaRao, AndhePallavi, "The 8051 Microcontrollers, Architecture and programming and Applications", Pearson Education, 2009.

6.Liu and G.A.Gibson, "Micro Computer System 8085/8088 Family Architecture. Programming and Design",2nd Edition, PHI, 1986.

7.Ajay.V. Deshmukh "Microcontrollers and Applications", TMGH, 2005.

8.Doughlas V.Hall, - Microprocessors and Interfacing, Programming and Hardware‖,MH,2012

9.A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGraw Hill, 2012


**E REFERENCES**

1.https://onlinecourses.nptel.ac.in/noc18_ec03/preview

2.http://www.avr-tutorials.com/general/microcontrollers-basics

3.https://www.tutorialspoint.com/embedded_systems/es_microcontroller.htm

**Table 1 : Mapping of COs with POs**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **Total** | **18** | **12** | **12** | **9** | **6** | **6** | **6** | **6** | | | | **12** | | |
| **Scaled Value** | **3** | **3** | **3** | **2** | **2** | **2** | **2** | **2** | | | | **3** | | |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC502 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | DIGITAL SIGNAL PROCESSING | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To introduce the mathematical approach to manipulate discrete time signals, which are useful to learn digital telecommunication.
- To bring out the concepts related to DFT and its computation
- To bring out the analysis and design techniques for digital filters
- To impart the concept of finite word length effect in signal processing
- To provide thorough understanding on the fundamentals and various types of digital signal processors

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the Discrete Fourier Transform to signal processing | Cognitive | Understanding |
| CO2 | ***Construct*** FIR filter | Cognitive | Applying |
| CO3 | ***Construct*** IIR filter | Cognitive | Applying |
| CO4 | ***Classify*** Finite word length Effects | Cognitive | Understanding |
| CO5 | ***Explain*** the hardware architecture of processors | Cognitive | Understanding |
| CO6 | ***Explain the applications of DSP*** | Cognitive | Understanding |

**UNIT I -DISCRETE FOURIER TRANSFORM** **8 Hours**

Introduction to DSP and its applications – Efficient computation of DFT, Properties of DFT , FFT algorithms – Radix-2, Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms –Use of FFT algorithms in Linear Filtering and correlation. Convolution –overlap save and overlap add method.

**UNIT II - DIGITAL FIR FILTERS DESIGN** **8 Hours**

Amplitude and phase responses of FIR filters – Linear phase filters – Windowing techniques for design of Linear phase FIR filters – Rectangular, Hamming, Hanning, Blackman, Kaiser windows – frequency sampling techniques, Realization structures for FIR

**UNIT III -DIGITAL IIR FILTERS DESIGN** **8 Hours**

IIR Filters – Magnitude response – Phase response – group delay - Design of Low Pass Butterworth filters (low pass) - Bilinear transformation – prewarping, impulse invariant technique - Realization structures for IIR Filters, direct-cascade and parallel form.

**UNIT IV- FINITE WORD LENGTH EFFECTS** **7 Hours**

Fixed point and floating point number representations-comparison- Truncation and rounding errors- Quantization noise – derivation for quantization noise power - coefficient quantization error- product quantization error-over flow error – Roundoff noise power –- limit cycle oscillations due to product round off and overflow errors – signal scaling- analytical model of sample and hold operations.

| UNIT V - DIGITAL SIGNAL PROCESSORS | 7 Hours |
|---|---|
| Introduction to DSP architecture – Harvard architecture - Dedicated MAC unit - Multiple ALUs, Advanced addressing modes, Pipelining, Overview of instruction set of TMS320C5X and C54X Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization | |
| **UNITI VI - APPLICATIONS OF DSP** | **7 Hours** |
| Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization | |

| HOURS | LECTURE | PRACTICAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**TEXT BOOKS**


1. Alan V. Oppenheim, Ronald Schafer, "Discrete Time signal Processing", Pearson Education,3rd Edition, 2010.
2. John G Proakis, Dimtris G Manolakis,"Digital Signal Processing Principles, Algorithms and Application",4th Edition, PHI, 2007,
3. Louis Scharf ,"Statistical Signal Processing", Pearson Education,1991.
4. B.Venkataramani& M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application" ,TMH, 2002.


**References**


1. Avtarsingh, S.Srinivasan, "DSP Implementation using DSP Microprocessor with Examples from TMS32C54XX", Thomson / Brooks Cole Publishers, 2003
2. S.Salivahanan, A.Vallavaraj, Gnanapriya, "Digital Signal Processing", McGrawHill TMH,2000.
3. JohnyR.Johnson Introduction to Digital Signal Processing", Prentice Hall, 1984.
4. S.K.Mitra, "Digital Signal Processing- A Computer based approach", Tata McGraw Hill, New Delhi, 1998.


**E-REFERENCES**

1. http://nptel.ac.in/courses/117102060/ (Prof: S. C. Dutta Roy, "Digital Signal Processing, Nptel online courses", Department of Electrical Engineering, Indian Institute of Technology, Delhi)
2. http://nptel.ac.in/courses/Webcourse- contents/IIT-KANPUR/Digi_Sign_Pro/ui/About-Faculty.html (Prof. Govind Sharma, "Digital Signal Processing, Nptel online courses", Department of Electrical Engineering, Indian Institute of Technology, Kanpur)

**Table1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **Total** | 18 | 12 | 12 | 12 | 6 | 6 | 6 | **6** | | | | 6 | 6 | 6 |
| **Scaled Value** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | **2** | | | | 2 | 2 | 2 |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC503 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ANTENNASAND WAVE PROPAGATION | 3 | 1 | 0 | 4 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 1 | 0 | 4 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVE**

- To give insight of the radiation phenomena.
- To give a thorough understanding of the radiation characteristics of different types of antennas
- To create awareness about the different types of propagation of radio waves at different frequencies

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Relate*** the parameters of antennas. | Cognitive | Understanding |
| CO2 | ***Explain*** the characteristics of monopole and dipole antenna | Cognitive | Understanding |
| CO3 | ***Compare*** the radiation characteristics of antenna arrays | Cognitive | Understanding |
| CO4 | ***Explain*** the operation of loop, helical and special antennas | Cognitive | Understanding |
| CO5 | ***Outline*** the radiation pattern of Reflector, lens, spiral and Micro strip antenna | Cognitive | Understanding |
| CO6 | ***Illustrate*** the methods of wave propagation and associated parameters. | Cognitive | Understanding |

**UNIT I - ANTENNA FUNDAMENTALS** — **8 + 3 Hours**

Radiation density , Radiated power, Radiation intensity, Antenna beam efficiency, Types of antenna based on radiation pattern, Basic parameters of radiation pattern , Antenna radiation efficiency, Directivity, Beam solid angle, Antenna gain, Radiation resistance, Antenna apertures, Antenna field zones, Antenna temperature, Effective height of antenna, Polarization, Friss transmission formula, Transmission path loss, Reciprocity, Reflection Coefficient, VSWR.

**UNIT II - MONO POLE AND DIPOLE ANTENNA,** — **7 + 3 Hours**

Radiation ,electric field and magnetic field, feeding techniques in dipole antenna, Hertzian dipole antenna, Half wave dipole antenna, Monopole antenna, Folded dipole antenna and Yagi Uda antenna,

**UNIT III - ANTENNA ARRAYS** — **8 + 3 Hours**

Basics, Two isotropic source array, Two point array separated by half wavelength, radiation pattern of 2 point antenna array, Pattern multiplication of 4 point sources and 8 point sources, Binomial array, Schelkunoff polynomial array, DolphTchebyScheff antenna array, TchebyScheff antenna array, Phased array, Frequency scanning array and Hansen Wood yard end fire array

| UNIT IV -LOOP ANTENNA,HELICAL ANTENNA AND OTHER SPECIAL ANTENNAS | 8 +2 Hours |
|---|---|

Loop antenna, Helical antenna, Turnstile antenna, Long wire resonant antenna, Travelling wave antenna, V antenna, Rhombic antenna, Horn antenna, PIFA antenna, Log periodic, Broadband antenna and Frequency independent antenna, Smart antenna,

| UNIT V -REFLECTOR ANTENNA , LENS ANTENNA, MICROSTRIP ANTENNA AND SPIRAL ANTENNA | 7 + 2 Hours |
|---|---|

Reflector antenna: Basics, Feeding methods, Aperture efficiency and design. Lens antenna, Comparison of reflector and lens antenna, Babinet's principle, Slot antenna, Microstrip antenna: Basics, feeding methods, Fringing effect and design of microstrip antenna, Spiral antenna

| UNIT VI -WAVE PROPAGATION | 7 + 2 Hours |
|---|---|

Structure of atmosphere , Radio wave propagation , Multiple hop propagation, Ground wave propagation , Sky wave propagation , Troposphere scatter propagation, Maximum usable frequency, Critical frequency Virtual height, Skip distance Duct propagation

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 15 | 60 |

**TEXT BOOK**


1. Balanis, "Antenna Theory ", 2nd Edition, John Wiley & Sons,2003.
2. Edward C.Jordan and Keith G.Balmain, "Electromagnetic Waves and RadiatingSystems" Prentice Hall of India, 2006.
3. John D Kraus," Antennas for all Applications", 3rd Edition, Mc Graw Hill,2005.


**REFERENCES**


1. John D.Kraus and RonalatoryMarhefka, "Antennas For All Applications", 3rd Edition, Tata McGrawHill,2003.
2. R.E.Collins, "Antennas and Radio Propagation ", McGraw-Hill,1987.
3. Constantine. A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition,2006.
4. Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition, NewAge International Publishers, 2006.
5. S. Drabowitch, "Modern Antennas", 2nd Edition, Springer Publications,2007.
6. Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition,2006.
7. H.Sizun "Radio Wave Propagation for Telecommunication Applications", FirstIndian Reprint, Springer Publications, 2007.


**E- REFERENCES**

1. http://nptel.ac.in/courses/117101056/48 (NPTEL: Prof R.K.Shevgaonkar, Transmission Lines and E.M. Waves)

**Table1:Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 2 |
| **CO 2** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 2 |
| **CO 3** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 2 |
| **CO 4** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 2 |
| **CO 5** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 2 |
| **CO6** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | 2 |
| **Total** | 18 | 12 | 6 | 6 | 6 | 6 | 6 | 6 | | | | 6 | | 12 |
| **Scaled Value** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | | 3 |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSECODE | | | XEC504 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | COMMUNICATION THEORY | 3 | 1 | 0 | 4 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 4 | 0 | 0 | | 3 | 1 | 0 | 4 |

**LEARNING OBJECTIVES**

- To introduce the concepts of various analog modulations and their spectral characteristics
- To impart the knowledge of effect of Noise in various communications
- To enhance the fundamental knowledge on pulse modulation system
- To emphasis the students with information theory

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** amplitude modulation and demodulation techniques. | Cognitive | Understanding |
| CO2 | ***Explain*** frequency modulation and demodulation techniques | Cognitive | Understanding |
| CO3 | ***Outline*** the noise effects in AM and FM systems | Cognitive | Understanding |
| CO4 | ***classify*** the different types of pulse modulation techniques | Cognitive | Understanding |
| CO5 | ***Outline*** Pulse Coded modulation | Cognitive | Understanding |
| CO6 | ***Illustrate*** the basic concepts of Information theory and coding | Cognitive | Understanding |

| **UNIT - I : AMPLITUDE MODULATION** | **8 + 3 Hours** |
|---|---|
| Basic blocks of Communication System. Amplitude (Linear) Modulation – AM, DSB-SC, SSB-SC and VSB-SC. Methods of generation and detection. FDM. Super Heterodyne Receivers. | |
| **UNIT - II : FREQUENCY MODULATION** | **8 + 3 Hours** |
| Angle (Non-Linear) Modulation - Frequency and Phase modulation. Transmission Bandwidth of FM signals, Methods of generation and detection. FM Stereo Multiplexing. | |
| **UNIT - III : NOISE EFFECTS IN AM AND FM RECEIVERS** | **7 +2 Hours** |
| Noise - Internal and External Noise, Noise Calculation, Noise Figure. Noise in linear and nonlinear AM receivers, Threshold effect. Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction, Pre-emphasis and De-emphasis. | |
| **UNIT - IV : PULSE MODULATION TECHNIQUE** | **7 + 2 Hours** |
| Sampling Process, PAM, PWM and PPM generation and detection. | |
| **UNIT - V : PULSE CODED MODULATION** | **7 + 2 Hours** |
| PCM, Adaptive Differential Pulse-Code Modulation-Delta Modulation, Line Codes, Time-Division Multiplexing. | |
| **UNIT - VI : INFORMATION THEORY AND CODING** | **8 + 3 Hours** |
| Information -Entropy-Source-Coding Theorem-Lossless Data Compression Algorithms-Discrete Memory less Channels-Mutual Information-Channel Capacity-Special Channels-Channel-Coding Theorem | |

| HOURS | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 15 | 60 |

**TEXT BOOKS**

1. S.Haykins, "Communication Systems" , Wiley India Pvt. Ltd, Noida – 201301, India 4 Edition, 2009.
2. B.P. Lathi and Zhi Ding, "Modern Digital and Analog Communication ", The Oxford Series in Electrical and Computer Engineering, 5th Edition, Oxford University Press India, Ground Floor, 2/11, Ansari Road, Daryaganj, New Delhi 110002, India, 2017

**REFERENCE BOOK**

1. Proakis and Salenhi, "Communication Systems Engineering ", Pearson Education India, Noida, 201301, India, 2nd edition, 2015

**E REFERENCES AND EQUIVALENT COURSE**

1. PROF. GOUTAM DAS, IIT Kharagpur, Analog Communication, NPTEL, https://nptel.ac.in/courses/117/105/117105143/

**Table1: Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **Total** | 18 | 12 | 12 | 6 | 6 | 6 | 6 | **6** | | | | 6 | 6 | 6 |
| **Scaled Value** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | 2 | 2 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSECODE | | | XEC507 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | MICROPROCESSORS AND MICROCONTROLLERSLABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 0.5 | 0.25 | 0.25 | | 0 | 0 | 2 | 2 |

**LEARNING OBJECTIVES**

- To familiarize with 8085 arithmetic and logical codes.
- To make the students understand the interfacing of peripheral devices with 8085 kit.
- To make the students understand the interfacing of peripheral devices with 8086 kit.
- To make the students to understand the arithmetic, logical and bit manipulation with 8051.
- To familiarize on peripheral interfacing with 8051.

| | COURSE OUTCOMES | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Develop*** the basic programs using 8085 Microprocessor | Cognitive Psychomotor Affective | Applying |
| CO2 | ***Develop*** the basic programs using 8086 Microprocessor | Cognitive Psychomotor Affective | Applying |
| CO3 | ***Develop*** program for sorting and searching operation using 8085 | Cognitive Psychomotor Affective | Applying |
| CO4 | ***Develop*** the basic programs to interface 8085 Microprocessor with other devices | Cognitive Psychomotor Affective | Applying |
| CO5 | ***Develop*** the basic programs to interface 8051 Microcontroller with other devices | Cognitive Psychomotor Affective | Applying |
| CO6 | ***Develop*** program for the timer applications using 8051 Microcontroller. | Cognitive Psychomotor Affective | Applying |

**LIST OF EXPERIMENTS**

1. Programs for 8 bit Arithmetic operations Using 8085.
2. Programs for 16 bit Arithmetic operations Using 8085.
3. Arithmetic Program using 8086.
4. Programs for Sorting Using 8085
5. Programs for Searching Using 8085
6. Interfacing and Programming of stepper motor 8085.
7. Interfacing and programming 8279,8259 and 8253 with 8085.
8. Interfacing ADC and DAC using 8085

9. Programming using Arithmetic.Logical and bit manipulation instruction of 8051 microcontroller.
10. Interfacing and Programming of DC motor using 8051
11. Serial Communication between two microcontroller kit using 8051.
12. Interfacing ADC and DAC with 8051.

| | PRACTICAL | TOTAL |
|---|---|---|
| **HOURS** | **30** | **30** |

**Table 1 : Mapping of COs with Pos**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **Total** | **18** | **12** | **12** | **12** | **12** | **12** | **12** | **6** | **6** | | **6** | **6** | **6** | **6** |
| **Scaled Value** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | 2 | 2 | 2 | 2 |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | XEC508 | L | T | P | C |
|---|---|---|---|---|---|
| COURSE NAME | DIGITAL SIGNAL PROCESSING LABORATORY | 0 | 0 | 1 | 1 |

| PREREQUISITES | | | | L | T | P | H |
|---|---|---|---|---|---|---|---|
| C | P | A | | 0 | 0 | 2 | 2 |
| 0.5 | 0.25 | 0.25 | | | | | |

**LEARNING OBJECTIVES**

- To compute the output response of the system for FFT spectrum.
- To make the students understand the behavior and response of the filter using different methods.
- To educate the students with the generation of the signals and arithmetic operation using DSP Processor.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Experiment*** of linear and circular convolution | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO2 | ***Experiment*** DFT and IDFT of a signal | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO3 | ***Experiment*** FFT and IFFT of a signal | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO4 | ***Experiment*** IIR filters | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO5 | ***Experiment*** FIR filters | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |
| CO6 | ***Experiment*** generation of sine waves | Cognitive<br>Psychomotor<br>Affective | Applying<br>Mechanism<br>Responding |

| USING MATLAB®/SCILAB®&TMS320C5X | |
|---|---|
| **S.No** | **List of Experiments** |
| 1. | Generation of signals(Analog & Digital) (Using SciLab) |
| 2. | Convolution of two sequences. (Using SciLab) |
| 3. | Calculation of DFT and IDFT of a signal. (Using SciLab) |
| 4. | Calculation of FFT and IFFT of a signal. (Using SciLab) |
| 5. | Design of IIR filters. (Using SciLab) |
| 6. | Design of FIR filters. (Using SciLab) |
| 7. | Sine Wave generation (Using TMS320C5X) |

| | |
|---|---|
| 8. | Convolution of two sequences (Using TMS320C5X) |
| 9. | Calculation of DFT( Using TMS320C5X) |
| 10. | Calculation of FFT( Using TMS320C5X) |
| 11. | Implementation of IIR filter (Using TMS320C5X) |
| 12. | Implementation of FIR filter (UsingTMS320C5X) |

| HOURS | PRACTICAL | TOTAL |
|---|---|---|
| | 30 | 30 |

**Table 1 : Mapping of COs with Pos**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **Total** | **18** | **12** | **12** | **12** | **12** | **12** | **12** | **6** | **6** | | **6** | **6** | **6** | **6** |
| **Scaled Value** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | 2 | 2 | 2 | 2 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC601 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | DIGITAL COMMUNICATION | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To impart the knowledge on the principles of sampling & quantization
- To instruct the various waveform coding schemes
- To familiarize the various baseband transmission schemes
- To enhance the fundamental knowledge on the various band pass signaling schemes
- To equip the students with the fundamentals of channel coding

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | Outline PCM, Delta modulation and different types of line coding | Cognitive | Understanding |
| CO2 | ***Outline*** various methods to mitigate the effects of noise and ISI in baseband pulse transmission. | Cognitive | Understanding |
| CO3 | ***Compare*** various digital modulation techniques | Cognitive | Understanding |
| CO4 | ***Illustrate*** various error control techniques for reducing bit errors in digital communication. | Cognitive | Understanding |
| CO5 | ***Explain*** Spread Spectrum Communication. | Cognitive | Understanding |
| CO6 | ***Explain*** Multiple Access Schemes | Cognitive | Understanding |

**UNIT I WAVEFORM CODING & REPRESENTATION** 8 Hours

PCM and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ - Manchester

**UNIT II - BASEBAND TRANSMISSION & RECEPTION** **8 Hours**

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding - Eye pattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization

**UNIT III-DIGITAL MODULATION** **8 Hours**

Introduction – Geometric Representation of Signals -Conversion of the Continuous AWGN Channel into a Vector Channel - Optimum Receivers Using Coherent Detection- Probability of Error- Pass band Transmission model- Generation, Detection, Signal space diagram, bit error probability and Power spectra of ASK,BPSK, QPSK,QAM, FSK and MSK schemes – Differential phase shift keying – Comparison of Digital modulation systems using a single carrier – Carrier and symbol synchronization.

| UNIT IV-ERROR CONTROL CODING | 7 Hours |
|---|---|
| Discrete memory less channels – Linear block codes - Cyclic codes - Convolutional codes –Maximum likelihood decoding of convolutional codes-Viterbi Algorithm, Trellis codedModulation, Turbo codes, Introduction to LDPC codes, Polar Codes: Channel combining, Channel splitting, Polar coding | |
| **UNIT V-SPREAD SPECTRUM COMMUNICATION** | **7 Hours** |
| Pseudo- noise sequences –a notion of spread spectrum – Direct sequence spread spectrum with coherent binary phase shift keying – RAKE Receiver, Signal space Dimensionality and processing gain –Probability of error – Frequency –hop spread spectrum –Pseudorandom Sequence Generation ,Maximum Length Sequences , Gold Sequences , Barker Sequences , Time-Hopping Spread Spectrum System with Pseudorandom Pulse Position Selection.Case study on SS for 3G, Wireless LAN and Satellite systems. | |
| **UNIT VI -MULTIPLE ACCESS TECHNIQUES** | **7 Hours** |
| Introduction- Frequency Division Multiple Access-Time Division Multiple Access- Code Division Multiple Access-Single-Carrier CDMA-Multi-Carrier CDMA-Orthogonal Frequency Division Multiple Access-Single-Carrier FDMA-Space Division Multiple Access- Case Study: Multiple Access Scheme in GSM, 3GPP LTE Cellular System | |

| | LECTURE | TOTAL |
|---|---|---|
| HOURS | 45 | 45 |

**TEXT BOOK**

1. Simon Haykins, “Communication Systems”, 4thEdition, John Wiley & Sons, Reprint 2008.
2. Wesołowski, “Introduction to Digital Communication Systems”, John Wiley & Sons, 2009.

**REFERENCE**

1. John Proakis, Massoud Salehi, "Digital Communications", 5th Editions, McGraw Hill Education India, 2014.
2. John R.Barry, Edward A. Lee, David G.Messerschmitt, “Digital Communication”, 3rd Edition, Kluwer Academic Publishers, 2004.
3. E. Arıkan, “Channel polarization: A method for constructing capacity-achieving codes for symmetric binary-input memoryless channels,” IEEE Trans. Inform. Theory, vol. 55, pp. 3051–3073, July 2009.

**E- REFERENCES**

1. http://freevideolectures.com/Course/2311/Digital-Communication(NPTEL,Digital Communication, Prof. Bikash Kumar Dey,IIT Bombay)

2. http://www.nptel.ac.in/syllabus/117105077/ (NPTEL, Digital Communication, Prof. SaswatChakrabarti, Prof. R.V. Rajakumar,IIT Kharagpur)

**Table1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **Total** | 18 | 12 | 12 | 6 | 6 | 6 | 6 | **6** | | | | 6 | 6 | 6 |
| **Scaled Value** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | 2 | 2 |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC602 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | MICROWAVE ENGINEERING AND FIBER OPTIC COMMUNICATION | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES | | Domain | Level |
|---|---|---|---|
| CO1 | ***Explain*** the operation of passive microwave components. | Cognitive | Understanding |
| CO2 | ***Explain*** the operation of microwave tubes and semiconductor devices | Cognitive | Understanding |
| CO3 | ***Outline*** the methods for measurement of microwave parameters | Cognitive | Understanding |
| CO4 | ***Outline*** the transmission characteristics of optical fibers | Cognitive | Understanding |
| CO5 | **Illustrate** the working principle of optical sources, detectors and components | Cognitive | Understanding |
| CO6 | **Illustrate** the working principle of fiber optic communication system | Cognitive | Understanding |

| **UNIT I - MICROWAVE PASSIVE COMPONENTS** | **8 Hours** |
|---|---|
| Microwave frequency range, - Advantages, Dis-advantages and applications of microwaves. Scattering matrix -Properties of S matrix- Microwave junctions - Tee junctions -Magic Tee - Rat race couplers- Corners - bends and twists - Directional couplers - Ferrites - Gyrator- Isolator-Circulator - Attenuator - Phase changer | |
| **UNIT II - MICROWAVE TUBES AND SEMICONDUCTOR DEVICES** | **8 Hours** |
| Microwave tubes : Construction and operation of Multicavity Klystron, Reflex Klystron, Traveling Wave Tube, Magnetron. Tunnel diode, Varactor diode, Step recovery diodes , Gunn diode- IMPATT and TRAPATT devices and parametric amplifier. | |
| **UNIT III - MICROWAVE MEASUREMENTS** | **7 Hours** |
| Measurement of power, wavelength, impedance, VSWR, attenuation, Q and Phase shift. | |
| **UNIT IV - TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS** | **7 Hours** |
| Ray theory of transmission- Total internal reflection-Acceptance angle – Numerical aperture – Skew rays – phase and group velocity – Single Mode and Multimode fibers- Step index Fiber and Graded Index FiberAttenuation – Material absorption losses in silica glass fibers – Linear and Non linear Scattering losses - Fiber Bend losses – Intra and inter Modal Dispersion | |
| **UNIT V -OPTICAL SOURCES , DETECTORS AND COMPONENTS** | **8 Hours** |
| Light Emitting Diodes (LED) , Light amplification and Stimulated emission of radiation (LASER) PIN Photo diode, Avalanche photo diodes, Optical connectors, Splices and Couplers. | |

| UNIT VI- FIBER OPTIC COMMUNICATION | | | | 7 Hours |
|---|---|---|---|---|
| Block diagram of Optical Communication System , Optical Transmitter, Receiver | | | | |
| **HOURS** | **LECTURE** | **TUTORIAL** | **PRACTICAL** | **TOTAL** |
| | **45** | **0** | **0** | **45** |

**TEXT BOOKS**

1. Samuel Y. Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006.
2. John M. Senior, "Optical Fiber Communication", 2nd Edition, Pearson Education, 2007.
3. Gerd Keiser, "Optical Fiber Communication", 3rd Edition, McGraw Hill, 2000.

**REFERENCES**

1. Robert E.Collin, "Foundations of Microwave Engineering",Mc Graw Hill, 1992.
2. Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill, 2004.
3. D.M.Pozar, "Microwave Engineering", John Wiley &Sons, 2006.
4. John Gowar, "Optical Communication Systems", Prentice Hall of India, 2001.
5. Rajiv Ramaswami, Kumar Sivarajan, Galen Sasaki, "Optical Networks: A Practical Perspective", 3rd Edition, Morgan Kaufmann, 2010.
6. Govind P. Agrawal, "Fiber Optic Communication Systems", 3rd Edition, John Wiley &Sons, 2004.

**E-REFERENCES**

1. http://www.nptel.ac.in/downloads/117101054/
2. http://www.microwaves101.com
3. http://www.lightwaveonline.com

**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| **Total** | 18 | 12 | 12 | 6 | 6 | 6 | 6 | **6** | | | | 6 | 6 | 6 |
| **Scaled Value** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | 2 | 2 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| Course Code | XGS605 | L | T | P | SS | C |
|---|---|---|---|---|---|---|
| COURSE NAME | PROFESSIONAL SKILLS | 1 | 0 | 2 | 0 | 3 |
| Pre-requisites | | L | T | P | SS | H |
| C: P: A | 2.6:0.4:0 | 1 | 0 | 4 | 0 | 5 |

| COURSE OUTCOMES: | | Domain | Level |
|---|---|---|---|
| CO1 | ***Ability*** to understand communications | Cognitive | Remembering |
| CO2 | ***Apply*** the known skills for career | Cognitive | Applying |
| CO3 | ***Identify*** inner strength | Cognitive | Remembering |
| CO4 | ***Construct*** the attitude as a professional | Cognitive | Creating |
| CO5 | ***Practicing*** Etiquettes | Psychomotor | Guided Response |

| **UNIT I – Communication** | **9** |
|---|---|
| 1.1 – Brainstorming<br>1.2 – LSRW | |
| **UNIT II – Career Skills** | **9** |
| 2.1 – Resume & CV preparing Skills<br>2.2 – Interview Skills<br>2.3 – Exploring Career Opportunities | |
| **UNIT III – Team Skills** | **9** |
| 3.1 – Listening as a Team Skill<br>3.2 – Team Building at work place | |
| **UNIT IV – Professional Skills** | **9** |
| 4.1 – Attitude and Goal Setting<br>4.2 – Verbal and Non Verbal Communications | |
| **UNIT V – Professional Etiquettes** | 9 |
| Social Etiquettes<br>Cultural Ethics at work place | |

**Suggested Readings:**

(i) Er. A. K. Jain, Dr. Pravin S. R. Bhatia, Dr. A. M. Sheikh Professional Communication Skills S. Chand Publications, 2015

(ii) Alan Pannett. *Key Skills for Professionals: How to Succeed in Professional Services*, Kogan Page; 1st edition, 2013

**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | | | | | | 2 | | 1 | | | | | |
| **CO 2** | 2 | | | | | | 2 | | 1 | | | | | |
| **CO 3** | 1 | | | | | | 1 | | 1 | | | | | |
| **CO 4** | 2 | | | | | | 1 | | 1 | | | | | |
| **CO 5** | | | | | | | | | | | | | | |
| **CO6** | | | | | | | | | | | | | | |
| **Total** | 7 | | | | | | 6 | | 4 | | | | | |
| **Scaled Value** | 2 | | | | | | 2 | | 1 | | | | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | XEC607 | L | T | P | C |
|---|---|---|---|---|---|
| COURSE NAME | ANALOG AND DIGITAL COMMUNICATION LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITES | | L | T | P | H |
| | | 0 | 0 | 2 | 2 |

| C | P | A |
|---|---|---|
| 0.5 | 0.25 | 0.25 |

**LEARNING OBJECTIVES**

- To introduce the generation of analog modulation and demodulation.
- To convey time division multiplexing and demultiplexing.
- To familiarize the generation and demodulation of pulse analog modulation techniques.
- To acquire the knowledge on the sampling and reconstruction of analog signal.
- To enrich the knowledge on pulse digital modulation techniques.
- To explore the concept of line coding and decoding.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Construct*** the Amplitude Modulation and Demodulation circuits and ***show*** their input and output waveform. | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO2 | ***Construct*** the Frequency Modulation, Demodulation circuit and ***show*** their input and output waveform. | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO3 | ***Build*** the circuit of AM and FM receivers and ***show*** their performance characteristics | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO4 | ***Build*** the circuit of Time Division Multiplexing and demultiplexing and ***show*** their output characteristics | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO5 | ***Build*** Pulse analog modulation and demodulation circuit and ***show*** their output characteristics | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO6 | ***Build*** Pulse digital modulation and demodulation circuit and ***show*** their output characteristics. | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |

| S.No | List of Experiments |
|---|---|
| 1. | Amplitude modulation generation and demodulation |
| 2. | AM receiver Analysis: Sensitivity and Selectivity. |
| 3. | Frequency modulation generation and demodulation. |
| 4. | FM receiver Analysis: Sensitivity and Selectivity. |
| 3 | Sampling and Reconstruction. |
| 4 | Pulse Amplitude Modulation and Demodulation. |
| 5 | Pulse Width Modulation and Demodulation. |
| 6 | Pulse Position Modulation and Demodulation. |
| 7 | Line coding and decoding. |
| 8 | PCM modulation and demodulation. |

| | |
|---|---|
| 9 | Delta modulation and Demodulation. |
| 10 | Time Division Multiplexing and Demultiplexing. |
| 11 | Amplitude Shift Keying modulation and demodulation. |
| 12 | Frequency Shift Keying modulation and demodulation. |

| HOURS | PRACTICAL | TOTAL |
|---|---|---|
| | 30 | 30 |

**TEXT BOOKS**

1. JOHN W. LEIS, "Communication Systems Principles Using MATLAB" 1st Edition, Wiley, 2018.
2. Kwonhue Choi and Huaping Liu, "Problem-Based Learning in Communication Systems Using MATLAB and Simulink (IEEE Series on Digital & Mobile Communication)" 1st Edition, Wiley-IEEE Press, 2016

**REFERENCES**


1. Amplitude Modulation Transmitter and Receiver User Manual, ACLT 001, United Electro technologies, Bangalore
2. Frequency Modulation Transmitter and Receiver User Manual, United Electro technologies, Bangalore
3. Pulse Modulation Trainer PAM/PWM/PPM DCT 007 User Manual, United Electro technologies, Bangalore
4. Channel Encode/Decode DCL -00 &DCL User Manual, Khodayss Systems Limited, Bangalore
5. Sampling and Reconstruction Unit DCLT001 User Manual, United Electro technologies, Bangalore
6. Pulse Code Modulation & Demodulation (Model No: VCT -07) User Manual, Vi Microsystems PVT Ltd, Chennai
7. Delta PCM Trainer (Model No: VCT -12) User Manual, Version 2.0, Vi Microsystems PVT Ltd, Chennai
8. Differential PCM Trainer (VCT – 34) User Manual Version 1.0, Vi Microsystems PVT Ltd, Chennai
9. TDM, PAM Modulation and Demodulation User Manual Version 1.0, Vi Microsystems PVT Ltd, Chennai


**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 2** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO6** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **Total** | **18** | **18** | **18** | **18** | **12** | **12** | **12** | **6** | **6** | | **6** | **12** | **6** | **6** |
| **Scaled Value** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | | 2 | 3 | 2 | 2 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | XEC608 | L | T | P | C |
|---|---|---|---|---|---|
| COURSE NAME | MICROWAVE ENGINEERING AND FIBER OPTIC COMMUNICATION LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITES | Communication Theory | L | T | P | H |
| C: P: A | 1:0:0 | 0 | 0 | 2 | 2 |

**LEARNING OBJECTIVES**

- To familiarize microwave components.
- To understand the operation and working microwave tube
- To enrich the knowledge on the measurement of various parameters of microwave systems.
- To explore the characteristics of optical sources and optical detectors
- To acquire the characteristics of optical communication link

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Construct*** the microwave circuits and show the characteristics of E,H planes Tees | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO2 | ***Construct*** the microwave circuits and show the characteristics of Reflex klystron and Gunn Diode | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO3 | ***Construct*** the microwave circuits and measure the various parameters | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO4 | ***Construct*** the optical communication circuits and measure the various parameters | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO5 | ***Construct*** the optical communication circuits and show the characteristics | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO6 | ***Build*** optical communication link and show the performance | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |

| S.No. | List of Experiments | | |
|---|---|---|---|
| | **Microwave Engineering Experiments** | | |
| 1 | Study of E-Plane T, H-Plane T and Magic T, Isolator, Directional Coupler and Circulator | | |
| 2 | Characteristics of Reflex Klystron | | |
| 3 | Characteristics of Gunn Diode | | |
| 4 | VSWR, Frequency and Wave Length Measurement | | |
| 5 | Attenuation and Power measurement | | |
| 6 | Radiation Pattern and Gain of Antennas. | | |
| | **Optical Communication Experiments** | | |
| 7 | Numerical Aperture Determination for Fiber | | |
| 8 | Measurement of Propagation Loss and Bending Loss in the Fiber | | |
| 9 | VI characteristics of Fibre Optic LED. | | |
| 10 | VI characteristics of Photo Detector. | | |
| 11 | Analog Fiber Optic Communication Link | | |
| 12 | Fibre Optic Analog and Digital Links | | |
| | | **PRACTICAL HOURS** | **TOTAL HOURS** |
| | | **30** | **30** |

**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 2** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO 5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **CO6** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | 1 | 1 |
| **Total** | **18** | **18** | **18** | **18** | **12** | **12** | **12** | **6** | **6** | | **6** | **12** | **6** | **6** |
| **Scaled Value** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | | 2 | 3 | 2 | 2 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC701 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | VLSI DESIGN AND EMBEDDED SYSTEMS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**LEARNING OBJECTIVES**

- To enrich students with the knowledge of IC fabrication techniques
- To provide students with a solid foundation on combinational and sequential circuits using Verilog .
- To expose the students on embedded system design and development
- To provide students with the software and hardware concept of processor in real time environment.
- To develop an understanding on the basic concepts of the peripherals in embedded systems.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** the characteristics of MOS transistor devices | Cognitive | Understanding |
| CO2 | ***Outline*** the features of CMOS Technology | Cognitive | Understanding |
| CO3 | ***Summarize*** the applications of Verilog HDL and VHDL | Cognitive | Understanding |
| CO4 | ***Explain*** the Embedded Systems architecture, memory and interfacing technique | Cognitive | Understanding |
| CO5 | ***Illustrate*** the Inter processes communication and its operating systems. | Cognitive | Understanding |
| CO6 | **Compare** the I/O devices and the network devices. | Cognitive | Understanding |

| **UNIT I - INTRODUCTION MOS TRANSISTOR** | **7 Hours** |
|---|---|

Review of MOS transistor models. CMOS logic families including static, dynamic and dual rail logic, i.e., Parallel & Series Equivalent circuits; Static CMOS Circuit Design, High Speed Dynamic CMOS logic families; Precharge-Evaluate logic; Dynamic CMOS logic circuits, cascading, charge sharing and clock distribution.

| **UNIT II -CMOS TECHNOLOGY** | **7 Hours** |
|---|---|

An overview of Silicon semiconductor technology, Basic CMOS technology: well, P well, Twin tub and SOI Process. Interconnects, circuit elements: Resistors, capacitors, Electrically alterable ROMs, bipolar transistors, Latch up and prevention. Layout design rules, physical design: basic concepts, physical design of logic gates: Inverter, NAND, NOR, Design Hierarchies.

| **UNIT III - VERILOG HDL and VHDL** | **9 Hours** |
|---|---|

Basic Concepts: VLSI Design flow, identifiers, gate primitives, value set, ports, gate delays, structural gate level and switch level modeling, Design hierarchies, Behavioral and RTL modeling: Operators, timing controls, Procedural assignments conditional statements, Data flow modeling and RTL. Structural gate level description of decoder, equality detector, comparator, priority encoder, D-latch, D-ff, half adder, Full adder, Ripple Carry adder,Programming of PALs,ASIC design flow. Design methodology: Introduction to hardware description languages (VHDL), logic, circit, and layout verification. Design examples.

| **UNIT IV - INTRODUCTION TO EMBEDDED SYSTEMS AND DESIGN ANALYSIS** | **8Hours** |
|---|---|

Complex systems and microprocessors – Embedded system design process – Formalism for system design-ARM processor – Architecture, Instruction sets and programming. CPU: Programming input and output – Coprocessor – Memory system mechanism– Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.

**UNIT V - PROCESSES,OPERATING SYSTEMS AND EMBEDDED SOFTWARE** | **7Hours**

Multiple tasks and processes – Context switching – Scheduling policies – Interprocess communication mechanisms – Performance issues-Programming embedded systems in assembly and C – Meeting real time constraints –Multi-state systems and function sequences. Embedded software development tools –Emulators and debuggers.

**UNIT VI - DEVICES AND BUSES FOR DEVICES NETWORK** | **7 Hours**

I/O devices – device I/O types and examples – synchronous – Iso-synchronous and asynchronous communications from serial devices – examples of internal serial –communication devices – UART and HDLC – parallel port devices – sophisticated interfacing features in devices/ports – timer and counting devices – '12C', 'USB', 'CAN' and advanced I/O serial high speed buses – ISA, PCI, PCIX, CPCI and advanced buses.

| | LECTURE | TOTAL |
|---|---|---|
| | 45 | 45 |

**TEXT BOOK**


1. Frank Vahid and Tony Givargis, "Embedded System Design", 3rd Edition, Wiley India, 2002.
2. Arnold S. Berger "Embedded Systems Design", 1st Edition, Taylor & Francis, 2002.
3. Rajkamal "Embedded Systems", 2ndEdition, Tata McGraw Hill, 2008.
4. A. Pucknell and Kamran Eshraghian, "Basic VLSI Design", 3rdEdition,PHI,1995.
5. K. Lal Kishore, V.S.V. Prabhakar, "VLSI Design", I.K. International Pvt.Ltd, 2010.
6. Neil H.E Weste, David Money Harris, "CMOS VLSI Design",3rd Edition, Pearson Education, 2005.
7. Neil weste and Kamran Eshraghian "Principles of CMOS VLSI Design – A Systems Perspective", 2nd Edition, Pearson Education, Reprint 2010.
8. Principles of CMOS VLSI Design, Addison Wesley N. Weste and K. Eshranghia Addison Wesley. 1985
9. The Design and Analysis of VLSI Circuits, L. Glaser and D. Dobberpuhl ,Addison Wesley,1985
10. Introduction to VLSI Systems ,C. Mead and L. Conway ,Addison Wesley1979
11. Digital Integrated Circuits: A Design Perspective, J. Rabaey, Prentice Hall India, 1997
    5.VHDL ,D. Perry, McGraw Hill International 1995 2nd Ed.,


**REFERENCES**


1. David Kleidermacher, Mike Kleidermacher, "Embedded Systems Security: Practical Methods for Safe and Secure Software and Systems Development", PHI, 2012.
2. Chattopadhyan, "Embedded System Design", 3rdEdition, PHI,2013.
3. M.J.S.Smith: "Application Specific integrated circuits", Pearson Education, 1997.
4. Wayne Wolf, "Modern VLSI Design", Pearson Education, 2003.
5. Bob Zeidmin "Introduction to verilog", Prentice Hall, 1999.
6. J .Bhaskar, "Verilog HDL Primer", Prentice Hall, 1999.
7. E. Fabricious, "Introduction to VLSI design", McGrawHill, 1990.
8. C. Roth, "Digital Systems Design Using VHDL", Thomson Learning, 2000.


**E-REFERENCES**

1. http://web.cs.mun.ca/~paul/transistors/node3.html
2. http://www.csee.umbc.edu/~cpatel2/links/315/lectures/chap3_lect09_processing2.pdf
3. http://www.aicdesign.org/scnotes/2002notes/Chapter02-2UP(8_13_02).pdf

4. www.verilog.com
5. http://www.ece.umd.edu/class/enee359a/verilog_tutorial.pdf
6. https://www.vidyarthiplus.com/vp/attachment.php?aid=24159
7. https://www.vidyarthiplus.com/vp/attachment.php?aid=20222
8. http://ic.sjtu.edu.cn/ic/dic/wp-content/uploads/sites/10/2013/04/CMOS-VLSI-design.pdf
9.https://swayam.gov.in/course/3573-embedded-systems-design

**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **Total** | **18** | **16** | **12** | **9** | **6** | **6** | **6** | **6** | | | | **6** | | |
| **Scaled Value** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | | | | 2 | | |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC702 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | MODERN CONTROL SYSTEMS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To Introduce students about the concept of transfer function of digital system
- To provide knowledge of the stability of control systems
- To impart clear idea about optimal and fuzzy logic controllers

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | Explain the various process in discretization of systems and Summarize the importance of transfer function for digital systems | Cognitive | Understanding |
| CO2 | Explain State Space Analysis | Cognitive | Understanding |
| CO3 | Outline the Stability Analysis Techniques for digital control systems | Cognitive | Understanding |
| CO4 | Illustrate various digital controller design methods | Cognitive | Understanding |
| CO5 | Illustrate the optimal control systems | Cognitive | Understanding |
| CO6 | Outline fuzzy logic and usage of fuzzy logic in digital control system | Cognitive | Understanding |

**UNIT-I: Introduction to digital control** **8 Hours**

Discrete time system representation-Mathematical modeling of sampling process-Data reconstruction-sample and hold devices – D/A and A/D conversion – sampling theorem – Realizable reconstruction methods (ZOH and FOH). Transfer function of ZOH and FOH.-Revisiting Z-transform -Mapping of s-plane to z-plane-Pulse transfer function-Pulse transfer function of closed loop system-Sampled signal flow graph

**UNIT-II: State Space Analysis** **8 Hours**

State space modeling of digital systems with sample and hold – state transition equation of digital time in variant systems – solution of time in variant discrete state equations by the Z-Transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan canonical form. Computation of state transition matrix-Transformation to phase to variable canonical form-The state diagram – decomposition of

| | |
|---|---|
| digital system – Response of sample data system between sampling instants using state approach. | |
| **UNIT- III:Stability Analysis Techniques.** | **8 Hours** |
| Stability: Definition of stability – stability tests – The second method of Liapunov Bilinear transformation.- Discrete-time stability via Routh-Hurwitz test.-Jury's stability test.-Root-locus and Nyquist tests- Bode methods. | |
| **UNIT-IV: Digital Controller Design** | **7 Hours** |
| Direct digital design; steady-state accuracy-Direct digital design; other requirements- Nyquist stability criteria-Bode plot-- Phase-lag compensation- Phase-lead compensation-Lead/lag tradeoffs, other compensators- Root-locus design- Numeric design of PID controllers- Direct design method of Ragazzini-Design with deadbeat response-Pole placement through state feedback | |
| **UNIT-V: Optimal Control** | **7 Hours** |
| Basics of optimal control-Performance indices-Linear Quadratic Regulator (LQR) design. Numerical Methods to Solve Optimal Control Problems | |
| **UNIT-VI: Fuzzy Logic Control for Discrete-Time Systems** | **7 Hours** |
| Introduction to fuzzy logic- Adaptive FLC of Discrete-Time Systems-Robustness Issue in Discrete-Time Fuzzy Control-Stability Issue in Discrete-Time Fuzzy Control | |

| | **LECTURE** | **TOTAL** |
|---|---|---|
| **HOURS** | **45** | **45** |

**Text Books**


1. Katsuhiko Ogata "Discrete-Time Control Systems" Pearson Education India, 2nd edition, 2015
2. Benjamin C. Kuo "Digital Control System", Oxford University Press, Second edition, 2012
3. Torregrosa, Juan R.Jiang, Yiming Yang, Chenguang Ma, Hongbin, "A Review of Fuzzy Logic and Neural Network Based Intelligent Control Design for Discrete-Time Systems".Discrete Dynamics in Nature and Society , Hindawi, Volume, 2016 https://doi.org/10.1155/2016/7217364, 2016


**References:**


1. Dr. Indrani Kar and Prof. S. Majhi, "Digital Control System - Web course through NPTEL", Department of Electronics and Communication Engineering, IIT Guwahati.


**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 3** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 4** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **CO6** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 2 | | |
| **Total** | 18 | 12 | 12 | 12 | 6 | 6 | 6 | **6** | | | | 12 | | |
| **Scaled Value** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | | | | 2 | | |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XUM008 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ENVIRONMENTAL SCIENCES | 0 | 0 | 0 | 0 |
| C | P | A | | L | T | P | H |
| 0 | 0 | 0 | | 3 | 0 | 0 | 3 |

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Describe*** the significance of natural resources and ***explain*** anthropogenic impacts. | Cognitive | Remembering, Understanding |
| CO2 | ***Illustrate*** the significance of ecosystem and biodiversity for maintaining ecological balance | Cognitive | Understanding |
| CO3 | ***Identify*** the facts , consequences , preventive measures of major pollution and ***Recognize*** the disaster phenomenon | Cognitive | Remembering, Affective |
| CO4 | ***Explain*** the socio- economics, policy dynamics and***practice*** the control measures of global issues for sustainable development. | Cognitive | Applying |
| CO5 | ***Recognize*** the impact of population and ***apply*** the concept to develop various welfare programs. | Cognitive | Understanding Applying |

| UNIT – IINTRODUCTION TO ENVIRONMENTAL STUDIES AND ENERGY | 9 |
|---|---|

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

| UNIT – IIECOSYSTEMS AND BIODIVERSITY | 9 |
|---|---|

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

| UNIT – III ENVIRONMENTAL POLLUTION | 12 |
|---|---|

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Soil waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: flood, earthquake, cyclone and landslide.

| UNIT –IV SOCIAL ISSUES AND THE ENVIRONMENT | 9 |
|---|---|

Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation – Consumerism and waste products – Environment Production Act – Air (Prevention

| |
|---|
| and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness. |

| **UNIT –V HUMAN POPULATION AND THE ENVIRONMENT** | **6** |
|---|---|
| Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education - HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies. | |

| | **LECTURE** | **TUTORIAL** | **TOTAL** |
|---|---|---|---|
| | **45** | **0** | **45** |

**TEXT BOOKS**

1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co, USA, 2000.
2. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, UK, 2003
3. Trivedi R.K and P.K.Goel, Introduction to Air pollution, Techno Science Publications, India, 2003.
4. Disaster mitigation, Preparedness, Recovery and Response, SBS Publishers & Distributors Pvt. Ltd, New Delhi, 2006.
5. Introduction to International disaster management, Butterworth Heinemann, 2006.
6. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, New Delhi, 2004.

**REFERENCE BOOKS**

1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media, India, 2009.
2. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
3. S.K.Dhameja, Environmental Engineering and Management, S.K.Kataria and Sons, New Delhi, 2012.
4. Sahni, Disaster Risk Reduction in South Asia, PHI Learning, New Delhi, 2003.
5. Sundar, Disaster Management, Sarup & Sons, New Delhi, 2007.
6. G.K.Ghosh, Disaster Management, A.P.H.Publishers, New Delhi, 2006.

**E RESOURCES**

1. Bharat Raj Singh , 2015,Global Warming: Causes, Impacts and Remedies , InTech
2. Richard C. J. Somerville , The Forgiving Air: Understanding Environmental Change , 1998,University of California Press
3. Benny Joseph, Environmental Studies, 2005,Tata McGraw Hill.

**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | | | | | | | | | | | 1 | | |
| **CO 2** | 2 | | | | | 2 | 1 | | | 1 | | 1 | | |
| **CO 3** | 2 | 1 | 3 | | | 3 | 1 | | 2 | 1 | | 1 | | |
| **CO 4** | 1 | 1 | 2 | | | 3 | 2 | 3 | | | | 1 | | |
| **CO 5** | 2 | 1 | 1 | | | 3 | | | | | | 1 | | |
| **Total** | 10 | 3 | 6 | | | 11 | 4 | 3 | 2 | 2 | | 5 | | |
| **Scaled Value** | 2 | 1 | 2 | | | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

| COURSE CODE | | | XEC706 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | VLSI DESIGN AND EMBEDDED SYSTEMS LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 0 | 0 | 0 | | 0 | 0 | 2 | 2 |

**LEARNING OBJECTIVES**

- To acquaint the students with the concept of FGPA and constructthe FPGA circuits.
- To give insight to the students to developthe codesfor the circuit using Verilog.
- To emphasis the students with the design and develop the software and hardware concept of processor in real time environment.
- To equip the students with the serial communication port ,RTOS on embedded systems
- To inculcate the understanding of interfacing of data I/O devices with embedded systems in real time and use the peripherals in embedded systems.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Develop the program using Logic Gates*** | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO2 | ***Develop the program for Combinational Logic circuit*** | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO3 | ***Develop the program for*** Sequential logic circuit | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO4 | ***Develop*** the program for communications port in the embedded systems. | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO5 | ***Develop*** the program for interfacing of data with the peripherals by the embedded systems. | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO6 | ***Develop*** the Arm processor to interface with the peripheral systems. | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |

| S. No | List of Experiment |
|---|---|
| 1 | Display the text in 2 x16 LCD using FPGA. |
| 2 | Study of simulation and synthesis for Logic Gates |
| 3 | Study of simulation and synthesis, place, root and back annotation for FPGAs |

| | |
|---|---|
| 4 | Study and implementation of schematic entry and Verilog code simulation of pipelined serial and parallel adder to add/subtract 8 number of size, 12 bit each in 2's complement. |
| 5 | Implementation of LEDs blinking controlled by switches using Verilog codes for Combinational circuits. |
| 6 | Implementation of LEDs blinking controlled by switches using Verilog codes for Sequential circuits. |
| 7 | Interfacing the LED using ARM Development board . |
| 8 | Interfacing to Input/output Devices (keyboard /LCD)using ARM Development board. |
| 9 | Serial communication using I2C with ARM Development Board. |
| 10 | Interfacing the stepper motor/servo motor/DC with ARM cortex board. |
| 11 | Interfacing EPROM and interrupt with ARM cortex board. |
| 12 | Interfacing the ADC and DAC with ARM cortex board. |

| | PRACTICAL | TOTAL |
|---|---|---|
| **HOURS** | **30** | **30** |

**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | | |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | | |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | | |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | | |
| **Total** | **18** | **12** | **12** | **12** | **12** | **12** | **12** | **6** | **6** | | **6** | **6** | | |
| **Scaled Value** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | | 2 | 2 | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC707 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | MORDERN CONTROL SYSTEMS LABORATORY | 0 | 0 | 1 | 1 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 0 | 0 | 2 | 2 |
| 1 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To compute the output response of the system for FFT spectrum.
- To make the students understand the behavior and response of the filter using different methods.
- To educate the students with the generation of the signals and arithmetic operation using DSP Processor

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Develop*** programme and sketch the state space representation of signals | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO2 | Develop the programme and implement PID controller and compensator. | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO3 | Develop the program and study the performance of optimal control | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO4 | Develop the stats space model for step and frequency response | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO5 | Develop the program for PID controller | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |
| CO6 | Develop the program for lead lag compensator | Cognitive<br>Psychomotor<br>Affective | Applying<br><br>Responding |

**USING MATLAB**

| Sl.No | List of Experiments |
|---|---|
| 1. | Write a programme to discretize a system and sketch the various results. |
| 2. | Sketch various parameters of a state space model using a computer programme. |

| | |
|---|---|
| 3. | Write programme to implement PID controller and compare various techniques used for implementation. |
| 4. | Write a programme to implement compensators and differentiate various types. |
| 5. | Survey and point out the advanatges of FLC and Optimal control when compared to PID controllers. |
| 6. | Write a Matlab/Scilab programme to Discretize a continous system using Zero-order hold, First-order hold, Impulse invariant methods. |
| 7. | Create a state space model for a control system and plot the step, frequency and phase response in Matlab/Scilab |
| 8. | Demonstrate effect of stability margins on closed-loop response characteristics of a control system using Matlab/Scilab |
| 9. | Design and apply a digital PID controller for a simple application |
| 10. | Design a PID Controller by using Ziegler Nichols tuning rules. |
| 11. | Check controllanility of a given system using Gilberst test in Scilab/Matlab. |
| 12. | Demonstrate Lead Compensator using Scilab. |
| 13 | Demonstrate Lag Compensator using Scilab. |
| 14 | Demonstrate Lead-Lag Compensator using Scilab. |
| 15 | Study experiment on FLC. |
| 16 | Study experiment on Optimal Control. |

| HOURS | TUTORIAL | PRACTICAL | TOTAL |
|---|---|---|---|
| | **0** | **30** | **30** |

**Table 1 : Mapping of COs with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 3** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **CO6** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **Total** | **18** | **12** | **12** | **12** | **12** | **12** | **12** | **6** | **6** | | **6** | **6** | **6** | **6** |
| **Scaled Value** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | | 2 | 2 | 2 | 2 |

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

1 - Low Relation, 2- Medium Relation, 3- High Relation

## ELECTIVES

| COURSECODE | | | XEC505A | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | COMPUTER ORGANIZATION AND ARCHITECTURE | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**LEARNING OBJECTIVES:**

- To make students understand the basic structure and operation of digital computer
- To familiarize with implementation of fixed point and floating-point arithmetic operations
- To study the design of data path unit and control unit for processor
- To understand the concept of various memories and interfacing
- To introduce the parallel processing technique

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Outline*** and ***explain*** Basics of a computer system | Cognitive | Remembering, Understanding |
| CO2 | ***Describe*** and ***apply*** arithmetic performance and operations. | Cognitive | Remembering, Applying, Understanding |
| CO3 | ***Describe the*** processors. | Cognitive | Remembering, Applying, Understanding |
| CO4 | ***Explain*** and ***justify*** Memory devices and Device drivers, | Cognitive | Understanding, Applying, Evaluate |
| CO5 | ***Outline*** and ***illustrate*** advanced computer architecture | Cognitive | Remembering, Understanding |
| CO6 | ***Illustrate*** *pipelining and* advanced branch prediction techniques in computer architecture | Cognitive | Remembering, Understanding |

| UNIT I - COMPUTER ORGANIZATION & INSTRUCTIONS | 9 Hours |
|---|---|

Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operationsand Operands, Representing instructions, Logical operations, control operations.

| UNIT II – ARITHMETIC OPERATIONS | 9 Hours |
|---|---|

Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Subword parallelism.

| UNIT III -THE PROCESSOR | 9 Hours |
|---|---|

Introduction, Logic Design Conventions, Building a Data path - A Simple Implementation scheme - An Overview of Pipelining - Pipelined Data path and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions

**UNIT IV – MEMORY AND I/O ORGANIZATION** **9 Hours**

Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Device

**UNIT V - ADVANCED COMPUTER ARCHITECTURE-I** **9 Hours**

Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers - Introduction to Multiprocessor network topologies.

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**TEXT BOOK**

1. David A. Patterson and John L. Hennessey, ―Computer Organization and Design‖, Fifth edition, Morgan Kauffman / Elsevier, 2014.
2. Miles J. Murdocca and Vincent P. Heuring, ―Computer Architecture and Organization: An Integrated approach‖, Second edition, Wiley India Pvt Ltd, 2015

**REFERENCES**

1. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, ―Computer Organization―, Fifth edition, Mc Graw-Hill Education India Pvt Ltd, 2014.
2. William Stallings ―Computer Organization and Architecture‖, Seventh Edition, Pearson Education, 2006.
3. Govindarajalu, ―Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014.

**Table 1: Mapping of COs with POs**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 0 | 1 | 3 | 1 | 1 | 2 | 3 | 1 | 0 | 3 | 3 | 3 |
| **CO 2** | 3 | 2 | 1 | 3 | 3 | 1 | 0 | 3 | 2 | 3 | 0 | 3 | 3 | 3 |
| **CO 3** | 1 | 1 | 1 | 2 | 3 | 3 | 0 | 3 | 2 | 3 | 0 | 3 | 3 | 3 |
| **CO 4** | 1 | 2 | 0 | 1 | 3 | 0 | 0 | 3 | 3 | 2 | 0 | 3 | 3 | 3 |
| **CO 5** | 2 | 2 | 0 | 2 | 3 | 3 | 0 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| **CO6** | 3 | 3 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 3 | 3 |
| Total | 13 | 11 | 2 | 12 | 18 | 8 | 1 | 17 | 16 | 15 | 1 | 18 | 18 | 18 |
| Scaled Value | 3 | 3 | 1 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

1 – 5 → 1,  6 – 10 → 2,  11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC505B | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | INTRODUCTION TO ARTIFICIAL INTELLIGENCE | 3 | 0 | 0 | 3 |
| | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | Represent knowledge using propositional calculus and predicate calculus. | Cognitive | Understanding |
| CO2 | Solve search problems by applying a suitable search strategy | Cognitive | Applying |
| CO3 | Use inference rules to produce predicate calculus expression. | Cognitive | Applying |
| CO4 | Apply and design a fuzzy logic system using fuzzy rules | Cognitive | Applying |
| CO5 | Understand various optimization methods and know about genetic algorithm | Cognitive | Understanding |

**UNIT I - INTRODUCTION** **9 Hours**

History of AI; Characteristics of AI applications, Problem Solving by Search and Control Strategies, General Problem Solving, Production Systems, Control Strategies; Forward and Backward Chaining, Exhaustive Searches: Depth First and Breadth First Search.

**UNIT II -SEARCH STRATEGIES** **9 Hours**

Hill climbing - Backtracking - Graph search - Properties of A* algorithm - Monotone restriction - Specialized production systems - AO* algorithm. Constraint Satisfaction problems Game Playing Min Max Search procedure.

**UNIT III - KNOWLEDGE REPRESENTATION** **9 Hours**

Game playing - Knowledge Representation, Knowledge Representation using Predicate Logic, Introduction to Predicate Calculus, Reasoning, Use of Predicate Calculus, Knowledge Representation using other Logic-Structured Representation of Knowledge, STRIPS

**UNIT IV - FUZZY SET THEORY** **9 Hours**

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

| UNIT V - OPTIMIZATION | | | 9 Hours |
|---|---|---|---|
| Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search. | | | |
| | **LECTURE** | **TUTORIAL** | **TOTAL** |
| | **45** | **0** | **45** |

**TEXT BOOKS**

1. Elaine Rich and Kevin Knight: Artificial Intelligence – Tata McGraw Hill, 2008
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.
3. G.Luger, W.A. Stubblefield, "Artificial Intelligence", 3rd Edition,Addison-Wesley Longman, 1998

**REFERENCES**

1. Nils J. Nilsson: Principles of Artificial Intelligence – Narosa Publication house.
2. Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
3. Artificial Intelligence, Winston, Patrick, Henry, Pearson Education.
4. Artificial Intelligence by Gopal Krishna, Janakiraman.
5. N.J. NILSSON, "Principles of Artificial Intelligence", Narosa Publishing House, 1980

**Table 1: Mapping of COs with POs**

| | **PO1** | **PO2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 2** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 3** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO 5** | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **CO6** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| **Total** | **18** | **16** | **12** | **9** | **6** | **6** | **6** | **6** | | | | **6** | | |
| **Scaled Value** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | | | 2 | | |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSECODE | | | XEC505C | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | RADIO FREQUENCY ELECTRONICS | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**LEARNING OBJECTIVES:**

| | COURSE OUTCOMES | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Discuss*** the difference between DC/Low frequency circuits and high frequency circuits and **explain** the importance of matching | | Understanding |
| CO2 | ***Choose*** smith chart as a tool for RF circuit design and ***sketch*** various paramters involved in RF and microwave circuit design | | Applying |
| CO3 | ***Describe*** and ***Explain*** RF and Microwave amplifiers | | Remembering Understanding |
| CO4 | ***Describe*** and ***Explain*** RF and Microwave oscillators | | Remembering Understanding |
| CO5 | ***Describe*** and ***Explain*** RF and Microwave mixers | | Remembering Understand |
| CO6 | ***Describe*** and ***Explain*** RF and Microwave switches | | Remembering Understanding |

| **UNIT – I UNIQUENESS OF RF CIRCUITS** | **8 Hours** |
|---|---|

RF/Microwaves versus DC or low AC signals, EM spectrum, wave length and frequency, introduction to component basics, resonant circuits,

analysis of a simple circuit in phasor domain, impedance transformers, RF impedance matching,three element matching.

| **UNIT – II SMITH CHART FOR RF AND MICROWAVE CIRCUIT DESIGN** | **10 Hours** |
|---|---|

Introduction, a valuable graphical aid the smith chart,derivation of smith chart, description of two types of smith charts, smith charts circular scales,

smith charts radial scales, the normalized impedance-admittance (ZY) smith chart introduction, applications of the smith chart, distributed circuit applications, lumped element circuit applications.

| **UNIT – III RF AND MICROWAVE AMPLIFIERS** | **7 Hours** |
|---|---|

types of amplifiers, small signal amplifiers, design of different types of amplifiers, multistage small signal amplifier design, high-power amplifiers, large signal amplifier design, microwave power combining/dividing techniques, signal distortion due to inter modulation products, multistage amplifiers, large signal design.

| **UNIT – IV RF AND MICROWAVE OSCILLATORS** | **7 Hours** |
|---|---|

Introduction, oscillator versus amplifier design, oscillation conditions: Two port NR oscillators, a special case: One port NR oscillator, condition of stable oscillation, design of transistor oscillators, generator-tuning networks: Fixed frequency oscillators, frequency tunable oscillators

| **UNIT – V MIXERS** | **7 Hours** |
|---|---|

Mixer characteristics: Image frequency, conversion loss, noise figure; Devices for mixers: p-n junctions, schottky barrier diode, FETs; Diode mixers: Small-signal characteristics of diode, single-ended mixer, large-signal model,

| **UNIT VI –SWITCHES** | **6 Hours** |
|---|---|

Devices for microwave switches: PIN diode, BJT, FET; Device models; Types of switches; Switch configurations; Basic theory of switches; Multi-port, broad-band and isolation switches.

| | **LECTURE** | **TUTORIAL** | **TOTAL** |
|---|---|---|---|
| **HOURS** | **45** | **0** | **45** |

**TEXT BOOKS**

1. Mathew M. Radmanesh, Radio Frequency and Microwave Electronics, prentice hall,2001.

**REFERENCE BOOK**

1. Pozar, D.M. Microwave and RF Design of Wireless Systems, John Wiley & Sons. 2001
2. Samuel. Y. Liao, Microwave Devices and Circuits, 3/e, Pearson Education, 2014.
3. Annapurna Das and Sisir K. Das ,Microwave Engineering, Tata Mcgraw Hill, 2013.

| COURSE CODE | | | XEC505D | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | RADAR TECHNOLOGIES | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | Nil | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

| COURSE OUTCOMES<br>At the end of this course completion, the student can able to | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Identify*** the Radar parameters | Cognitive | Understanding |
| CO2 | ***Differentiate*** various radar types | Cognitive | Remembering |
| CO3 | ***Compare*** different tracking and filtering schemes | Cognitive | Remembering |
| CO4 | ***Apply*** signal processing in target detection | Cognitive | Understanding |
| CO5 | ***Explain*** Radar transmitter blocks | Cognitive | Understanding |
| CO6 | ***Explain*** Radar receiver blocks | Cognitive | Understanding |

**UNIT I -INTRODUCTION TO RADAR EQUATION** — **8 Hours**

The Origins of Radar ,Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.

**UNIT II -CW, MTI AND PULSE DOPPLER RADAR** — **8 Hours**

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target 157 Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar

**UNIT III -TRACKING RADAR** — **8 Hours**

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction , state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering.

**UNIT IV -RADAR SIGNAL PROCESSING** — **7 Hours**

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar

**UNIT V -RADAR TRANSMITTERS** — **7Hours**

Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers, Other RF Power Sources.

**UNIT VI- RADAR RECEIVERS** — **7Hours**

The Radar Receiver , Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors- Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters

**Total Hours :**

**45**

**TEXT BOOKS**

1. Habibur Rahman," Fundamental Principles of Radar", CRC press, Taylor and Francis, 2019.
2. M. R. Richards, J. A. Scheer, W. A. Holm, Editors "Principles of Modern Radar, Basic Principles", SciTech Publishing, 2012
3. Mark A. Richards, William L. Melvin "Principles of Modern Radar Basic Principles" SciTech Publishing Incorporated, 2023

**REFERENCES**

1. Nathansan, "Radar design principles-Signal processing and environment", PHI, 2nd Edition,2007.
2. M.I.Skolnik , "Introduction to Radar Systems", Tata McGraw Hill 2006.
3. Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw-Hill, 2005.
4. Hugh D. Griffiths, Christopher J. Baker "An Introduction to Passive Radar", Artech House Second Edition, 2022

**E -REFERENCES**

1. https://nptel.ac.in/courses/108105154
2.https://www.iitr.ac.in/Main/uploads/File/2017/co19122017(1).pdf
3. https://www.academia.edu/37031854/Detailed_Study_Material_of_Radar_Technology

| COURSE CODE | | | XEC603A | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | INTRODUCTION TO DATA STRUCTURE | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES:**

| COURSE OUTCOMES | | Domain | Level |
|---|---|---|---|
| CO1 | To understand the concepts of ADTs | Cognitive | Remembering, Understanding |
| CO2 | To Learn linear data structures – lists, stacks, and queues | Cognitive | Remembering |
| CO3 | To understand sorting, searching and hashing algorithms | Cognitive | Remembering, Understanding |
| CO4 | To apply Tree and Graph structures | Cognitive | Understanding |
| CO5 | Critically analyze the various sorting algorithms | Cognitive | Remembering |
| CO6 | Apply the different linear and non-linear data structures to problem solutions. | Cognitive | Understanding |

**UNIT I - LINEAR DATA STRUCTURES – LIST** — **9 Hours**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

**UNIT II-LINEAR DATA STRUCTURES – STACKS, QUEUES** — **9 Hours**

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues.

**UNIT III- NON LINEAR DATA STRUCTURES – TREES** — **9 Hours**

Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree -B+ Tree – Heap – Applications of heap.

**UNIT IV- NON LINEAR DATA STRUCTURES -GRAPHS** — **9 Hours**

Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

**UNIT V- SEARCHING, SORTING AND HASHING TECHNIQUES** — **9 Hours**

Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

| | LECTURE | TOTAL |
|---|---|---|
| HOURS | 45 | 45 |

**TEXT BOOKS**

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, ―Data Structures Using C‖, Second Edition , Oxford University Press, 2011

**REFERENCES**

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, ―Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, ―Data Structures and Algorithms‖, Pearson Education,1983.
3. Stephen G. Kochan, ―Programming in C‖, 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C‖, Second Edition, University Press, 2008

| COURSECODE | | | XEC603B | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | APPLIED MACHINE LEARNING | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**LEARNING OBJECTIVES**

| | COURSE OUTCOMES | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Describe*** the types of learning and linear models used in ML | Cognitive | Remembering |
| CO2 | ***Explain*** Linear Regression and Decision Trees | Cognitive | Understanding |
| CO3 | ***Describe*** basics of probabilistic classifiers used in ML | Cognitive | Remembering |
| CO4 | ***Describe*** basics of nonprobabilistic classifiers used in ML | Cognitive | Remembering |
| CO5 | ***Describe*** and ***Explain*** ANN | Cognitive | Remembering, Understanding |
| CO6 | ***Describe*** CLT and clustering techniques used in ML | Cognitive | Remembering |

**UNIT I - Introduction and Linear Models** — **9 Hours**

Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, concept learning-Linear modelling - Defining the model -Modelling assumptions - Defining what a good model is - The least squares solution

**UNIT II - Linear Regression and Decision Trees** — **9 Hours**

Linear Regression for Machine Learning-Linear Regression Model Representation-Linear Regression Learning the Model-Simple Linear Regression-Ordinary Least Squares-Gradient Descent-Regularization-Making Predictions with Linear Regression-Preparing Data For Linear Regression - Decision tree representation- ID3 learning algorithm- Entropy, Information gain- Overfitting

**UNIT III - Probabilistic Classifiers** — **4 Hours**

The Bayes classifier - Likelihood -class-conditional distributions . - Prior class distribution - Example -Gaussian class-conditionals - Making predictions -The naive Bayes assumption - Example - classifying text - Smoothing -Logistic regression - Motivation -Nonlinear decision functions - Nonparametric models -the Gaussian process.

**UNIT IV -Non Probabilistic Classifiers –** — **7 Hours**

nearest neighbours -Choosing if - Support vector machines and other kernel methods - The margin - Maximising the margin - Making predictions-Support vectors-Soft margins-Kernels

**UNIT V - Introduction to Neural network** — **7 Hours**

Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network.

**UNIT VI – CLT and Clustering in Machine Learning** — **9 Hours**

Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning. Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model- A generative process - Mixture model likelihood -The EM algorithm.

| | LECTURE | TOTAL |
|---|---|---|
| HOURS | 45 | 45 |

**TEXT BOOKS**

2. Tom M. Mitchell, "Machine Learning ",McGraw Hill Education; First edition , 2017

3. Simon Rogers and Mark Girolami, "A First Course in Machine Learning", Chapman & Hall/CRC Machine Learning & Pattern Recognition Series,CRC Press

**REFERENCE BOOK**

1. EthemAlpaydin, "Machine Learning: The New AI",The MIT Press, 2017
2. John D. Kelleher, Brian Mac Namee and Aoife D'Arcy,"Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies",The MIT Press; Illustrated edition , 2015
3. Peter Flach , "Machine Learning Paperback", Cambridge English,2015

**E REFERENCES and Equivalent Course**

1. Prof Sudeshna Sarkar, "NPTEL Introduction to Machine Learning", Indian Institute of Technology Kharagpur, https://nptel.ac.in/courses/106/105/106105152/
2. **Equivalent Course – Yes**

| COURSE CODE | | | XEC603C | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | WIRELESS COMMUNICATIONS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To enhance the fundamental knowledge on the characteristic of wireless channel
- To acquaint the students with the design of a cellular system
- To expose the students on various digital signaling techniques and multipath mitigation techniques
- To educate the students with the concepts of multiple antenna techniques

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Explain*** cellular architecture and system capacity. | Cognitive | Understanding |
| CO2 | ***Explain*** different types of wireless channels | Cognitive | Understanding |
| CO3 | ***Illustrate*** Multiple access techniques. | Cognitive | Understanding |
| CO4 | ***Illustrate*** equalization and diversity techniques.. | Cognitive | Understanding |
| CO5 | ***Describe*** MIMO systems. | Cognitive | Understanding |
| CO6 | ***Describe*** information capacity of fading and non fading channels. | Cognitive | Understanding |

**UNIT - I CELLULAR ARCHITECTURE** — **9 Hours**

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference,– Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity trucking & grade of service – Coverage and capacity improvement.

**UNIT - II WIRELESS CHANNELS** — **9 Hours**

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters- Coherence bandwidth – Doppler spread & Coherence time, fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

**UNIT - III MULTIPLE ACCESS AND MODULATION TECHNIQUES** — **9 Hours**

FDD-TDD,FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK,QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

**UNIT - IV MULTIPATH MITIGATION TECHNIQUES** — **9 Hours**

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

**UNIT - V MULTIPLE ANTENNA TECHNIQUES** — **9 Hours**

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

| | LECTURE | TOTAL |
|---|---|---|
| | 45 | 45 |

**TEXT BOOKS**

1.Rappaport,T.S., ―Wireless communications‖, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)

2. Andreas.F. Molisch, ―Wireless Communications‖, John Wiley – India, 2006. (UNIT III,V)

**REFERENCES**

1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011.

2. Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications,Artech House, 2000.

3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2005.

4. Upena Dalal, ―Wireless Communication‖, Oxford University Press, 2009.

| COURSE CODE | | | XEC603D | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | AVIONICS SYSTEMS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | Nil | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES: At the end of this course completion, the student can able to | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | *Understand* the basics of avionics | Cognitive | Understanding |
| CO2 | *Explain* Avionics systems | Cognitive | Understanding |
| CO3 | *Select* a suitable architecture and data bus based on the requirements | Cognitive | Remembering |
| CO4 | *Compare* the different display technologies used in cockpit | Cognitive | Remembering |
| CO5 | *Explain* the principles of flight control systems and the importance of FMS | Cognitive | Understanding |
| CO6 | *Describe* the communication and navigation techniques used in aircrafts | Cognitive | Understanding |

| UNIT I INTRODUCTION TO AVIONICS | 7 Hours |
|---|---|
| Basics of Avionics-Basics of Cockpits – Need for Avionics in civil and military aircraft and space systems – Integrated Avionics Architecture –Military and Civil system – | |
| **UNIT IIAVIONIC SYSTEMS** | **8Hours** |
| Typical avionics System and Sub systems – Design and Technologies – Requirements and Importance of illities of Avionic Systems. | |
| **UNIT III DIGITAL AVIONICS BUS ARCHITECTURE** | **8 Hours** |
| Evolution of Avionics architecture– Avionics Data buses MIL-STD-1553, MIL-STD-1773, ARINC429, ARINC-629, AFDX/ARINC-664, ARINC-818 – Aircraft system Interface | |
| **UNIT IV COCKPIT DISPLAYS AND MAN-MACHINE INTERACTION** | **8 Hours** |
| Trends in display technology- CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) –-Civil cockpit and military cockpit: MFD, MFK, HUD, HDD, HMD, HOTAS – Glass cockpit. | |
| **UNIT V FLIGHT CONTROL SYSTEMS** | **7 Hours** |
| Introduction to Flight control systems and FMS– Longitudinal control – Lateral Control –Autopilot – Flight planning – Radar Electronic Warfare - Certification-Military and civil aircrafts. | |
| **UNIT VI NAVIGATION SYSTEMS** | **7 Hours** |
| Overview of navigation systems - Communication Systems – Radio navigation – Types & Principles – Fundamentals of Inertial Sensors – INS – GNSS -- GPS – Approach and Landing Aids – ILS & MLS – Hybrid Navigation | |
| **Total Hours : 45** | |

**TEXT BOOKS**

1.R.P.G. Collinson, “Introduction to Avionics”, Springer Publications, Third Edition, 2011
2.Cary R .Spitzer, “The Avionics Handbook”, CRC Press, 2000.

**REFERENCES**

1. Guoqing Wang, Wenhao Zhao “The Principles of Integrated Technology in Avionics Systems”Elsevier Science, 2020
4. Myron Kayton , Walter R. Fried “Avionics Navigation Systems” 2nd Edition, Wiley Publication,2008.
5. Jim Curren, “Trend in Advanced Avionics”, IOWA State University, 1992.

**E-REFERENCES**

1.https://www.tonex.com/training-courses/avionic-systems-engineering-bootcamp-course/
2.https://www.cranfield.ac.uk/courses/short/aerospace/introduction-to-avionics
3.https://itpscanada.com/courses/avionics-systems-flight-tests-civil-onsite/

| COURSE CODE | | | XEC703A | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | INTRODUCTION TO OPERATING SYSTEMS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To expose the students to fundamentals of operating system

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Understanding*** concept of operating system | Cognitive | Understanding |
| CO2 | ***Understanding*** the concept of process | Cognitive | Analyzing |
| CO3 | ***Understanding*** the concurrency and scheduling | Cognitive | Applying |
| CO4 | ***Understanding*** the concept of memory | Cognitive | Understanding |
| CO5 | ***Understanding*** the concept of input and output | Cognitive | Understanding |
| CO6 | ***Uunderstaning*** the concept of file system | Cognitive | Understanding |

| UNIT I – INTRODUCTION | 8 Hours |
|---|---|

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System

| UNIT II –PROCESS | 8 Hours |
|---|---|

Process States, Process Description and Process Control. Processes and Threads, Types of Threads, Multicore and Multi-threading, Windows 7 - Thread and SMP Management.

| UNIT III - CONCURRENCY AND SCHEDULING | 8 Hours |
|---|---|

Principles of Concurrency - Mutual Exclusion, Semaphores, Monitors, Readers/Writers problem. Deadlocks – prevention- avoidance – detection, Scheduling- Types of Scheduling – Scheduling algorithms.

| UNIT IV –MEMORY | 7 Hours |
|---|---|

Memory management requirements, Partitioning, Paging and Segmentation, Virtual memory - Hardware and control structures, operating system software, Linux memory management, Windows memory management.

| UNIT V -INPUT/OUTPUT | 7 Hours |
|---|---|
| .I/O management and disk scheduling – I/O devices, organization of I/O functions; OS design issues, I/O buffering, disk scheduling, Disk cache.. | |
| **UNIT VI: FILE SYSTEMS** | **7 Hours** |
| File management – Organization, Directories, File sharing, and Record blocking, secondary storage management | |

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**TEXT BOOKS**

1. Operating Systems: Design and Implementation, Textbook by Andrew S. Tanenbaum.
2. Modern Operating Systems, Andrew S. Tanenbaum
3. Operating Systems: Internals and Design Principles, by William Stallings.

**REFERENCES**

1. Operating System Concepts" by Avi Silberschatz and Peter Galvin

2. "Operating Systems: Internals and Design Principles" by William Stallings

3. "Operating Systems: A Concept-Based Approach" by D M Dhamdhere

4. "Operating System: A Design-oriented Approach" by Charles Crowley

**E REFERENCES**

1. https://nptel.ac.in/courses/106/108/106108102/

| COURSE CODE | | | XEC703B | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | ARTIFICIAL INTELLIGENCE FOR ROBOTICS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

- To expose the students to fundamentals of AI and expert systems and its application in Robotics.

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Understanding*** Fundamental concept of AI and expert system | Cognitive | Understanding |
| CO2 | ***Understanding*** Concept of AI programming languages | Cognitive | Analyzing |
| CO3 | ***Understanding*** robot language | Cognitive | Applying |
| CO4 | ***Understanding*** Applications of AI in the field of Robotics | Cognitive | Understanding |
| CO5 | ***Understanding*** program control statement | Cognitive | Understanding |
| CO6 | ***Understanding*** the role of sensors | Cognitive | Understanding |

| UNIT I – INTRODUCTION TO ROBOT PROGRAMMING | 8 Hours |
|---|---|
| Robot software functions - coordinate systems, position control, other control functions, subroutines, Program planning for Robot flow charting for robot programs with few examples | |
| **UNIT II - METHODS OF ROBOT PROGRAMMING** | **8 Hours** |
| Online programming, off-line programming, advantages of off-line programming, lead through methods - powered lead through, manual lead through, Teach pendant, Robot program as a path in space, defining position in space, motion interpolation, WAIT, SIGNAL and DELAY commands, Branching capabilities and Limitations of head through methods. | |
| **UNIT III - ROBOT LANGUAGES** | **8 Hours** |
| Textual ROBOT Languages, first generation and second generation languages, structure of a robot language - operating systems, Elements and Functions, constants, variables and other data objects, Motion commands, points in workspace, End effector and sensor commands, computations and operations, program control and subroutines, communications and Data processing | |
| **UNIT IV - VAL II** | **7 Hours** |
| General description, Monitor commands, motion command, Hand Control, Configuration control, interlock commands, INPUT/OUTPUT Controls, Program Control, examples | |
| **UNIT V -AML** | **7 Hours** |
| General description, AML statements, Constant and variables, program control statements, motion commands, | |
| **UNIT VI - SENSORS** | **7 Hours** |
| Sensor commands, Grip sensing capabilities, Data processing, examples | |

| | LECTURE | TUTORIAL | TOTAL |
|---|---|---|---|
| | 45 | 0 | 45 |

**TEXT BOOKS**

1. D.Roy Choudhry, Shail Jain, - Linear Integrated Circuits‖, New Age International Pvt. Ltd., 2018, Fifth Edition.

2. Sergio Franco, - Design with Operational Amplifiers and Analog Integrated Circuits‖, 4th Edition, Tata Mc Graw-Hill, 2016
3. Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 4/e, Tata McGraw Hill, 2015

**REFERENCES**

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, 'Industrial Robotics Circuits‖, Sixth Edition, PHI, 2001.
2. Technology, Programming and Applications', Mc Graw Hill Book company, 1986
2. Bernard Hodges, 'Industrial Robotics', Second Edition, Jaico Publishing House, 1993

**E REFERENCES**

1. https://nptel.ac.in/courses/107/106/107106090/

| COURSE CODE | | | XEC703C | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | WIRELESS NETWORKS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES | | Domain | Level |
|---|---|---|---|
| CO1 | ***Describe*** and ***compare*** various Multiple Radio Access | Cognitive | Remembering, Evaluating |
| CO2 | ***Describe*** Wide Area Networks. | Cognitive | Remembering |
| CO3 | ***Define*** and ***explain*** various Wireless LAN standards | Cognitive | Remembering, Understanding |
| CO4 | ***Describe*** wireless MAN and PAN. | Cognitive | Remembering, |
| CO5 | ***Explain*** the features of 4G and 5G networks | Cognitive | Understanding |
| | | | |

**UNIT I - MULTIPLE RADIO ACCESS** — **9 Hours**

Medium Access Alternatives: Fixed-Assignment for Voice Oriented Networks Random Access for Data Oriented Networks, Handoff and Roaming Support, Security and Privacy.

**UNIT II - WIRELESS WANS** — **9 Hours**

First Generation Analog, Second Generation TDMA – GSM, Short Messaging Service in GSM, Second Generation CDMA – IS-95, GPRS - Third Generation Systems (WCDMA/CDMA 2000)

**UNIT III- WIRELESS LANS** — **9 Hours**

Introduction to wireless LANs - IEEE 802.11 WLAN – Architecture and Services, Physical Layer- MAC sublayer- MAC Management Sublayer, Other IEEE 802.11 standards, HIPERLAN, WiMax standard.

**UNIT IV- WIRELESS MANS AND PANS** — **9 Hours**

Wireless MANs – Physical and MAC layer details, Wireless PANs – Architecture of Bluetooth Systems, Physical and MAC layer details, Standards.

**UNIT V - 4G NETWORKS** — **9 Hours**

LTE -Network Architecture and Interfaces -FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization –LTE Security Architecture –Interconnection with UMTS and GSM –LTE Advanced (3GPPP Release 10) -4G Networks and Composite Radio Environment –Protocol Boosters –Hybrid 4G Wireless Networks Protocols –Green Wireless Networks –Physical Layer and Multiple Accesses –Channel Modeling for 4G–Introduction to 5G

| | LECTURE | TOTAL |
|---|---|---|
| HOURS | 45 | 45 |

**TEXT BOOKS**


1. William Stallings, “Wireless Communications and networks”, 2nd Edition, Pearson / Prentice Hall of India, 2007.
2. Dharma Prakash Agrawal and Qing-An Zeng, “Introduction to Wireless and Mobile Systems”, 2nd Edition, Thomson India Edition, 2007.
3. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014
4. Savo G Glisic, “Advanced Wireless Networks –4G Technologies”, John Wiley & Sons, 2007


**REFERENCES BOOKS**


1. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.
2. Kaveth Pahlavan, Prashant Krishnamurthy, “Principles of Wireless Networks”, Pearson Education Asia, 2002.

3. Gary. S. Rogers and John Edwards, “An Introduction to Wireless Technology”, Pearson Education, 2007.
4. Clint Smith, P.E. and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill, 2007.
5. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.

**E REFERENCES**

1. http://www.ed2go.com/online-courses/wireless-networking
2. https://www.cbtnuggets.com/it-training/network-administration-engineering/wireless-networking

| COURSE CODE | | | XEC703D | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | SATELLITE COMMUNICATION | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | Nil | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES: At the end of this course completion, the student can able to | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | *Understand* evaluation of Satellite Communication | Cognitive | Understanding |
| CO2 | *Compare* the satellite orbits | Cognitive | Understanding |
| CO3 | *Explain* the satellite subsystems | Cognitive | Understanding |
| CO4 | *Explain* the satellite link power budget | Cognitive | Understanding |
| CO5 | *Identify* access technology for satellite | Cognitive | Understanding |
| CO6 | *Describe* various satellite applications | Cognitive | Understanding |

| UNIT I - EVOLUATION OF SATELITE COMMUNICATION | 8 Hours |
|---|---|
| SYNCOM,COMSAT, Global Service, INTELSAT, Pan Am Sat, EUTELSAT and SES, DTH Development, MSS Development | |
| **UNIT II -SATELLITE ORBITS** | **8 Hours** |
| Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion. | |
| **UNIT III -SPACE SEGMENT** | **8 Hours** |
| Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem. | |
| **UNIT IV-SATELLITE LINK DESIGN** | **7Hours** |
| Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse. | |
| **UNIT V -SATELLITE ACCESS AND CODING TECHNIQUES** | **7 Hours** |
| Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes. | |
| **UNIT VI- SATELLITE APPLICATIONS** | **7 Hours** |
| INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH). | |
| **Total Hours : 45** | |

**TEXT BOOKS**

1 Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2017.
2. Timothy Pratt, Charles, W. Bostain, Jeremy E.Allnutt,"SatelliteCommunication",3rd Edition, Wiley Publications,2021

**REFERENCES**

1. Tri T. Ha, "Digital Satellite Communications", 2nd edition, Mc Graw Hill education, 2017.
2. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communications Systems Engineering", 2nd edition , Prentice Hall/Pearson , 2013.
3. M. Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 1999.
4. Gerard Maral, Michel Bousquet, Zhili Sun , "Satellite Communications Systems Systems, Techniques and Technology", Wiley 2020.

5. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 2003.

**E-REFERENCES**

1.https://archive.nptel.ac.in/courses/117/105/117105131/

2.https://nptel.ac.in/courses/105107194

| COURSE CODE | | | XEC801A | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | FUNDAMENTALS OF KOTLIN PROGRAMMING | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**LEARNING OBJECTIVES**

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Identify, explain*** and ***discuss*** various basics needed for programming in Kotlin | Cognitive | Remembering Understanding |
| CO2 | ***Describe*** objects and classes in Kotlin and ***use*** them to write programmes | Cognitive | Remembering and applying |
| CO3 | ***Describe***functions in Kotlin and ***use*** them to write programmes | Cognitive | Remembering and applying |
| CO4 | ***Explain*** and ***use*** various Higher Order Functions and Functional Programming | Cognitive | Remembering and applying |
| CO5 | ***Describe***Properties in Kotlin | Cognitive | Remembering, |
| CO6 | ***Describe***Collections in Kotlin | Cognitive | Remembering |

**UNIT I - KOTLIN BASICS** — **8 Hours**

Using the command line to compile and run Kotlin code -Kotlin runtime -The REPL -Kotlin for scripting -Kotlin with Gradle -Kotlin with Maven -IntelliJ and Kotlin -Eclipse and Kotlin -Mixing Kotlin and Java in a project -Vals and vars -Type inference -Basic types -Numbers -Booleans -Chars -Strings -Arrays -Comments -Packages -Imports -Wildcard imports -Import renaming -String templates -Ranges -Loops -Exception handling -Instantiating classes -Referential equality and structural equality -This expression -Scope -Visibility modifiers-Private -Protected -Internal -Control flow as expressions -Null syntax -Smart casts -Explicit casting -When expression -When (value) -When without argument -Function Return -Type hierarchy

**UNIT II - OBJECT-ORIENTED PROGRAMMING IN KOTLIN** — **8 Hours**

Classes -Access levels -Nested classes -Data classes -Enum classes -Static methods and companion objects -Interfaces -Inheritance -Visibility modifiers -Abstract classes -Interface or abstract class -Polymorphism -Overriding rules -Inheritance versus composition -Class delegation -Sealed classes

**UNIT III -FUNCTIONS IN KOTLIN** — **8 Hours**

Defining functions -Single expression functions -Member functions -Local functions -Top-level functions -Named parameters -Default parameters -Extension functions -Operators -Function literals -Tail recursive functions -Varargs -Spread operator -Standard library functions -Generic functions -Pure functions -Java from Kotlin -Kotlin from Java

**UNIT IV -HIGHER ORDER FUNCTIONS AND FUNCTIONAL PROGRAMMING** — **8 Hours**

Higher order functions -Closures -Anonymous functions -Function references -Function-literal receivers -Functions in the JVM -Function composition -Inline functions -Currying and partial application-Memoization -Type alias -Either -Custom DSLs -Validation and error accumulation

**UNIT V -PROPERTIES** — **7 Hours**

Why use properties?-Syntax and variations -Visibility-Late initialization -Delegated properties -Lazy initializations -Lateinit versus lazy -Observables -A non-null property delegate -Properties or methods?

**UNIT VI – COLLECTIONS** — **6 Hours**

Class hierarchy -Arrays -Lists -Maps -Sets 3-Read-only views -Indexed access –Sequences

| HOURS | LECTURE | TOTAL |
|---|---|---|

| | | |
|---|---|---|
| | **45** | **45** |

**TEXT BOOKS**

1. Stephen Samuel and Stefan Bocutiu, "Programming Kotlin", Packt Publishing Ltd. Livery Place, 35 Livery Street, Birmingham, B3 2PB, UK, 2017

**REFERENCE BOOK**

1. Dawn Griffiths and David Griffiths, "Head First Kotlin" O'Reilly Media, Inc.1005 Gravenstein Highway North Sebastopol, CA 95472, USA, 2019
2. Pierre-Yves Saumont , "The Joy of Kotlin" Manning Publications; 1st edition , 20 Baldwin RoadPO Box 761, Shelter Island, NY 119642019, 2019

**E REFERENCES and Equivalent Course**

**1.** Google Inc., "Kotlin Bootcamp for Programmers" https://developer.android.com/courses/kotlin-bootcamp/overview

| COURSE CODE | | | XEC 801B | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | INTERNET OF THINGS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

**LEARNING OBJECTIVES**

| COURSE OUTCOMES | | Domain | Level |
|---|---|---|---|
| CO1 | *Describe* Internet of Thins (IoT) and *explain* various IoT related technologies | Cognitive | Remembering, Understanding |
| CO2 | *Describe* resource management in IoT. | Cognitive | Remembering |
| CO3 | *Describe* and *distinguish* various the architecture, platforms, services of IoT. | Cognitive | Remembering, Understanding |
| CO4 | *Explain* how IoT can be integrated to IP | Cognitive | Understanding |
| CO5 | *Describe* various IoT applications | Cognitive | Remembering |
| | | | |
| CO6 | *Describe* and *distinguish* various real time IoT devices. | Cognitive | Understanding |

**UNIT I - INTRODUCTION AND ENABLING TECHNOLOGIES IN IOT** — **9 Hours**

IoT, Machine to Machine, Web of Things, Definition- Major components if IoT devices-Control Units-Sensors-Communication Modules-Power Sources Vision- Characteristics - Layered Architecture- Landscape-- IoT Functional View-IoT related Internet Technology-cloud computing-Networks and Communications related to IoT-Processes related to IoT-Data Management related to IoT-Security Privacy and Trust-Devices level energy issues-Standards related to IoT

**UNIT II- RESOURCE MANAGEMENT IN THE INTERNET OF THINGS** — **9 Hours**

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object – Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects

**UNIT III- ARCHITECTURE, PLATFORMS, SERVICES** — **9 Hours**

The Layering concepts , IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN, Platforms - IBM watson-Intel Platform- Carriot Platform- Webnms-deviceWISE

**UNIT IV- SCALABLE INTEGRATION FRAMEWORK** — **9 Hours**

Introduction- IPV6 Potential- IoT6- IPV6 for IoT- Adapting IPV6 to IoT requirement- IoT6 architecture - DigCovery- IoT6 Integration with cloud and EPICS- Enabling Heterogeneous Integration- IoT6 Smart Office use case- Scalability perceptive.

**UNIT V- IOT APPLICATIONS** — **9 Hours**

Smart Environments and Smart Space creation - Connected Devices illustration-Industrial IoT-IERC application Domains-SmartEnvironment Monitoring- Smart Energy - Smart building-Smart Transport and mobility-IoT Smart X applications

| | LECTURE | TOTAL |
|---|---|---|
| HOURS | 45 | 45 |

**TEXT BOOKS**

| | |
|---|---|
| | 1. Ovidiu Vermesan, Peter Friess, "Internet of Things- From Research and Innovation to market Deployment", River Publishers, 2014. |
| | **REFERENCES** |
| | 1. Arshdeep Bahga, Vijay Madisetti Internet of Things: A Hands-On Approach Hardcover – Madisetti Publishers, 2014<br>2. Samuel Greengard, "The Internet of Things", MIT Press, 2015. |
| | **E REFERENCES** |
| | 1. http://postscapes.com/internet-of-things-resources/ |

**Table 1: Mapping of COs with POs**

| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 1 | 3 | | | | | | | | 1 | | 2 | 2 | 3 |
| **CO 2** | 1 | 3 | | | | | | | | | | 1 | 2 | 3 |
| **CO 3** | 1 | 3 | | | | | | | | 1 | | 1 | 2 | 3 |
| **CO 4** | 1 | 2 | | | | | | | | | | 1 | 2 | 3 |
| **CO 5** | | 2 | | | | | | | | | | 1 | 2 | 3 |
| **Total** | 4 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | | 6 | 10 | 15 |
| **Scaled Value** | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 3 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3
1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSECODE | | | XEC801C | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | FUNDAMENTALS OF 5G TECHNOLOGY | 3 | 0 | 0 | 3 |
| PREREQUISITE | | | | | | | |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 3 | 0 | 0 | 3 |

**LEARNING OBJECTIVES**

| | COURSE OUTCOMES | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Discuss*** the need for 5G communication and ***summarize*** the requirement | Cognitive | Understanding |
| CO2 | ***Describe*** Machine type communication in 5G and ***list*** the features of the same | Cognitive | Remembering |
| CO3 | ***Explain***s mall cells and ***defend*** the usage of small cells in 5G | Cognitive | Remembering |
| CO4 | ***Explain*** milli meter wave communication and bean forming in 5G | Cognitive | Understanding |
| CO5 | ***Describe*** orthogonal radio-access technologies in 5G | Cognitive | Understanding |
| CO6 | ***Describe*** **non-** orthogonal radio-access technologies in 5G | Cognitive | Understanding |

**UNIT I - INTRODUCTION** **7 Hours**

Rationale of 5G: high data volume, twenty-five billion connected devices and wide requirements - 10 pillars of 5G-Requirements and key performance indicators 5G system concept Concept overview Extreme mobile broadband Massive machine-type communication Ultra-reliable machine-type communication - Dynamic radio access network 3- Lean system control plane - Localized contents and traffic flows -Spectrum toolbox -The 5G architecture -High-level requirements for the 5G architecture.

**UNIT II- MACHINE-TYPE COMMUNICATIONS** **7 Hours**

Introduction - Use cases and categorization of MTC - MTC requirements -Fundamental techniques for MTC - Data and control for short packets -Non-orthogonal accessG protocols - Massive MTC - Design principles -Technology components - Summary of mMTC features - Ultra-reliable low-latency MTC - Design principles - Technology components.

**UNIT III - SMALL CELLS FOR 5G MOBILE NETWORKS** **8 Hours**

Introduction- What are Small Cells? - WiFi and Femtocells as Candidate Small-Cell Technologies - WiFi and Femto Performance – Indoors vs Outdoors -Capacity Limits and Achievable Gains with Densification - Gains with Multi-Antenna Techniques -Gains with Small Cells - Mobile Data Demand - Approach and Methodology - Demand vs Capacity - Small-Cell Challenges

**UNIT IV - MILLIMETER WAVE COMMUNICATIONS FOR 5G** **9Hours**

Spectrum challenges in 5G-5G spectrum landscape and requirements-5G spectrum technologies-Millimeter wave communications -Spectrum and regulations-Channel propagation-Hardware technologies for mmW systems-Device technology- Antennas-Beamforming architecture-Deployment scenarios - Architecture and mobility - Dual connectivity - Mobility -Beamforming - Beamforming techniques-Beam finding-Physical layer techniques-Duplex scheme - Transmission schemes

**UNIT V - ORTHOGONAL RADIO-ACCESS TECHNOLOGIES** **7 Hours**

Access design principles for multi-user communications-Orthogonal multiple-access systems- Spread spectrum multiple-access systems -Capacity limits of multiple-access methods - Multi-carrier with filtering: a new waveform - Filter-bank based multi-carrier - Universal filtered OFDM

**UNIT VI - INON ORTHOGONAL RADIO-ACCESS TECHNOLOGIES** **7Hours**

| |
|---|
| Non-orthogonal schemes for efficient multiple access - Non-orthogonal multiple access (NOMA) - Sparse code multiple access (SCMA) - Interleave division multiple access (IDMA) - Radio access for dense deployments - OFDM numerology for small-cell deployments - Small-cell sub-frame structure - |

| | LECTURE | TOTAL |
|---|---|---|
| | 45 | 45 |

**TEXT BOOK**

1. Jonathan Rodriguez" Fundamentals of 5G Mobile Networks", John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom
2. AfifOsseiran, Jose F . Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology" Cambridge University Press, 2016.

**REFERENCES**

1.Erik Dahlman (Author), Stefan Parkvall (Author), Johan Skold (Author),"5G NR: The Next Generation Wireless Access Technology",Academic Press; 2nd edition , 2020.

2.by Sasha Sirotkin,"5G Radio Access Network Architecture: The Dark Side of 5G ",Wiley-IEEE Press; 1st edition , 2020.

E-**REFERENCES**

1. Prof. Suvra Sekhar Das, IIT Kharagpur, NPTEL, Evolution of Air Interface Towards 5G", https://nptel.ac.in/courses/108/105/108105134/

**Table 1: Mapping of COs with POs:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 1 | 3 | | 2 |
| **CO 2** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 3 | | 2 |
| **CO 3** | 3 | 2 | 3 | 1 | 1 | 3 | 3 | 1 | 3 | 2 | 2 | 3 | | 2 |
| **CO 4** | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 1 | 2 | 3 | | 2 |
| **CO 5** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 1 | 3 | 1 | 2 | 3 | | 2 |
| **CO6** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 1 | 3 | 1 | 2 | 1 | | 2 |
| **Total** | 18 | 10 | 16 | 7 | 10 | 13 | 16 | 6 | 15 | 7 | 11 | 16 | | 12 |
| **Scaled Value** | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | | 3 |

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3

1 - Low Relation, 2- Medium Relation, 3- High Relation

| COURSE CODE | | | XEC801D | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | REMOTE SENSING | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | Nil | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES: At the end of this course completion, the student can able to | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | *Understand* the remote sensing technology | Cognitive | Understanding |
| CO2 | *Explain* the principles of electromagnetic radiation | Cognitive | Understanding |
| CO3 | *Describe* the atmospheric radiation interactions | Cognitive | Understanding |
| CO4 | *Understand* the laws of planetary motion | Cognitive | Understanding |
| CO5 | *Classify* the different types of resolution. | Cognitive | Understanding |
| CO6 | *Distinguish* the concepts of digital interpretation | Cognitive | Understanding |

| UNITI INTRODUCTION TO REMOTE SENSING | 6 Hours |
|---|---|
| Definition – components of Remote Sensing – History of Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods | |
| **UNIT II ELECTROMAGNETIC RADIATION** | **7 Hours** |
| Electromagnetic Spectrum – Radiation principles - Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff‘s law – Radiation sources: active & passive – Radiation Quantities. | |
| **UNIT III EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL** | **8Hours** |
| Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance– Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region. | |
| **UNIT IV ORBITS AND PLATFORMS** | **8 Hours** |
| Motions of planets and satellites – Newton ‘s law of gravitation – Gravitational field and potential - Escape velocity - Kepler ‘s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit | |
| **UNIT V SENSING TECHNIQUES** | **8 Hours** |
| Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites. | |
| **UNIT VI DATA PRODUCTS AND INTERPRETATION** | **8 Hours** |
| Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification | |
| | **Total Hours : 45 Hours** |

**TEXTBOOKS:**

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, “Remote Sensing and Image interpretation”, John Wiley and Sons, Inc., New York, 2015.

2. George Joseph and C Jeganathan, “Fundamentals of Remote Sensing”, Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

**REFERENCES**

1 Stanley A Morain; Amelia M Budge; Michael S Renslow. “Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing”, Virginia, USA,2019, 4th edition

2. Verbyla, David, “Satellite Remote Sensing of Natural Resources” CRC Press,2022 first edition.

3. Paul Curran P. J. “Principles of Remote Sensing Longman”, RLBS, 1996.

4. Charles Elachi and Jacob Van Zyl,“Introduction to Physics and Techniques of Remote Sensing”. 2021 3rd Edition, Wiley Publication.

5. BasudebBhatta, “Remote Sensing and GIS”, Oxford University Press, 2020 third edition

**E-REFERENCES**

1.https://nptel.ac.in/courses/105108077

2.https://archive.nptel.ac.in/courses/105/103/105103193/

3.https://elearning.iirs.gov.in/

| COURSE CODE | | | XECOE1 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | DISPLAY SYSTEMS | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | Nil | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES: At the end of this course completion, the student can able to | | DOMAIN | LEVEL |
|---|---|---|---|
| CO1 | ***Understand*** the technical requirement of different types of displays systems | Cognitive | Understand |
| CO2 | ***Explain*** Head mounted displays | Cognitive | Understand |
| CO3 | ***Compare*** analyze the various low power lighting systems | Cognitive | Understand |
| CO4 | ***Explain*** the operation of TFTs and LCD displays | Cognitive | Understand |
| CO5 | ***Analyze*** the various kinds of emissive displays | Cognitive | Understand |
| CO6 | critically ***evaluate*** the recent advancements in the displays device technology | Cognitive | Understand |

| UNIT I | 8 Hours |
|---|---|
| Requirements of displays. Display technologies, CRT, Flat panel display. | |
| **UNIT II** | **8 Hours** |
| Head mounted displays. Displays less than and greater than 0.5 m diagonal. | |
| **UNIT III** | **8Hours** |
| Low power and light emitting displays,Touch screen display | |
| **UNIT IV** | **7 Hours** |
| Operation of TFTs and MIMS. LCDs, Brightness Types of LCD displays. | |
| **UNIT V** | **7 Hours** |
| Emissive displays, ACTFEL, Plasma display and Field emission displays, operating principle and performance. | |
| **UNIT VI** | **7Hours** |
| 3D, HDTV, Advanced display technologies, Technical issues in displays. | |
| **Total Hours : 45** | |

**TEXTBOOKS:**

1. L.W. Mackonald & A.C. Lowe, “Display Systems, Design and Applications” Wiley, 2003.
2. E.H. Stupp &M. S. Brennesholtz, Projection Displays, Wiley,1999
3. Robert L. Myers “Display Interfaces Fundamentals and Standards” By Wiley,2003

**REFERENCES**

1.Michael E. Miller “Color in Electronic Display Systems -Advantages of Multi-primary Displays”Springer International Publishing, 2018
2 Peter A. Keller, “Electronic Display Measurement: Concepts, Techniques, and Instrumentation” Wiley-Inter science, 1997.

**E-REFERENCES**

1.https://www.digimat.in/nptel/courses/video/106106090/L03.html
2.https://archive.nptel.ac.in/courses/106/106/106106090/

| COURSE CODE | | | XECOE1 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | HUMAN ASSIST DEVICES | 3 | 0 | 0 | 3 |
| PREREQUISITES | | | Nil | L | T | P | H |
| C | P | A | | 3 | 0 | 0 | 3 |
| 3 | 0 | 0 | | | | | |

| COURSE OUTCOMES: At the end of this course completion, the student can able to | | Domain | Level |
|---|---|---|---|
| CO1 | ***Explain*** the principles and construction of artificial heart | Cognitive | Understanding |
| CO2 | ***Understand*** various mechanical techniques that improve therapeutic technology | Cognitive | Understanding |
| CO3 | ***Explain*** the functioning of the membrane or filter that cleanses the blood | Cognitive | Understanding |
| CO4 | ***Describe*** the tests to assess the respiratory aids . | Cognitive | Understanding |
| CO5 | ***Describe*** the tests to assess the hearing aids | Cognitive | Understanding |
| CO6 | ***Analyze*** and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy. | Cognitive | Understanding |

| **UNIT I - HEART LUNG MACHINE AND ARTIFICIAL HEART** | **9 Hours** |
|---|---|
| Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle. | |
| **UNIT II -CARDIAC ASSIST DEVICES** | **8 Hours** |
| Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques. | |
| **UNIT III -ARTIFICIAL KIDNEY.** | **8 Hours** |
| Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type. | |
| **UNIT IV -RESPIRATORY AND HEARING AIDS** | **7 Hours** |
| Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. | |
| **UNIT V- RESPIRATORY AND HEARING AIDS** | **7 Hours** |
| Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction. | |
| **UNIT VI -RECENT TRENDS** | **6 Hours** |
| Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms. | |
| | **Total Hours : 45** |

**TEXTBOOKS:**

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
2. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004 3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006
3. Ladan Najafi, Donna Cowan "Handbook of Electronic Assistive Technology" By Elsevier Science, 2018

**REFERENCES**

1.Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.
2. D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010
3. Dilber Uzun Ozsahin “Modern Practical Healthcare Issues in Biomedical Instrumentation” Elsevier Science, 2021

**REFERENCES**

1.https://onlinelibrary.wiley.com/doi/abs/10.1002/asjc.2548
2.https://ieeexplore.ieee.org/document/5512465?denied=
3.https://www.binaryrobotics.in/products-and-services/human-assist-robotics

| COURSE CODE | | | XECHR1 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | SERVICE ROBOTICS WITH DRIVES AND SENSORS | 1 | 0 | 2 | 3 |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 1 | 0 | 4 | 5 |

PREREQUISITE: -NIL

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| After the completion of the course, students will be able to | | | |
| **CO1** | ***Analyze*** the Anatomy of a mobile robot | Cognitive | Analyzing |
| **CO2** | Virtually ***Build*** robots in Coppelia Sim | Cognitive | Applying<br>Creating |
| **CO3** | ***Build*** circuits by interfacing sensors and motors with Arduino | Cognitive | Applying<br>Creating |
| **CO4** | ***Build*** Intelligent Behavior in service Robots | Cognitive | Applying<br>Creating |
| **CO5** | ***Understand*** the concept of drives and sensors | Cognitive | Remembering<br>Understanding |

**UNIT I - Principles of Robotics** **3+6**

Introduction to Robotics – What is a robot , Field of Robotics , Robot Classification – Applications of Robots - Introduction to Coppelia Sim – Why we need simulations , How to make the best use of Simulation in Robotics , Difference between Proprietary and Open Source simulations , What is Coppelia Sim , Fundamentals of Coppelia Sim , Building Blocks of Mobile Robot – Coppelia Sim – Station components of Coppelia Sim, Toolboxes in Coppelia - Work with Mobile Robots in Coppelia Sim –Robot Frames – Robot Assembly in Coppelia Sim – Building Blocks of a mobile Robot – Joints – Primitive Shapes – Types of Locomotion – Differential Drive Principle and Locomotion – What is a Differential Drive Robot – Mathematical Modelling of Differential Drive Mechanics – Mobile Robot Principles – Limitations of Mobile Robots – Various Mobile Robot Paradigms – Programming a Differential Drive robot – Programming in Coppelia Sim – What is Lua Programming language – Scripts in Coppelia Sim – Teleoperation of a Differential Drive Robot I – Control of Virtual mobile Robot in Coppelia Sim using Keyboard – Programming the control structure for Robot Teleoperation – Teleoperation of a Differential Drive Robot II – Program debugging and error correction in coppelia sim

**Lab:**

1. **Offline Programming with Coppelia Sim**
2. **Workspace building with Coppelia Sim**
3. **Modelling Differential Drive Robot in Coppelia Sim**
4. **Programming Differential Drive Robot in Coppelia Sim**
5. **Teleoperate a Mobile Robot**

**UNIT II -Robot Perception** **3+6**

Introduction to Braitenberg Robots – Braitenberg Principle – Examples of Braitenberg Robots – Different Robot Paradigms – Working with Reactive Paradigm – Imparting Intelligent Behaviors using Braitenberg Principle – Examples of Braitenberg Robots – Introduction to Robot Perception – What is a Sensor – Characteristics of a Sensor – Different sensors for Service Robots – Working with Proximity sensors – Principles and Types of Proximity Sensors – Object Detection in Coppelia Sim – Proximity sensors for detecting obstacles – Data Acquisition from Robots – Case Study –

Introduction to Robot Mapping – Using proximity sensors for Robot Mapping – Obstacle Avoidance in Coppelia Sim – Different Obstacle Avoidance algorithms – Working with Bug 1 and Bug 2 algorithms – Maze Building – Using Vision sensors for Obstacle detection and Avoidance – Introduction to Vision Sensors – Fundamentals of Vision sensors – Principles of Camera and Image formation – Applications of Vision sensors in Robotics – Image Processing in Coppelia Sim – Object Detection using Vision – Braitenberg Robots – Line following – Principles of Line following Sensors used in Line Following – Applications of Line following robots in Industry – Visual Servoing – What is Visual Servoing – Sensors used in visual Servoing – Fundamentals of Object tracking – Gesture Recognition – Detecting Gestures using Camera – Introduction to Python – Python Crash course – Connecting Python with Coppelia Sim – Gesture Recognition in Python

**Lab:**

6. **Robot Mapping**
7. **Performing Obstacle Avoidance in Coppelia Sim**
8. **Building and Programming a Line following robot in Coppelia Sim**
9. **Gesture Recognition Robot**

| **UNIT III - Aerial & Bio Inspired Robots** | **3+6** |
|---|---|

Introduction to Aerial Vehicles - Parts of a quadcopter & Flying Techniques - Piloting
Way point programming - Building of Drone Frame - Aerial Mapping - Inspection of quarantine zones – Bioinspired Robots - Control of legged robot in Coppelia Sim - What is a gait? - Different gait motions in animals & humans - Assembly of legged robot - Calibration and control of legged robot - Programming of legged robot - What is a Humanoid Robot – Principle of Humanoid Robot – Handling Gaits in Humanoid Robots – Challenges in Biped Motion

**Lab:**

**10. Building a Mobile Robot Motion model**
**11. Programming and Controlling an Unmanned Aerial Vehicle**
**12. Gait Analysis and Control of Bio inspired Robots**
**13. Working with Humanoid Robots**

| **UNIT IV -Building Robots (Hardware)** | **3+6** |
|---|---|

Build Robots in Real Time – Arduino – Fundamentals of Arduino – Components in Prag Auxiliary Kit – Programming LED, Motors in Arduino – Working with a Potentiometer in Arduino – Programming sensors in Arduino – Build Robots in Real time – Robot Assembly – Assembling a Mobile Robot – Connecting Arduino with Ultrasonic Sensor – Connecting Arduino with Infra-red sensors – Understanding Omni Directional Motion in Mobile Robot – Building Braitenberg Robots in Real time

**Lab:**

**14. Building a Bluetooth-controlled Robot**
**15. Build an Obstacle Avoidance Robot**
**16. Build a Line Following Robot**

| **UNIT V –Drives and Sensors** | **3+6** |
|---|---|

Principles of Hydraulics- Construction of Hydraulic circuits-valves-direction controlvalve, pressure release valve, pressure regulate valve, oil tank & filters - Principles onofpneumatics-Constructionofpneumaticcircuits-valves-directioncontrolvalve, pressurereleasevalve,pressureregulate valve,aircompressors& filters–Introductionto Industrialsensors-studyofcharacteristicsofinductive,capacitive,resistive,photoelectric sensorsandultrasonic sensor.

**Lab:**

**21. Hydraulic-Operationofsingleactinganddoubleactingcylinders**
**22. Operationofelectrohydraulics**
**23. Pneumatics-Operationofsingleactinganddoubleactingcylinders**

| | | | |
|---|---|---|---|
| **24. Operationofelectropneumatics**<br>**25. Sensors-inductive,capacitive,resistive**<br>**Sensors-photoelectricsensorsandultrasonicsensors** | | | |
| **LECTURE** | **TUTORIAL** | **PRACTICAL** | **Total hours** |
| **15** | **0** | **30** | **45** |
| | | | |
| **TEXT BOOKS:** | | | |
| 1.Springer Handbook of Robotics. (n.d.). Germany: Springer International Publishing. | | | |
| **REFERENCES:** | | | |
| 1.Introduction to Robotics by J.J. Craig, Addison-Wesley Publishing Company, 1986 owozin and Lampert<br>2.J.Buchli (eds.): "Mobile Robots - Moving Intelligence", Published by Advanced Robotic Systems International Verlag, 2006 | | | |

| COURSE CODE | | | XECHR2 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | INDUSTRIAL ROBOTICS AND AUTOMATION | 1 | 0 | 2 | 3 |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 1 | 0 | 4 | 5 |

PREREQUISITE:

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| After the completion of the course, students will be able to | | | |
| **CO1** | ***Analyze*** the Anatomy of an Industrial Robot | Cognitive | Analyzing |
| **CO2** | ***Illustrate*** Industrial Robot Operation | Cognitive | Understanding |
| **CO3** | ***Build*** a Robot Work cell using ABB Robot Studio | Cognitive | Application Creating |
| **CO4** | ***Analyze*** Rapid programming commands for Industrial Robotics | Cognitive | Application Creating |
| **CO5** | ***Understand*** the construction of logic circuits using PLC | Cognitive | Remembering Understanding |

**UNIT I - Fundamentals of Industrial Robotics** **3+6**

Basics of Industrial Robot - What is an Industrial Robot? - Building blocks of Industrial Robots - Robot Modes & Manual Motion Types - Major Stakeholders of Industrial Robotics - Robotics Environment & Career - Offline Simulation Tool - Industrial Robot Operation - Usage and Applications of Industrial Robots - Automatic Motion Types – Introduction to Robot Studio - Importing robot and virtual controller - Robot Specification - Robot Jogging - What is a Teach Pendent? - Creating targets & paths - Robot Frames - Modes of operation - Industrial Robot Programming Language - Types of Robot Programming - Various Robot Programming languages - Motion Commands in RAPID - Path planning

**Lab:**

1. **Fundamentals of Robot Studio**
2. **Robot Jogging in ABB Robot Studio**
3. **Robot Modes of Operation**
4. **Online Programming using Virtual Teach Pendant**
5. **Creating & Teaching Targets and Paths**

**UNIT II - Virtual Commissioning using Industrial Robot** **3+6**

What is Virtual Commissioning - What is Robot Dispensing - Import Robot & - Components – Dispensing - Dispensing Robot Work cell - Auto Path and Tool Orientation Correction - Path Planning for Dispensing - Material Handling - Robot Work cell - Smart Components Design - Gripper Integration with Robot - Pick & Place with ABB Smart Gripper

**Lab:**

6. **Virtual Commissioning of Robot Dispensing work cell**
7. **Auto path in ABB Robot Studio**
8. **Virtual Commissioning of Material Handling Operation**

**UNIT III -Build Robot Work cells using ABB Powerpacs** **3+6**

What is a Powerpac – Working on conveyor Tracking - What is Conveyor Tracking? - Introduction to parallel Robots - Logic Formulation of Conveyor Tracking - Conveyor Tracking

in ABB Robot studio - Robot Powerpacs – Palletizing Introduction to Palletizing operation - Component Checklist in Palletizing work cell - Virtual commissioning of a Robot Palletizing Work cell - Cycle time analysis - Robot Powerpacs - 3D printing - Introduction to Rapid Prototyping - Various Rapid Prototyping Techniques - Fundamentals of 3D printing - Virtual commissioning of a robot 3D printing work cell

**Lab:**

9. **Conveyor Tracking in ABB Robot studio**
10. **Building a Palletizing operation using Palletization powerpac**
11. **Optimizing operation Cycle time**
12. **Building a robot 3D printing operation using 3D printing powerpac**

| **UNIT IV -Robot Operation** | **3+6** |
|---|---|

Robot Operation – Understanding the anatomy of industrial robot - Robot work envelope - Robot specifications - Remote operation of Manipulator - What is lead through programming? - Joint Interpolation and Linear Interpolation - Jogging of robots - Online programming - Path planning using lead through programming - Robot End Effector – Performing the robot application – Working with IRC5 – Working with Emergency and General Stops

**Lab:**

13. Robot Jogging of ABB Robot using Teach pendant
14. Working with Industrial Robot Controller 5
15. Online Programming with Teach Pendant
16. Building Robot Application using ABB Robot

| **UNIT V –Programmable Logic Controllers** | **3+6** |
|---|---|

IntroductiontoIndraLogic–Understandingtheconstructionofbasiclogiccircuits–AND,OR,NOTetc–Logiccircuitsimulation-set,rest,latching,subprogramming-Introduction to Hardware kit L20DB .Function-user define function and library function-timers –Ontimer, OFF timer, Counters-UP counter and Down counter, Triggers-Riseing trigger and falling triggers

**Lab:**

21.Trafficlightsignalcontrol22.Oiltankfillingstation23.Double actingcylinders24.IntegrationofsensorswithPLC25.Smartroom

| **LECTURE** | **TUTORIAL** | **PRACTICAL** | **Total Hours** |
|---|---|---|---|
| **15** | **0** | **30** | **45** |

**TEXT BOOKS:**

Introduction to Robotics by J.J. Craig, Addison-Wesley Publishing Company, 1986 owozin and Lampert

**REFERENCES:**

Programming and Virtual Commissioning Reference Material by Prag Robotics
ABB Robot Studio Official Documentation
The Robotics Primer, Maja J. Mataric, MIT Press, 2007

**E-REFERENCES:**

Robot Modeling and Control", Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, 2005

| COURSE CODE | | | XECHR3 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | FUNDAMENTALS OF ROS AND EMBEDDED IN ROBOTICS | 1 | 0 | 2 | 3 |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 1 | 0 | 4 | 5 |

PREREQUISITE: NIL

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| After the completion of the course, students will be able to | | | |
| **CO1** | ***Design*** Robot architecture based on the Environment condition | Cognitive | Creating |
| **CO2** | ***Analyze*** uncertainty in sensors | Cognitive | Analyzing |
| **CO3** | ***Apply*** Path planning and navigation in unknown environment | Cognitive | Applying |
| **CO4** | ***Build*** Robot Software using Robot Operating System | Cognitive | Applying Creating |
| **CO5** | ***Understand*** the programming concept in firebird V kit | Cognitive | Remembering Understanding |

**UNIT I - Essentials for Robot Operating System** **3+4**

Introduction to Mobile Robots - What is a Mobile Robot? - Different Types of Mobile Robot - Applications of Mobile Robots - Architecture of a Mobile Robot - Challenges in Mobile Robotics - Different Robot Drives – Wheeled Robotics - Characteristics of a Wheeled Robot - Different Types of Mobile Robot Drives - Holonomic and Non-Holonomic Motion - Various Steering Mechanisms – Robot Paradigms - What is a Robot Paradigm? - Working with Reactive Paradigm - Introduction to Deliberative Paradigm - Working with Hybrid Paradigm – Introduction to ROS - What is Simulation? - Need for Simulation - Simulation Environments for Robotics - What is ROS? - Features of ROS - ROS - Types, Distributions & Programming languages – Software Installation - Installing Virtual Machine - Installing Ubuntu - Installing ROS - Checking of ROS Installation - Installing VS Code - Explain Basic Movement – Linux Basics - Understanding File Hierarchy and Navigation - Understanding File Permissions - File and Folder Handling - Administrative Management - Package Management – C++ basics - Enabling C++ Extensions - Datatypes & Variables – Loops - Conditional Statements

**Lab:**

1. **Crash course on Linux management**
2. **Foundations of C++**
3. **Crash Course on Python**

**UNIT II - Fundamentals of Robot Operating System** **3+6**

Fundamentals of ROS - Creating Catkin Workspace - Understanding Packages - Create ROS Package - Building Environment in Gazebo - Installation of TurtleBot Packages - Import In-built Robots in ROS - Installing Teleoperation Dependencies - Teleoperation of Mobile Robot in ROS - Understanding ROS Nodes - Intuition of ROS Topics - ROS Services and Parameters - ROS Launch - Introduction to ROS Message and SRV - ROS Publisher and Subscriber - Build Custom Robot in ROS - Principle of Differential Drive Robot - Building URDF File and Robot Base - Building Robot Wheels - Joining Wheels and Base - Test URDF File - Creating Launch File and Launching Code - Visualization using RViz - Creating Macro-Based Files - Programming Robot Macro File - Programming Gazebo Macro File - Converting Macro File to URDF - Creating Launch Files and Folder - Creating Launch File for Gazebo - Creating Launch File for Environment - Creating Robot

World - Launching Gazebo Environment - Programming Mobile Robot Macro File - Teleoperation of Mobile Robots

**Lab:**

4. **Fundamental Operations of Robot operating system**
5. **Teleoperation of Turtle Bot in ROS**
6. **Building a URDF file for Mobile Robot**
7. **Foundations of Rviz and Gazebo**
8. **Programming Gazebo Macro files**
9. **Programming Differential Robot Macro file**

| **UNIT III - Robot Perception in Robot Operating System** | **3+6** |
|---|---|

Introduction to Robot Perception - What is Robot Perception? - Sensor Classification Characterizing sensor performance - Representing Uncertainty - Introduction to Proximity sensors - Modifying Robot Macro File for SONAR - Modifying Gazebo Macro File for SONAR - Executing SONAR Robot – Robot Vision in ROS - Vision Sensors for Robotics - Basic Image Processing Operations in OpenCV - What is CV Bridge? - Video Processing in ROS - Understanding Template Matching - Template Matching using CV Bridge – Uncertainty in Robot Sensors – Handling Sensors using - Probability – Robot Localization - What is Localization? - Challenges in Robot Localization - Adaptive Monte Carlo Localization – Introduction to Robot Mapping - What is Robot Mapping? - Autonomous Mapping techniques - Introduction to - Occupancy Grid maps - Creating Launch File

**Lab:**

10. **Obstacle detection and Avoidance in Robot Operating System**
11. **Template matching in ROS**
12. **Building Map using LIDAR and Gmapping Package**
13. **Adaptive Monte Carlo Localization in Robot Operating System**

| **UNIT IV - Path planning and Navigation** | **3+7** |
|---|---|

Path planning and Navigation - What is Robot Path planning? - Road Map path planning - Visibility Graphs - Potential Field Path planning - Obstacle Avoidance - Working with Bug Algorithms - Dynamic Window approach - Understanding Navigation Architectures - Navigation Stack in ROS – Introduction to SLAM - What is Simultaneous Localization and Mapping - Challenges in Simultaneous Localization and Mapping - Various SLAM Techniques - Performing Simultaneous Localization and mapping in ROS

**Lab:**

14. **Path Planning of Mobile Robot using Local planner**
15. **Working with Dynamic Window approach in ROS**
16. **Working with Navigation stack in ROS**

| **UNIT V -Embedded system programming usinge-yantra** | **3+7** |
|---|---|

Introductionto EyantraTeam-Architecture ofFirebirdVkit-sensorsinfirebirdVkit-encoders-Introductiontoembeddedsystem codingandburningofcode.

**Lab:**

**21.Line trackingrobot**
**22.Programming for s curved motion**
**23.Programmingforobstacledetection**
**24.Material handling system**
**25.Service/Surveybot**

| LECTURE | TUTORIAL | PRACTICAL | Total hours |
|---|---|---|---|
| 15 | 0 | 30 | 45 |

**TEXT BOOKS:**

Introduction to Autonomous Mobile Robots, 2nd Edition, Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, MIT Press, 2011

| **REFERENCES:** |
| --- |
| Modern Robotics: Mechanics, Planning, and Control, Kevin M. Lynch and Frank C. Park, Cambridge University Press, 2017, ISBN 9781107156302<br>Planning Algorithms, Steven M. LaValle, Cambridge University Press, 2006<br>Computational Principles of Mobile Robotics, Gregory Dudek and Michael Jenkin, Cambridge University Pres, 2010 |
| **E-REFERENCES:** |
| Thrun, Burgard, Fox: Probabilistic Robotics, MIT Press, 2005 |

| COURSE CODE | XECHR4 | L | T | P | C |
|---|---|---|---|---|---|
| COURSE NAME | ARTIFICIAL INTELLIGENCE AND COMPUTER VISION FOR ROBOTICS | 1 | 0 | 2 | 3 |

| C | P | A | L | T | P | H |
|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 1 | 0 | 4 | 5 |

PREREQUISITE:

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| After the completion of the course, students will be able to | | | |
| **CO1** | ***Define*** intelligence and its paradigms | Cognitive | Remembering |
| **CO2** | ***Build*** Machine Learning Models | Cognitive | Applying Creating |
| **CO3** | ***Build*** Vision pipelines with Digital image processing techniques | Cognitive | Applying Creating |
| **CO4** | ***Compare*** feature extraction methods | Cognitive | Understanding |
| **CO5** | ***Build*** Deep learning Based Robot Applications | Cognitive | Applying Creating |

**UNIT I - Foundations of Artificial Intelligence** **3+4**

Introduction to Artificial Intelligence - What is Artificial Intelligence? - Different paradigms in Artificial Intelligence - Applications of Artificial Intelligence in Robotics – Elements of Artificial Intelligence - What is an Agent - Different types of Agents - What is an Environment - Nature of the environments – Search Algorithms in Robotics - What is Search - Uninformed Search - Different Uninformed Search Algorithms - Implementation of BFS algorithm in Python - Greedy search algorithm - A* Algorithm - Finding Optimal Path using Search algorithms - Robot Navigation using A* Algorithm – What is State estimation? – Noise in Robot Sensors

**Lab:**

1. **Implementation of Breadth First Search Algorithm in Python**
2. **Robot Navigation using A* algorithm**

**UNIT II -Nuances for Machine Learning** **3+6**

Introduction to Machine learning - What is Machine Learning? - Paradigms in Machine learning - Difference between classical AI and Machine Learning - Applications of Machine Learning - Introduction to Python Packages – NumPy - What is NumPy? - Arrays in NumPy - Creating Vectors – Matrices - Matrix Operations - Trace, Determinant, Inverse - Sparse Matrix - n-dimensional array - Introduction to Python Packages – Pandas - Introduction to Data frames, Data structures - Data sorting - Data Iteration - Handling Text data - Introduction to Machine Learning - Basics of Machine Learning - Types of Machine Learning - Machine Learning Algorithms - Mathematical foundations - Supervised Learning – Classification - Difference between regression and classification - Introduction to Logistic Regression and support vector machine - Mathematical foundations-Logistic Regression - Programming of Logistic Regression in Python-scikit learn

**Lab:**

3. **Essentials of Python for Machine Learning – NumPy**
4. **Essentials of Python for Machine Learning – Pandas**
5. **Building a Logistic Regression Model in Python**

**UNIT III - Computer Vision for Robotics** **2+6**

Fundamentals of Computer Vision - Introduction to Computer vision - Applications of Computer vision - Difference between computer vision and Digital Image Processing -

Introduction to Image formation - Introduction to vision sensors - What is an Image? - How is an Image formed? - Image formation using Lens - Pinhole & Perspective projection – Depth of Field - Image parameters - Primitives and Transformations - Geometric Image formation - Camera Model – Image sensing - Image sensing Pipeline - Types of Image sensors - Characteristics of an Image sensor - Sensing Color - Camera response and stereo imaging - Fundamentals of Image operations - Image Processing - Installation of OpenCV - Reading Images - Reading Videos - Changing Color spaces - Image Resizing - Color Change - Pixel Manipulation -Blurring Image – Blending - Subtraction – Image – Thresholding & Filtering - What is Thresholding - Working and Types of Thresholding - Introduction to Simple Thresholding - Programming Simple Thresholding – Color - What is Adaptive Thresholding - Types of Adaptive Thresholding - Adaptive Thresholding - Gaussian & Mean - What is an Image Filter - Noise in Images = Working with Gaussian Filter - Working with Sobel Filter - Working with Prewitt Filter

**Lab:**

6. **Fundamentals of Image Processing in OpenCV**
7. **Image Thresholding and Filtering**
8. **Morphological Operations in OpenCV**

| **UNIT IV - Feature Extraction and Object Recognition** | **3+8** |
|---|---|

Feature Extraction - Introduction to Feature extraction - Various Feature Extraction Techniques - What is Edge detection? - Various Edge detection techniques - Boundary Detection – Skeletonization - Introduction to Histogram of Gradients - Understanding Feature Matching Using HOG - Introduction to SIFT detector - Image Stitching - Motion Detection - What is Motion Detection? - Motion field - Introduction to Optical Flow - Optical Flow constraint equation - Introduction to Dense Optical Flow - Applications of Optical Flow - Image Recognition I – What is Image recognition – Challenges in Image Recognition – Feature Extraction - Introduction to Dimensionality Reduction - Principle Component Analysis - Creating final Dataset for Image Recognition - Introduction to Support Vector Machines - Mathematical Intuition of SVM - Generation of Eigen Faces using PCA - Image recognition using SVM in Python - Confusion Matrix

**Lab:**

9. **Feature Extraction using Edge detection in Open CV**
10. **Implementation of Scale Invariant Fourier Transform in Open CV**
11. **Implementation of Dense Optical Flow in OpenCV**
12. **Image Recognition using PCA and SVM**

| **UNIT V -Deployment of Artificial Intelligence on Edge** | **4+6** |
|---|---|

Artificial Intelligence on edge - Computation for Artificial Intelligence - Deploying AI on embedded devices - Various single board architectures for Artificial Intelligence – Working with Tiny ML kit – Architecture of Arduino Nano 33 BLE sense – Data Acquisition using sensors – Working with OVI7675 camera module – Data Streaming and transfer using Bluetooth – Creating Machine Learning Pipeline on embedded devices

**Lab:**

13. **Data Acquisition from Accelerometer, gyroscope and magnetometer**
14. **Building a Weather prediction Model using TinyML kit**
15. **Build an Audio Classification Model using TinyML kit**
16. **Develop a Fruit classification Model using TinyML kit**
17. **Develop a Gesture Control Model using TinyML kit**

| LECTURE | TUTORIAL | PRACTICAL | Total hours |
|---|---|---|---|
| 15 | 0 | 30 | 45 |

| |
|---|
| **TEXT BOOKS:** |
| Mitchell, T. M. (1997). Machine Learning. Germany: McGraw-Hill.<br>Computer Vision: Algorithms and Applications, by Richard Szeliski |
| **REFERENCES:** |
| Machine Learning: A Probabilistic Perspective, Kevin P. Murphy<br>Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce |
| **E-REFERENCES:** |
| |

| COURSE CODE | | | XECHR5 | L | T | P | C |
|---|---|---|---|---|---|---|---|
| COURSE NAME | | | DEEP LEARNING FOR ROBOTICS | 1 | 0 | 2 | 3 |
| C | P | A | | L | T | P | H |
| 3 | 0 | 0 | | 1 | 0 | 4 | 5 |

PREREQUISITE:

| COURSE OUTCOMES | | DOMAIN | LEVEL |
|---|---|---|---|
| After the completion of the course, students will be able to | | | |
| **CO1** | ***Summarize*** the Nuances of Deep Learning | Cognitive | Understanding |
| **CO2** | ***Build*** Deep Learning applications using TensorFlow | Cognitive | Applying<br>Creating |
| **CO3** | ***Analyze*** the architecture and working of Jetson Nano | Cognitive | Analyzing |
| **CO4** | ***Build*** Deep Learning Pipelines using Jetson Nano | Cognitive | Understanding |
| **CO5** | ***Compare*** Deep Learning Models | Cognitive | Creating |

**UNIT I -Foundations of Deep Learning** **3+2**

Introduction to Deep learning - What is Deep Learning? - Challenges in Machine Learning - Representation Learning - Deep Learning Vs Machine Learning - Why go deep? - Applications of Deep learning - Various Deep Learning Models – Working with Pycharm - Fundamentals of Neural Networks – What is an Artificial Neural Network – Structure of Artificial Neural Network – Motivation of Deep Learning from Biological Neurons – Working with Fundamental Neural Networks – McCulloch Pitts Neuron – Boolean Functions – XOR problem – Components of a Neural Network – Weights and Bias – Activation Functions – Threshold Value - Perceptron Learning Rule

**Lab:**

1. **Installation of PyCharm**
2. **Software Handling in PyCharm**
3. **Building a Simple Artificial Neural Network**
4. **Building a Single Layer Perceptron Model**

**UNIT II - Fundamentals of Tensor Flow** **3+6**

Developer Tools for Deep Learning Project - Introduction to TensorFlow - Installation of TensorFlow - What is a Tensor? - TensorFlow Ecosystem - What is Keras? – Tensor Data structure – Rank – Shape – Type – Tensor Handling and Manipulation – Importing and Handling Data in TensorFlow – Exploring Data – Feature Extraction - Building Neural Network in TensorFlow – Working with Tensor Board - Scales and Metrics in Tensor Board - Visualizing Image data in Tensor Board - Model graphs in Tensor Board – Optimization in TensorFlow – Learning parameters in Neural Networks - Gradient Descent Algorithm – Stochastic Gradient Descent Algorithm – Backpropagation - Hyper parameter tuning - Fairness Indicators

**Lab:**

5. **Fundamentals of TensorFlow – I**
6. **Fundamentals of TensorFlow - II**
7. **Build a Logistic Regression Model in TensorFlow**
8. **Implementation of Gradient Descent Algorithm**
9. **Implementation of Stochastic Gradient Descent Algorithm**

**UNIT III - Deep Neural Networks** **3+8**

What is Deep Neural Network? - Shallow Vs Deep Neural Networks - What are hidden units - Multi-Layered Perceptron - Build Multi-Layered Perceptron Using TensorFlow - Deep Learning in

Computer Vision - Challenges in Artificial Vision - Shift Invariance Systems - Understanding Convolutions - Fundamentals of Convolutional Neural Network - Components of Convolutional Neural Network - Convolutional Neural Network Architecture - Challenges with Convolutional Neural Network - Working with AlexNet, VGG Net, GoogLeNet - Applications of Convolutional Neural Networks in Vision - Build an Image classification Deep Learning Model using CNN - Hyper parameter tuning - Working with Transfer Learning - What is Transfer Learning? - Significance of Transfer Learning - Fundamentals of transfer learning – Developing an Audio Recognition system using transfer learning

**Lab:**

10. **Build a Multiple Layer Perceptron Model in TensorFlow**
11. **Building an Image recognition system using Convolutional Neural Network**
12. **Build a Transfer Learning Model for Audio Recognition**

| **UNIT IV - Recurrent Neural Networks and GAN** | **4+6** |
|---|---|

Recurrent Neural Networks - Sequential Data - Sequence Modelling - Problem with Vanishing and Exploding gradients - Back-propagation through time - Recurrent Neural Networks Architectures - Applications of Recurrent Neural Networks - Bidirectional RNN - Text Classification using RNN - Working with Long Short-Term Memory - The Long Short – Term Memory Networks - Working with Time series data – Image Captioning - Introduction to Generative Adversarial Networks - GAN Architecture - Generator Network - Discriminator Network - Minimax Formulation – DCGAN

**Lab:**

13. **Stock price prediction using Long Short-Term Memory**
14. **Developing an Image captioning Model**
15. **Building a simple Generative Model in TensorFlow**

| **UNIT V -Deep Learning Models with Jetson Nano** | **2+8** |
|---|---|

Introduction to Jetson Nano – Deploy Deep Learning on Embedded Device – Architecture and Pin Diagram of Jetson nano – Features in Jetson Nano – Basics of Linux – Installation of Operating System – Handling Vision in Jetson Nano – Image acquisition in jetson Nano – Computer vision operations in Jetson Nano – Video Analysis in Jetson Nano - Fundamentals of Pytorch – Pytorch Vs TensorFlow – Object Detection - Various Object Detection algorithms - Implementation of Object Detection using Deep Learning Model - Collision Avoidance - Various sensors for Detecting obstacles – Image collection and Annotation – Run inference on Jetson Nano – Basics of Image segmentation - Semantic Segmentation

**Lab:**

16. **Fundamentals of NVIDIA Jetson Nano**
17. **Video Analysis in Jetson Nano**
18. **Foundations of PyTorch**
19. **Object Detection and Localization**
20. **Semantic Segmentation in Jetson Nano**

| LECTURE | TUTORIAL | PRACTICAL | TOTAL HOURS |
|---|---|---|---|
| 15 | 0 | 30 | 45 |

**TEXT BOOKS:**

Goodfellow, I., Bengio, Y., Courville, A. (2016). Deep Learning. United Kingdom: MIT Press.

**REFERENCES:**

Skansi, S. (2018). Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence. Germany: Springer International Publishing.

Gibson, A., Patterson, J. (2017). Deep Learning: A Practitioner's Approach. Taiwan: O'Reilly Media.