# Course Curriculum for Degree Programme
# in
# Electronics & Communication Engineering

## Department of Electronics & Communication Engineering

**Sant Longowal Institute of Engineering & Technology**
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## VISION

The Department of Electronics & Communication Engineering shall strive to create engineering technocrats for addressing the global challenges in relevant areas to cater the ever-changing needs of society at National and International level.

## MISSION

1. To ensure dissemination of knowledge through effective teaching and learning in Electronics and Communication Engineering.
2. To excel in Research and Development activities in emerging areas.
3. To promote industry-institute and institute-institute linkages for sustainable development of academic, research, training and placement activities.
4. To establish centre of excellence in thrust areas to nurture the spirit of innovation and creativity among faculty and students.

## Programme Educational Objectives (PEOs)

1. To be well acquainted with fundamentals of Electronics & Communication Engineering for leading a successful career in industry or as an entrepreneur or pursuing higher education.
2. To inculcate rational approach towards constantly evolving technologies with ethical responsibilities.
3. To foster techno-commercial skills for innovative solutions in Electronics & Communication Engineering or related areas.
4. To participate in life-long learning in the relevant domain for addressing global societal needs.

## Programme Outcomes (POs)

After successful completion of B.E. (Electronics & Communication Engineering) program, the engineering graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Program Specific Outcomes (PSOs)

**PSO1:** Ability to participate successfully in competitive examinations, career advancement and higher studies with professional ethics.

**PSO2**: Ability to solve real world problems in Electronics and Communication Engineering using state of art techniques, along with analytical and managerial skills.

# B.E. (Electronics and Communication Engineering)

| Semester-I (Group-A) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | BSMA-401 | Engineering Mathematics I | 3 | 1 | 0 | 4 | 4 |
| 2 | BSPH-401 | Applied Physics | 3 | 1 | 0 | 4 | 4 |
| 3 | ESEE-401 | Elements of Electrical Engineering | 2 | 1 | 0 | 3 | 3 |
| 4 | ESCS-401 | Elements of Computer Engineering | 2 | 0 | 0 | 2 | 2 |
| 5 | ESEC-401 | Elements of Electronics Engineering | 2 | 0 | 0 | 2 | 2 |
| 6 | BSPH-402 | Applied Physics Lab | 0 | 0 | 2 | 2 | 1 |
| 7 | ESEE-402 | Elements of Electrical Engineering Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | ESCS-402 | Elements of Computer Engineering Lab | 0 | 0 | 4 | 4 | 2 |
| 9 | ESEC-402 | Elements of Electronics Engineering Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **12** | **3** | **10** | **25** | **20** |

| Semester-II A (Group-A) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | BSMA-402 | Engineering Mathematics II | 3 | 1 | 0 | 4 | 4 |
| 2 | BSCH-401 | Applied Chemistry | 3 | 1 | 0 | 4 | 4 |
| 3 | ESME-401 | Elements of Mechanical Engineering | 2 | 1 | 0 | 3 | 3 |
| 4 | ESME-402 | Workshop Technology and Practice | 1 | 0 | 0 | 1 | 1 |
| 5 | HSMC-401 | English Communication and Soft Skills | 1 | 0 | 0 | 1 | 1 |
| 6 | BSCH-402 | Applied Chemistry Lab | 0 | 0 | 2 | 2 | 1 |
| 7 | ESME-403 | Elements of Mechanical Engineering Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | ESME-404 | Engineering Drawing | 0 | 0 | 4 | 4 | 2 |
| 9 | ESME-405 | Workshop Technology and Practice Lab | 0 | 0 | 4 | 4 | 2 |
| 10 | HSMC-402 | English Communication and Soft Skills Lab | 0 | 0 | 2 | 2 | 1 |
| 11 | MCCH-401 | Environmental Studies | 3 | 0 | 0 | 3 | 0 |
| | | **Total** | **13** | **3** | **14** | **30** | **20** |
| **Semester-II-B** | | | | | | | |
| | TPIN-421 | Practical Training During Summer Vacations (In -house) 02 weeks | 0 | 0 | 40 | 40 | 1 (S/US) |
| | TPIN-422 | Technical Competency | 0 | 0 | 40 | 40 | 1 (S/US) |

| | Semester-III | | | | | | |
|---|---|---|---|---|---|---|---|
| S.No | Sub Code | Subject Name | L | T | P | Hrs. | Credits |
| 1 | BSMA-501 | Numerical and Statistical Methods | 3 | 0 | 0 | 3 | 3 |
| 2 | PCEC-511 | Network Analysis & Synthesis | 2 | 1 | 0 | 3 | 3 |
| 3 | PCEC-512 | Digital System Design | 2 | 1 | 0 | 3 | 3 |
| 4 | PCEC-513 | Signals & Systems | 2 | 1 | 0 | 3 | 3 |
| 5 | PCEC-514 | Electronic Devices & Circuits | 3 | 0 | 0 | 3 | 3 |
| 6 | BSBL-501 | Biology for Engineers | 2 | 0 | 0 | 2 | 2 |
| 7 | BSMA-502 | Numerical and Statistical Methods Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | PCEC-515 | Digital System Design Lab | 0 | 0 | 4 | 4 | 2 |
| | | **Total** | **14** | **03** | **06** | **23** | **20** |

| | Semester-IV-A | | | | | | |
|---|---|---|---|---|---|---|---|
| S.No | Sub Code | Subject Name | L | T | P | Hrs. | Credits |
| 1 | ESME-501 | Engineering Mechanics | 3 | 1 | 0 | 4 | 4 |
| 2 | PCEC-521 | Analog Communication | 3 | 0 | 0 | 3 | 3 |
| 3 | PCEC-522 | Analog Electronic Circuits | 2 | 1 | 0 | 3 | 3 |
| 4 | PCEC-523 | Microprocessor & Microcontroller | 3 | 0 | 0 | 3 | 3 |
| 5 | HSMC-501 | Principles of Management | 3 | 0 | 0 | 3 | 3 |
| 6 | PCEC-524 | Analog Electronic Circuits Lab | 0 | 0 | 2 | 2 | 1 |
| 7 | PCEC-525 | Microprocessor & Microcontroller Lab | 0 | 0 | 4 | 4 | 2 |
| 8 | PCEC-526 | MATLAB Programming Lab | 0 | 0 | 2 | 2 | 1 |
| 9 | MCMH - 501 | Constitution of India | 3 | 0 | 0 | 3 | 0 |
| | | **Total** | **17** | **02** | **8** | **27** | **20** |

| Semester-IV-B | | | | | | | |
|---|---|---|---|---|---|---|---|
| | TPID-521 | Industrial Training 02 weeks | 0 | 0 | 40 | 40 | 1 (S/US) |
| | EAA-521+ | Fractional credit course/Extra Academic Activity +GROUP A/B/C | 0 | 0 | 40 | 40 | 1 (S/US) |

| Semester-VA | | | | | | | |
|---|---|---|---|---|---|---|---|
| S.No | Sub Code | Subject Name | L | T | P | Hrs. | Credits |
| 1 | PCEC-611 | Digital Communication | 3 | 0 | 0 | 3 | 3 |
| 2 | PCEC-612 | EMF & Transmission Lines | 3 | 0 | 0 | 3 | 3 |
| 3 | OEXX-611 | Open Elective-1 | 3 | 0 | 0 | 3 | 3 |
| 4 | OEXX-612 | Open Elective-2 | 3 | 0 | 0 | 3 | 3 |
| 5 | PEEC-611 | Professional Elective-1 | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | HSMC-601 | Technical Communication | 2 | 0 | 0 | 2 | 2 |
| 7 | PCEC-613 | Analog & Digital Communication Lab | 0 | 0 | 4 | 4 | 2 |
| 8 | HSMC-602 | Technical Communication Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **17** | **0** | **6** | **23** | **20** |
| 9* | HDEC-611 | Hon's Subject-1 | | | | | 4 |
| 10* | HDEC-612 | Hon's Subject-2 | | | | | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Semester-VB** | | | | | |
| | EAA-611+ | Fractional credit course/Extra Academic Activity +GROUP A/B/C | 0 | 0 | 40 | 40 | 1 (S/US) |
| | | | | | | | |
| | | **Semester-VI-A** | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | PCEC-621 | Linear Integrated Circuits | 2 | 1 | 0 | 3 | 3 |
| 2 | PCEC-622 | Fiber Optics Communication | 3 | 0 | 0 | 3 | 3 |
| 3 | OEXX-621 | Open Elective-3 | 3 | 0 | 0 | 3 | 3 |
| 4 | OEXX-622 | Open Elective-4 | 3 | 0 | 0 | 3 | 3 |
| 5 | PEEC-621 | Professional Elective-2 | 3 | 0 | 0 | 3 | 3 |
| 6 | HSMC-603 | Engineering Economics and Entrepreneurship | 3 | 0 | 0 | 3 | 3 |
| 7 | PCEC-623 | Linear Integrated Circuits Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | PCEC-624 | Fiber Optics Comm. Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **17** | **1** | **4** | **22** | **20** |
| 9* | HDEC-621 | Hon's Subject-3 | | | | | 4 |
| | | | | | | | |
| | | **Semester-VI-B** | | | | | |
| | TPID-621 | Industrial Training 04 weeks | 0 | 0 | 40 | 40 | 2(S/US) |
| | EAA-622+ | Fractional credit course/Extra Academic Activity +GROUP A/B/C | 0 | 0 | 40 | 40 | 1 (S/US) |
| | | **Semester-VII** | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | PCEC-711 | Digital Signal Processing | 3 | 0 | 0 | 3 | 3 |
| 2 | PCEC-712 | Antenna and Wave Propagation | 3 | 0 | 0 | 3 | 3 |
| 3 | PEEC-711 | Professional Elective-3 | 3 | 0 | 0 | 3 | 3 |
| 4 | PEEC-712 | Professional Elective-4 | 3 | 0 | 0 | 3 | 3 |
| 5 | OEXX-711 | Open Elective-5 | 3 | 0 | 0 | 3 | 3 |
| 6 | PCEC-713 | Digital Signal Processing Lab | 0 | 0 | 2 | 2 | 1 |
| 7 | PCEC-714 | Antenna and Microwave Lab | 0 | 0 | 4 | 4 | 2 |
| 8 | PREC-711 | Project Stage I and Seminar | 0 | 0 | 4 | 4 | 2 |
| | | **Total** | **15** | **0** | **10** | **25** | **20** |
| 9* | HDEC-711 | Hon's Subject-4 | | | | | 4 |

| | Semester-VIII | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | PEEC-721 | Professional Elective-5 | 3 | 0 | 0 | 3 | 3 |
| 2 | PEEC-722 | Professional Elective-6 | 3 | 0 | 0 | 3 | 3 |
| 3 | PREC-721 | Project Stage II | 0 | 0 | 12 | 12 | 6 |
| | | **Total** | **6** | **0** | **12** | **18** | **12** |
| 4* | PHEC-721 | Hon's Project | 0 | 0 | 08 | 08 | 4 |
| | | | OR | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | INID-721 | Internship in Industry | 0 | 0 | 40 | 40 | 6 |
| 2 | PREC-721 | Project Stage II | 0 | 0 | 12 | 12 | 6 |
| | | **Total** | **0** | **0** | **52** | **52** | **12** |
| 3* | PHEC-721 | Hon's Project | 0 | 0 | 08 | 08 | 4 |
| | | | | | | | |

*For honour degree only

| Credit Structure of Undergraduate Engineering Program | | | | | | |
|---|---|---|---|---|---|---|
| **S.No** | **Category** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | Humanities and Social Sciences including Management courses | 9 | 0 | 4 | 13 | 11 |
| 2 | Basic Science courses | 17 | 4 | 6 | 27 | 24 |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc. | 12 | 3 | 18 | 33 | 24 |
| 4 | Professional core courses | 35 | 5 | 26 | 65 | 52 |
| 5 | Professional Elective courses relevant to chosen specialization/branch | 12 | 0 | 0 | 12 | 12 |
| 6 | Open subjects – Electives from other technical and /or emerging subjects | 15 | 0 | 0 | 15 | 15 |
| 7 | Project work | 0 | 0 | 12 | 12 | 6 |
| 8 | Seminar/Internship/ Industrial training | 0 | 0 | 204 | 204 | 13 |
| 9 | Any others [Mandatory Courses and Fractional Credit Courses] | 6 | 0 | 120 | 126 | 3 |
| | | | | | **Total** | **160** |

# List of Professional Electives

| Professional Elective-I | | |
|---|---|---|
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | PEEC-611A | Pulse and Digital Switching Circuits |
| 2 | PEEC-611B | MEMS |
| 3 | PEEC-611C | Information Theory & Coding |
| **Professional Elective-II** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | PEEC-621A | Control System Engineering |
| 2 | PEEC-621B | Telecommunication Switching Systems & Networks |
| 3 | PEEC-621C | MOS Device Physics & Modelling |
| **Professional Elective-III** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | PEEC-711A | Microelectronics |
| 2 | PEEC-711B | Optoelectronics Devices & Circuits |
| 3 | PEEC-711C | Computer Communication & Networks |
| **Professional Elective-IV** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | PEEC-712A | Microwave & Radar Engineering |
| 2 | PEEC-712B | Computer Architecture & Organization |
| 3 | PEEC-712C | Industrial Electronics |
| **Professional Elective-V** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | PEEC-721A | Wireless Sensor Networks |
| 2 | PEEC-721B | Satellite Communication |
| 3 | PEEC-721C | VLSI Circuits |
| **Professional Elective-VI** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | PEEC-722A | Wireless Communication |
| 2 | PEEC-722B | Electronic Measurement & Instrumentation |
| 3 | PEEC-722C | Neural Networks & Fuzzy Logic |

# List of Open Electives

| Open Elective-I | | |
|---|---|---|
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | OEEC-611A | Linear Integrated Circuits |
| 2 | OEEC-611B | Digital Electronics |
| 3 | OEEC-611C | Electronic Measurement & Instrumentation |
| **Open Elective-II** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | OEEC-612A | Principle of Communication Engineering |
| 2 | OEEC-612B | Optical Electronics |
| 3 | OEEC-612C | MATLAB Programming |
| **Open Elective-III** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | OEEC-621A | Microprocessor and Applications |
| 2 | OEEC-621B | VLSI Technology |
| 3 | OEEC-621C | Nano Technology |
| **Open Elective-IV** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | OEEC-622A | Biomedical Electronics |
| 2 | OEEC-622B | Control System Engineering |
| 3 | OEEC-622C | Electronic System Design |
| **Open Elective-V** | | |
| **S.No.** | **Sub Code** | **Subject Name** |
| 1 | OEEC-711A | Digital Systems |
| 2 | OEEC-711B | Microcontroller and Embedded Systems |
| 3 | OEEC-711C | Wireless Communication |

## ESEC-401
## Elements of Electronics Engineering

| | L | T | P | Credits |
|---|---|---|---|---|
| | 2 | 1 | 0 | 2 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The aim of this course is to provide an introduction and basic understanding of semiconductor devices viz. diodes, bipolar junction transistors, junction field effect transistors and operational amplifiers to develop the ability to design basic electronic circuits. The course also focuses on knowledge about number systems and logic circuits introducing basic gates and flip-flops.

**Course Outcomes**

1. Design simple combinational and sequential logic circuits.
2. Characterize semiconductors, diodes and transistors.
3. Apply the basics of diode and transistor to analyse the operation of electronic devices.
4. Design electronic circuits such as rectifiers, filters, voltage regulators, transistor amplifiers and operational amplifiers.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 0 | 0 | 2 | 1 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 0 | 0 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 2 |

**Unit-I** — **8 hrs**

**Number system and codes**: Decimal, binary, octal, and hexadecimal number system and their inter-conversions, Gray code, Excess-3 code.
**Logic gates and flip flops**: Definitions, symbols and truth table of NOT, OR, AND, NAND, NOR, XOR, XNOR gates, De-Morgan's theorems, realization of basic gates using universal gates; realization of simple Boolean equations using universal gates, introduction to K- map (3 variables), logic diagram, truth table and operation of latches and flip flops: RS, T, D, JK.

**Unit-II** — **8 hrs**

**Semiconductor devices**: Semiconductor materials: Ge, Si, intrinsic and extrinsic semiconductors, p-type, n-type, p-n junction theory and diodes, its V-I characteristic, equivalent model, diode applications- half wave, full wave and bridge rectifier circuits, filter circuits: inductor filters, capacitor filters, L- section filters, $\pi$- section filters, comparison of filters, clippers and clampers, Zener diode, its characteristics and application as a voltage regulator, LED, photodiode.

**Unit-III** — **8 hrs**

**Transistors**: Bipolar junction transistor (BJT): basic operation, biasing, concept of dc load line and operating point selection, CB, CE, and CC configurations, BJT as an amplifier and switch, introduction to JFET and MOSFET: construction and operation.

**Unit-IV** — **8 hrs**

**Operational amplifiers (Op-Amps.)**: Introduction, basic characteristics of ideal and practical Op-Amp, IC741 pin configuration, Op-Amp in different modes: inverting and non-inverting amplifier, basic applications: adder, subtractor, voltage follower, multiplier, differentiator & integrator, instrumentation amplifier.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Electronic Devices & Circuits | David A. Bell | Oxford University Press, 5th Edition 2010 |
| 2. Electronic Devices & Circuits | J. Millman & Halkias | McGraw Hill Education 3rd Edition 2010 |
| 3. Electronic Devices & Circuit Theory | Robert L. Boylsted, Louis Nashelsky | Pearson Education |
| 4. Digital Systems: Principles and Applications | Ronald J. Tocci | Pearson Education |

## ESEC-402
## Elements of Electronics Engineering Lab

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

**Course Objectives**

The aim of this lab is to give practical exposure to students by analyzing V-I characteristics of different semiconductor electronics devices and design of basic electronic circuits. This lab also includes verification and testing of truth table of various logic gates and flip flops.

**Course Outcomes**

1. Analyze and design various digital circuits using basic gates and flip flops.
2. Design practical circuits using semiconductor diodes.
3 Analyze various modes of transistors in different configurations.
4. Design circuits using transistors and Op-Amps.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 0 | 3 | 3 | 2 | 2 | 0 | 1 | 3 | 2 | 1 | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 0 | 1 | 3 | 2 | 1 | 0 | 1 | 2 |
| CO3 | 3 | 3 | 0 | 3 | 2 | 2 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |

**List of Experiments**:

1. Verification of the truth tables of basic gates, e.g., 7400, 7402, 7404, 7408, 7432, 7486.
2. Design all other gates using NAND and NOR gates.
3. Design S-R flip-flop using NOR/NAND gates.
4. Verify the truth table of J-K flip-flop (7476), D flip-flop (7474) and T flip-flop.
5. To observe and analyze V-I characteristics of PN junction diode.
6. To observe and analyze V-I characteristics of Zener diode.
7. Design and analysis of half wave rectifier with capacitor filter.
8. Design and analysis of center tap full wave rectifier with capacitor filter.
9. Design and analysis of bridge type full wave rectifier with capacitor filter.
10. Design and analysis of Zener as a voltage regulator.
11. To observe V-I characteristic of PNP and NPN transistor in common base configuration.
12. Design and analysis of Op-Amp as an inverting amplifier & non-inverting amplifier.
13. Design and analysis of Op-Amp as an integrator & differentiator.
14. To observe V-I characteristic of JFET.
15. To observe V-I characteristic of MOSFET.

**TPIN-421**
**Practical Training (In-house)**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 40 | 1 (S/US) |
| **Course Objectives** | In-house training is imparted with an objective to familiarize and provide "hands on" experience on the requisite tools, components and instruments to be used in Electronics and Communication Engineering. The students will be able to present their work in written, oral or formal presentation formats. | | | |
| **Course Outcomes** | After successful completion of industrial training, the students should be able to<br>**1.** understand the use of various tools, electronic components and measuring instruments.<br>**2.** carry out work successfully involving individuals and teamwork skills.<br>**3.** correlate the theoretical concepts with the practical aspects.<br>**4.** express their work effectively through verbal and written communication. | | | |

**Mapping of Course Outcomes with Program Outcomes**

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

**PCEC -511**
**Network Analysis and Synthesis**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 2 | 1 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

Network analysis and synthesis is the foundation on which most other courses in the electronics and electrical engineering are based. The main objective of this course is to provide platform to understand analysis of different networks and provide knowledge of network synthesis.

**Course Outcomes**

1. Apply basic circuital laws and simplify the network using reduction techniques.
2. Analyse circuits using Kirchhoff's laws and network simplification theorems.
3. Evaluate and compute transient response, steady state response, network functions.
4. Calculate two port network parameters.
5. Synthesize networks using Foster and Cauer forms.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 3 | 2 | 0 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 1 | 1 | 0 | 1 | 2 | 3 | 1 |
| CO3 | 1 | 3 | 1 | 3 | 3 | 2 | 0 | 1 | 2 | 0 | 1 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |
| CO5 | 3 | 1 | 2 | 3 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 2 | 2 | 1 |

**Unit-I** — **12 hrs**

**Basics of circuit analysis**: Two terminal circuit elements (resistor, capacitor and inductor) and their characteristics, ideal voltage and current source, energy concepts in two terminal elements-Delta transformation, Kirchhoff's Laws, nodal and mesh analysis.
**Network theorems:** Superposition theorem, reciprocity theorem, Thevenin's theorem, Norton theorem, Millman's theorem, maximum power transfer theorem, substitution theorem, compensation theorem, Tellegen's theorem (for both AC and DC excitations).

**Unit-II** — **12 hrs**

**Two port networks**: Introduction to single and two port networks, parameters of two port networks such as impedance, admittance, hybrid, transmission, etc. relationship among different parameters, series and parallel connections of two-port networks, conditions for symmetrical and reciprocal networks, duality.
**Resonance and magnetically coupled circuits:** Introduction to resonance, series resonance, parallel resonance, concept of self-inductance and mutual inductance, coupling coefficient, magnetically coupled circuits, simple series and parallel circuits, dot convention, ideal transformer.

**Unit-III** — **12 hrs**

**Transient and steady state analysis**: Transients in RL, RC circuits, initial conditions, time constants,concept of phasors, impedance and admittance, analysis of RL, RC and RLC circuits with sinusoidal and driving sources, steady state analysis using phasor, network function: one-port networks and two-port networks, impedance function and admittance function, transfer function, poles and zeros of network functions, restrictions on locations of poles and zeros in driving point functions and transfer functions, review of Laplace transform, solution of network equations using Laplace transform.

| Unit-IV | 12 hrs |
|---|---|
| **Network synthesis**: Hurwitz polynomials, positive real functions, synthesis of dissipative networks, Foster and Cauer realization (I, II forms) for LC, RL and RC networks.<br>**Graph theory:** Concept of network graph, tree, tree branches and links, tie-set and cut-set matrices, introduction to SPICE simulators and MATLAB for solving circuit problems. | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Fundamentals of Electric Circuits | Charles K. Alexander and Matthew N.O. Sadiku | Tata McGraw Hill |
| 2. Engineering Circuit Analysis | William H. Hayt and Jack Kemmerly | Tata McGraw Hill |
| 3. Network Analysis | Van Valkenburg | Prentice Hall of India |
| 4. Circuit and Networks: Analysis and Synthesis | A.Sudhakar and S.Palli | Tata McGraw Hill |
| 5. Networks and Systems | D. Roy Choudhary | New Age International |

## PCEC-512
## Digital System Design

| | L | T | P | Credits |
|---|---|---|---|---|
| | 2 | 1 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

This course provides a modern introduction to logic design and the basic building blocks used in digital system. The course deals with sequential circuits, random access memories, and modern logic devices such as field programmable logic gates. State machines will then be discussed and illustrated through case studies of more complex systems using programmable logic devices.

**Course Outcomes**

1. Analyse and design sequential and combinational systems.
2. Assess the performance of a given digital circuit with Mealy and Moore configurations.
3. Perform static timing analysis of the digital circuits/systems.
4. Design the digital system using VHDL and Compare the performance of a given digital circuits/systems with respect to their speed, number of IC's.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 3 | 2 | 2 | 3 |

**Unit-I** — **12 hrs**

**Basics of Digital System:** Review of number system, Boolean expressions and their minimization using K-map, logic gates, Combinational circuits**:** Ripple carry adder, BCD, High speed adder, Subtractor, Code conversion, Magnitude comparators, Applications of Encoders, Decoders, MUX, DEMUX, Implementations using ROM, PLA, PAL. Standard ICs and their applications. Using combinational modules to design digital systems

**Unit-II** — **16 hrs**

**Sequential Circuits:** Various types of latches and flip-flops and their conversions, Universal Shift Registers, Counters – Ring, Johnson, Design of synchronous and Asynchronous Counters, Timing issues, Setup and hold times, operating frequency limitations, Static Timing Analysis, Standard ICs for their applications, Finite State Machines – Moore and Mealy, Design of Synchronous and Asynchronous sequential circuits, Races and hazards, hazard free design.

**Unit-III** — **12 hrs**

**Introduction to VHDL**: Overview of digital system design with VHDL, basic language elements, data objects, classes and data types, operators, overloading, logical operators, VHDL representation of digital design entity and architectural declarations, introduction to behavioural, dataflow and structural models, applications of VHDL to design.

**Unit-IV** — **8 hrs**

**Digital logic families**: Characteristics of digital circuits: fan in, fan-out, power dissipation, propagation delay, noise margin, transistor-transistor logic (TTL), types of TTL gates, tristate logic & its applications, emitter coupled logic (ECL), CMOS, comparison of characteristics of TTL, ECL, and CMOS, interfacing of logic families.

**Semiconductor memories**: Memory organization, ROM, PROM, EPROM, EEPROM, RAM, Static RAM, Dynamic RAM cell, memory cell, reading & writing operation in RAM.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. An Engineering Approach to Digital Design | Fletcher William, I | 3rd Indian reprint, PHI, (1994). |
| 2. Digital Design | Morris Mano M | 3rd Edition, Pearson Education (2002). |
| 3. VHDL-Analysis and Modeling of Digital Systems | Navabi Z | McGraw Hill. |
| 4. Fundamentals of Logic Design | Charles H. Roth Jr | 4th Edition, Jaico Publishers (2002). |
| 5. VHDL for Programmable Logic | Skahill Kevin | 1st Indian Reprint, Pearson Education (2004). |
| 6. Verilog HDL: A Guide to Digital Design and Synthesis | Samir Palnitkar | 2nd Edition, Prentice Hall PTR |

**PCEC-513**
**Signals & Systems**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 2 | 1 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

This course aims to provide detailed description of continuous and discrete-time signals and systems, their properties, representations, and methods that are necessary for the analysis of continuous and discrete-time signals and systems. Knowledge of time-domain and frequency-domain representation and analysis using Fourier series and Transforms, Laplace-transform, to understand principles of random signals and random processes.

**Course Outcomes**

1. Identify and classify different types of signals and systems that are commonly used in engineering.
2. Differentiate between the properties of continuous-time and discrete-time systems and represent CT and DT systems in the frequency domain using Fourier analysis.
3. Apply transform techniques to analyse continuous-time and discrete-time signals and systems.
4. Understand the basic concepts of probability and random variables.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |

**Unit-I** — **12 hrs**

**Introduction**: Definition of signals and systems, elementary signals, classification of signals and systems, properties of systems.
**LTI systems:** Continuous-time and Discrete-time LTI systems, their properties.

**Unit-II** — **12 hrs**

**Fourier series representation of signals**: Fourier series representation of continuous-time and discrete-time periodic signals, properties of continuous-time and discrete-time Fourier series.
**Fourier transform**: Continuous-time Fourier transform of periodic and aperiodic signals, properties of continuous-time Fourier transform, discrete-time Fourier transform of periodic and aperiodic signals, convolution.

**Unit-III** — **12 hrs**

**Laplace transform (LT)**: One-sided Laplace transform (LT) of common signals, important theorems, and properties of LT, Inverse LT, solutions of differential equations using LT, bilateral LT, region of convergence (ROC).
**Z-Transform:** Z-Transform and its properties, Region of convergence and its properties, inverse z transform, transfer function, causality and stability, Unilateral Z-Transforms.

**Unit-IV** — **12 hrs**

**Random signal theory**: Concept of probability, random variables, commutative distribution function, probability density function (PDF), average value and variance of random variables, Gaussian (PDF), Rayleigh (PDF), mean, variance and PDF of the sum of random variables, correlation between two random variables.
**Random processes**: Introduction, classification, correlation, and auto correlation, stationary andergodic process.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Signals and Systems | Alan V. Oppenheim,<br>Alan S. Willsky | Pearson Education Limited,<br>(2013) |
| 2. Signal Processing and Linear Systems | B P Lathi | Oxford University Press,<br>(2003) |
| 3. Signals and Systems | T. Rawat | Oxford University Press,<br>(2010) |
| 4. Signals and Systems | Simon Haykin,<br>Barry Van Veen | John Wiley & Sons,<br>(2007) |

## PCEC-514
## Electronic Devices & Circuits

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 1 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**: The objective of this course is to familiarize with semiconductors devices. Qualitative analysis of PN junction diode and introduction to special purpose diodes. To study and analyze the performance of BJT, FETs, UJT on the basis of their operation and principle of working.

**Course Outcomes**:

1. Acquire knowledge about semiconductor physics for intrinsic and extrinsic materials and their properties.
2. Understand basics of various semiconductor diodes, BJTs and their qualitative and quantitative analyses.
3. Analyze the performance of FETs based on their operation and working.
4. Understand and analyze special purpose diodes and their applications in modern circuits.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 2 | 3 | 2 |

### Unit-I — 12 hrs

**Semiconductor physics**: The energy band theory in crystal, charge carriers in semiconductors, carrier concentrations, Fermi level, electron and hole concentration at equilibrium, carrier drift and diffusion, conductivity and mobility, carrier lifetime, Poisson's and continuity equation, Hall effect.

### Unit-II — 12 hrs

**The P-N junction theory**: P-N junction equilibrium condition, contact potential, equilibrium Fermi level, electric field, space charge at junction, qualitative theory of P-N junction, P-N junction as a diode, diode equation, volt- ampere characteristics, temperature dependence of V-I characteristic, diode models, depletion and diffusion capacitance, junction breakdown mechanism, diode switching characteristics.

**Special purpose devices**: Varactor diode, Tunnel diode, Schottky barrier diode, LED, photodiode, SCR.

### Unit-III — 12 hrs

**Bipolar junction transistor (BJT)**: Device structure and physical operation, transistor current components, modes of operation, common emitter, common base and common collector configurations, input, output characteristics, BJT specifications, DC and AC load line, DC operating point, DC Biasing circuits-fixed bias, emitter bias, voltage divider bias, voltage feedback, Bias stability, Stabilization against variation in Ico, VBE and $\beta$, Bias compensation.

### Unit-IV — 12 hrs

**Junction field effect transistor**: Basic n channel and p channel JFET operation, its V-I characteristics.

**Metal oxide semiconductor field effect transistor**: MOS Capacitor. Energy band diagram for MOS capacitor with p-type and n-type substrate, Space charge width, work function difference, flat band voltage, threshold voltage, Differential charge distribution, C-V characteristics for MOS capacitor, MOSFET structure and its classification and V-I characteristics of MOSFET.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Semiconductor Physics and Devices | Donald A. Neamen | Tata McGraw-Hill |
| 2. Electronic Devices & Circuits | J. Millman & C Halkias | McGraw Hill Education 3rd Edition 2010 |
| 3. Microelectronic Circuits | Adel S. Sedra, Kenneth C. Smith | Oxford Press 6th Edition 2013 |
| 4. Solid State Electronics Devices | Ben G Streetman & Sanjay Banerjee | PHI 6th edition, 2013 |

**PCEC-515**
**Digital System Design Lab**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 4 | 2 |

| | |
|---|---|
| **Course Objectives** | The aim of this lab is to verify and design of basic digital electronics circuits. It includes designing and testing of combinational circuits, sequential circuits, digital logic families and programmable logic devices. |
| **Course Outcomes** | 1. Analyze and implement various logic gates and Boolean functions.<br>2. Design and analyze combinational digital circuits.<br>3. Design and analyze sequential digital circuits.<br>4. Design memories and programmable logic devices. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 3 | 2 | 1 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 2 | 3 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO4 | 2 | 1 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |

**List of Experiments:**

**PART-A**

1. Introduction to Digital Electronics lab-nomenclature of digital ICs, specifications, study of the datasheet, concept of $V_{cc}$ and ground.
2. To verify De-Morgan's Theorem and Implementation of the given Boolean function using logic gates in both SOP and POS forms.
3. To realize half/full adder and half/full subtractor using basic/universal gates.
4. To realize parallel adder/subtractor using IC 7483.
5. To verify BCD to excess-3 code conversion using NAND gates.
6. To convert Gray code to binary number and binary number to Gray code.
7. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates. To implement the arithmetic circuits half adder, half subtractor, full adder and full subtractor using multiplexers.
8. To design and verify the operation of magnitude comparator.
9. Verification of state tables of RS, J-K, T and D Flip-Flops using NAND Gates with timing diagrams.

*Experimentation work to be supported by simulated results

**PART-B**

1. To design and implement a circuit for a 2 bit parallel adder using NAND gates only.
2. To design and implement the 4-bit synchronous counter.
3. To design and implement the 4-bit asynchronous counter.
4. VHDL code for Half/Full adder.
5. VHDL behavioral description of 4-bit ALU. The circuit performs two arithmetic and two logical operations that are selected by 2-bit input. The four operations are ADD, SUB, AND and OR.
6. VHDL program to count number of one's in 10-bit binary number.
7. VHDL code for 8:3 encoder.
8. VHDL code for positive edge triggered T-flip flop.
9. VHDL code for 8-bit SISO shift register.

*Experimentation work to be supported by simulated results

**PCEC-521**
**Analog Communication**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 1 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The course emphasizes on the use of essential analytical tools and theories of analog communication systems, understand various analog communication techniques, AM, FM transmission and reception circuits, analog pulse modulation techniques and noise in communication systems.

**Course Outcomes**

1. Gain knowledge about the fundamental concepts of various analog communication systems.
2. Design the AM, SSB, FM and PM transmission and reception circuits.
3. Analyze the performance of amplitude and frequency modulated systems and design of PAM, PWM and PPM systems.
4. Understand practical implementation issues and evaluate fundamental communication system parameters including noise.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 2 | 3 | 2 |

**Unit-I** — **12 hrs**

**Analog modulation techniques**: Introduction to modulation, need of modulation, theory of amplitude modulation, frequency spectrum of AM wave, AM power calculations, AM modulation with a complex wave, concepts of angle modulation, theory of frequency modulation, mathematical analysis of FM, spectra of FM signals, narrow band FM, wide band FM, phase modulation, phase modulation obtained from frequency modulation, comparison of AM, FM and PM.

**Unit-II** — **12 hrs**

**AM Transmission/AM Reception:** Introduction, Generation of Amplitude Modulation, Basic Principles of AM Generation; Square law Diode Modulation, Vander Bijl Modulation, Suppressed Carrier AM Generation, Ring Modulator, Balanced Modulator. Tuned Radio Frequency (TRF) Receiver, Basic Elements of AM Super-heterodyne receiver; RF Amplifiers Characteristics, Sensitivity, Selectivity, Image Frequency Rejection, Mixers Tracking and Alignment, Local Oscillator, IF Amplifier, AM Detectors; Envelope or Diode Detector, AGC, AM Receiver using Transistors Communication Receiver.

**Unit-III** — **12 hrs**

**FM Transmission/FM Reception:** Generation of FM by Direct Methods. Indirect Generation of FM; The Armstrong Method, FM Stereo Transmission. FM Receiver Direct Methods of Frequency Demodulation; Slope Detector, Travis Detector, Foster Seely or Phase Discriminator, Indirect methods of FM Demodulation; FM Detector using PLL and Stereo FM Multiplex Reception.

| Unit-IV | 12 hrs |
|---|---|
| **SSB Transmission/SSB Reception:** Advantages of SSB transmission, Generation of SSB; Independent Side-Band Systems (ISB), Vestigial Side-Band Modulation (VSB), SSB Product Demodulator, Balanced Modulator as SSB Demodulator, ISB/Suppressed Carrier receiver. **Pulse Modulation Transmission and Reception:** Introduction, Pulse Amplitude Modulation (PAM), PAM Modulator Circuit, Demodulation of PAM Signals, Pulse Time Modulation (PTM); Pulse Width Modulation (PWM), Pulse Position Modulation (PPM). | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Electronic Communication Systems | Kennedy, G. | Tata McGraw-Hill (2008) 4th ed |
| 2. Communication Systems | Haykin, S. | John Wiley & Sons (2009) 4th ed. |
| 3. Principles of Communication Systems | Taub, H&Schilling | John Wiley & Sons |
| 4. Electronic Communication Systems | Wayne Tomasi | Pearson Education (2011), 5th ed |

| PCEC-522<br>Analog Electronic Circuits | | | | |
|---|---|---|---|---|
| | L | T | P | Credits |
| | 2 | 1 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |
| Course Objectives | To study the transistor behaviour at low and high frequency and analyze the behaviour of multistage amplifier by coupling in different ways. To study different feedback configurations, oscillators, power amplifiers and tuned amplifiers. | | | |
| Course Outcomes | 1. Analyze the low and high frequency response of BJT, MOSFET.<br>2. Design transistor single stage, multistage amplifiers and tuned amplifiers.<br>3. Design multistage amplifiers and various coupling techniques.<br>4. Design and analyze feedback circuits and oscillators. | | | |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 0 | 0 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 2 | 3 | 2 |

| Unit-I | 12 hrs |
|---|---|

**Single stage BJT amplifiers**: Analysis of transistor amplifier circuit using h-parameters, CE amplifier, CB amplifier, emitter follower and comparison.
**Single stage MOS amplifiers:** Small signal operation and model, CS amplifier, CG amplifier and source follower and comparison. BJT current mirrors and MOS current mirrors circuits and their analyses.

| Unit-II | 12 hrs |
|---|---|

**Multistage amplifier**: Multi-stage amplifier gain, effect of loading, types of coupling, direct and RC coupled amplifiers, frequency response of a BJT and FET amplifier, cut-off frequencies and bandwidth, cascode amplifiers- MOS cascode, BJT cascode, cascode current source, double cascoding, folded cascode, Darlington amplifier.
**Transistor at high frequencies**: High frequency model of BJT and frequency response of CE amplifier, gain-bandwidth product, Miller's theorem, MOSFET at high frequency, common source amplifier at high frequencies, analysis using Miller theorem.

| Unit-III | 12 hrs |
|---|---|

**Feedback amplifiers**: Properties of negative feedback, four basic feedback topologies, analysis of current-series, current-shunt, voltage-series and voltage-shunt feedback amplifiers.
**Oscillators**- The oscillation criteria, Wien bridge, phase shift, LC tuned oscillators, crystal oscillators, astable multivibrator.

| Unit-IV | 12 hrs |
|---|---|

**Output stages and power amplifiers**: Classification of output stages, analysis of class-A output stage, class-B output stage, class AB output stage, class C output stage, harmonic distortion.
**Tuned amplifiers**: Basic principle, inductor losses, amplifiers with multiple tuned circuits, synchronous and stagger tuning, class C tuned amplifier.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Microelectronic Circuits | Adel S. Sedra, Kenneth C. Smith | Oxford Press 6th Edition 2013 |
| 2. Integrated Electronics | Millman & Halkias | Tata McGraw -Hill Education |
| 3. Electronics devices and circuit theory | Robert L Boylestad & Louis Nashelsky | Pearson Education |

**PCEC-523**
**Microprocessor & Microcontroller**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The objective of the course is to develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques. Students will be able to interface the microprocessor/microcontroller with the I/O devices to develop simple applications on microprocessor and microcontroller-based systems

**Course Outcomes**

1. Acquire the knowledge of hardware features, architecture of 8085.
2. Understand the importance of micro-processors and micro-controllers, detailed study of architecture and pin configuration of 8051.
3. Interpret the detailed study of programming concepts of 8051 micro-controller.
4. Analyze the concept of serial communication and interfacing the external devices with the 8085 & 8051.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 0 | 0 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 0 | 0 | 3 | 1 | 2 | 3 |

**Unit-I** — **12 hrs**

**Introduction to 8-bit microprocessor architecture:** Microprocessor architecture & its operations, memory, input / output, interfacing devices MPU.
**Programming using 8085 microprocessor**: Instruction set of 8085 microprocessor, Addressing modes, Timing diagram of the instructions (a few examples). Assembly language programming with examples, Counter and Time Delays, Stack and Subroutine,

**Unit-II** — **12 hrs**

**Interrupts**: 8085 interrupts, restart instructions, additional I/O concepts & processes.
**Parallel input/output and interfacing applications**: I/O Device Interfacing-I/O Mapped I/O and Memory Mapped I/O, Serial (using SID and SOD pins and RIM, SIM Instructions) and Parallel data transfer,

**Unit-III** — **12 hrs**

**Introduction to 8051 microcontrollers & Programming using8051 microcontroller:** Pin description and architecture of 8051 microcontroller, arithmetic, logic and single bit instructions, addressing modes. I/O instructions, memory read/write-only instructions, stack operations, conditional and un-conditional instructions, basic programming concepts.8051 interrupts, Timer/counter programming in the 8051.Comparison of Microprocessor and Microcontroller, micro controller and embedded processors**.**

**Unit-IV** — **12 hrs**

**Interfacing with External Devices:**
Introduction to 8155/8156,8255 A programmable peripheral interface, 8253/8254 programmable interval timers, 8259 a programmable interrupt controller, 8251 USART.
8051 connection to RS 232, Serial communication programming, Interfacing of 8051 microcontroller-LCD, ADC and DAC, Stepper motor.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Microprocessor Architecture-Programming & Applications with 8085/8080A | Ramesh S Gaonkar | 5th Edition, Penram International Publishing |
| 2. Introduction of Microprocessors & Microcomputers | Ram B | 4th Edition, Dhanpat Rai Publisher (P) Ltd. |
| 3. The 8051 Microcontroller and Embedded Systems | M.Mazidi, JG Maizidi | Pearson Education |
| 4. An introduction to Intel family of Microprocessors | James L Antonakes | 3rd Edition, Pearson Education |
| 5. The 8051 Microcontroller | Kenneth J. Ayala | Pearson Education |

**PCEC-524**
**Analog Electronics Circuits Lab**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

**Course Objectives**

This lab includes the analysis of analog electronic circuits using hardware kits as well as on ORCAD spice simulator. It also includes the study of response of multistage amplifiers under various coupling techniques. Further in this lab student will observe the frequency response of various amplifiers.

**Course Outcomes**

1. Analyze the frequency response of various coupling amplifiers.
2. Analyze the frequency response of FET amplifier.
3. Analyze the class A, B amplifiers and tuned voltage amplifier.
4. Design various feedback and oscillator circuits.

**Mapping of Course Outcomes with Program Outcomes**

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

**List of Experiments:**

Note: Experiments based upon hardware using hardware kits and rest using simulation with the help of simulation packages

1. To measure the h-parameters of CE configuration.
2. To determine the voltage gain of a two stage RC coupled amplifier.
3. To plot frequency response characteristics of Transformer coupled amplifier.
4. To plot frequency response characteristics of direct coupled amplifier.
5. To study the gain and frequency response of CS FET amplifier.
6. To plot frequency response of a tuned voltage amplifier and to calculate its resonant frequency.
7. To study the double ended tuned amplifier.
8. To study the class A power amplifier and find its efficiency.
9. To study the class B power amplifier and find its efficiency.
10. To study the cascode amplifier.
11. To study the concept of feedback in voltage amplifier.
12. To study the RC phase shift oscillator and measure its frequency of operation.
13. To study the LC oscillator and measure the frequency of operation.
14. To plot the frequency response of a Darlington amplifier. Calculate gain and bandwidth.

*Compare the results of each aim of experiment with ORCAD spice simulation.

**PCEC-525**
**Microprocessor & Microcontroller Lab**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 4 | 2 |

**Course Objectives**

This lab includes programming part of microprocessor and its interfacing to different I/O devices. It includes various programs to perform specific tasks i.e. addition, sorting, multiplication and many more. Students will be interface microprocessor 8085 kit to various peripheral devices such as RS-232C, 8155/8255.

**Course Outcomes**

1. Perform various arithmetic and sorting operations with the help of microprocessor.
2. Interface 8155/8255 with 8085 and 8051.
3. Interface with various peripheral devices such as external keyboard, printer, 8253, personal computers using RS232C.
4. Implement serial communication and interface external devices with 8085 and 8051

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 0 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |

**List of Experiments:**

**PART-A**

1. 2's compliment of 8-bit number.
2. 2's compliment of 16-bit number.
3. Program to shift a block of data from one memory location to another.
4. Multiplication by two, employing bit rotation.
5. Addition of two 16-bit numbers.
6. Interface ADC chip with microprocessor kit and verify its operation.
7. Interface DAC chip with microprocessor kit and verify its operation.
8. Interface an external 8253/8254 to the microprocessor kit at the address given. Hence,
   - **a)** generate a pulse train of specified duty cycle at the given output line,
   - **b)** operate as a: N counter,
   - **c)** Count a train of pulses for a given duration.
9. Interface seven segment display through8279.
10. Use the SOD line to generate a square wave of the specified duty cycle at a given frequency.

**PART-B**

1. Write a program to toggle all the bits of port 1 by sending to it the values 55H and AAH continuously. Put a time delay in between each issuing of data to port 1.
2. Multiply 25 by 10 using the technique of repeated addition.
3. Write a program to add the first 10 natural numbers.
4. Write a program to add two BCD numbers.
5. Write a program to perform the subtraction of two numbers.
6. Write a program to perform the division of two numbers.
7. Write a program using 8051 to split a byte into two nibbles and show results.
8. Create a square wave that has a high portion of 1085 μS and a low portion of 15 μS. Assume XTAL = 11.0592 MHz Use Timer 1.
9. Write the following programs:
   - **a)** Create a square wave of 50% duty cycle on bit 0 of port 1.
   - **b)** Create a square wave of 66% duty cycle on bit 3 of port 1.
10. Assuming XTAL =22 MHz, write a program to generate a pulse train of 2 seconds period on pin P2.4. Use Timer 1 in mode 1.
11. Design a counter for counting the pulse of an input signal. The pulse to be counted is fed to pin3.4. XTAL = 22MHz.
12. Design a circuit to interface ADC with microcontroller.
13. Design a circuit to interface DAC with microcontroller.
14. Design a circuit to interface LCD with microcontroller.
15. Design a circuit to interface keyboard with microcontroller.

## PCEC-526
## MATLAB Programming Lab

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

| | |
|---|---|
| **Course Objectives** | The aim of this course is to introduce the students to the MATLAB programming language for numerical computations and its application in engineering and technology |
| **Course Outcomes** | 1. Understand basic commands, manage contents and develop programs in MATLAB.<br>2. Perform mathematical modeling in MATLAB.<br>3. Evaluate, analyze and plot results.<br>4. Utilize programming skills to enhance learning and performance in engineering. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 3 | 3 | 1 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO4 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 3 | 3 |

**List of Experiments:**

**1.** Familiarizing with basic elements of MATLAB's desktop, MATLAB windows, MATLAB editor input-output, file types, general commands, variables, numbers, working with arrays of numbers and array arithmetic operations.
**2.** Write a MATLAB program to display a matrix. Also find its length, width, divergence, transpose and inverse.
**3.** Write a MATLAB program to calculate matrix addition, multiplication, division and eigen value calculations.
**4.** To study basic 2-D plots, style options, labels, title, legend, and other text objects, axis control, modifying plots specialized 2-D plots, layout of multiple plots, mesh and surface plots, 3-D plots.
**5.** Write a script file to calculate addition, subtraction, multiplication, division, square, square root, cube and cube roots of integer numbers.
**6.** Familiarizing with control flow structures branching statements, loops and their operators.
**7.** Write a script file to find the largest of three numbers (use if-elseif-else).
**8.** Generate a 10-by-10 matrix A = [akl], where akl = sin(k)cos(l). (use for loop)
**9.** The number π is divided by 2. The resulting quotient is divided by 2 again. This process is continued till the current quotient is less than or equal to 0.01. Write a script file to find the largest quotient that is greater than 0.01? (use while).
**10.** Write a script file to generate 5 different magic squares.
**11.** Fibonacci numbers are computed according to the following relation:
**12.** $F_n = F_{n-1} + F_{n-2}$, with $F_0 = F_1 = 1$
**13.** Create a function for generating the Fibonacci numbers with user defined function as (function f = $Fib_1$(n))
**14.** To study functions for numerical integration,
**15.** To study functions for differential and non-linear algebraic equations.
**16.** To study symbolic computation in MATLAB and evaluate symbolic expressions.

**MATLAB SIMULINK**

1. To generate BASK signal and observe the frequency spectrum on MULTISIM software.
2. To generate BPSK signal and observe the frequency spectrum on MULTISIM software.
3. To generate BFSK signal and observe the frequency spectrum on MULTISIM software.
4. To setup the model for BPSK baseband modulation for scatter plot to observe the constellation on MATLAB/SIMULINK software.
5. To setup the model for QPSK baseband modulation for scatter plot on to observe the constellation on MATLAB/SIMULINK software.
6. To setup the model for BFSK baseband modulation for scatter plot on to observe the constellation on MATLAB/SIMULINK software.
7. To setup the BPSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.
8. To setup the QPSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.
9. To setup the BFSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.

| TPID-521<br>Industrial Training (2 weeks) | | | | |
|---|---|---|---|---|
| | **L** | **T** | **P** | **Credits** |
| | **0** | **0** | **40** | **1 (S/US)** |
| **Course Objectives** | The main objective of industrial training is to familiarized students with industrial working environment and enhance their knowledge skills towards developing a holistic perspective to understand various practical issues and latest trends in the field. The students will be able to troubleshoot various engineering faults related to their respective fields. They will be able to learn ethical management practices. | | | |
| **Course Outcomes** | After successful completion of industrial training, the students should be able to<br>1: implement the technical skills as an individual and in team.<br>2: correlate the theoretical concepts with the real-life industrial environment.<br>3: achieve a long-term goal of transforming themselves into an optimum blend of theoretical and practicing engineers.<br>4: express their work effectively through verbal and written communication. | | | |

**Mapping of Course Outcomes with Program Outcomes**

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

**PCEC-611**
**Digital Communication**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The main objective of the course is to understand the fundamentals of digital communication system, the advantages over analog communication system and to provide in-depth knowledge of digital modulation schemes. It emphasizes on the performance analysis of digital communication system in the presence of noise, by calculating the probability of error for matched filter Receiver and various digital modulation techniques.

**Course Outcomes**

1. Understand the theoretical aspects of digital communication system useful for today's multidisciplinary applications.
2. Gain knowledge about various data formats for digital data transmission.
3. Analyze the generation and detection of various digital modulation schemes.
4. Compare the performance of different types of digital pulse and band pass modulation techniques in terms of error rate and spectral efficiency.
5. Calculate probability of error for matched filter receiver to analyze the performance of digital communication system in the presence of noise.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 0 | 1 | 2 | 3 | 3 |
| CO3 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 0 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 0 | 2 | 2 | 3 | 3 |

**Unit-I** — **12 hrs**

**Elements of digital communication system**: Block diagram of digital communication system, digital representation of analog signals, advantages and disadvantages of digital communication system, noisy communication channels, information and entropy.

**Pulse code modulation:** Sampling theorem for baseband and band pass signals, aliasing, signal recovery through holding, quantization of signals, quantization error, uniform and non-uniform quantization, dynamic range, A-law and μ-law companding, pulse code modulation (PCM), differential pulse code modulation (DPCM), need of predictor, delta modulation (DM), adaptive delta modulation (ADM), comparison of PCM, DPCM and DM.

**Unit-II** — **12 hrs**

**Line coding schemes**: Power spectral density (PSD) of sequence of random pulses, power spectral density of digital data, introduction to line codes and its properties, unipolar, polar and bipolar signalling formats, NRZ& RZ modulation formats, ON-OFF signalling, AMI and Manchester coding and their power spectra, comparison among various line codes, pulse shaping.

| Unit-III | 12 hrs |
|---|---|
| **Digital modulation techniques:** Digital modulation formats, binary amplitude shift keying (BASK) modulator, coherent and non-coherent ASK detection, binary phase shift keying (BPSK) transmitter, coherent BPSK detection, differential PSK, quadrature phase shift keying modulation (QPSK) transmitter and receiver, offset QPSK, M-ary BPSK, quadrature amplitude modulation (QAM), binary frequency shift keying (BFSK) transmitter, non-coherent FSK detector, coherent FSK detector, M-ary FSK, minimum shift keying (MSK) and Gaussian minimum shift keying (GMSK), power spectral analysis and comparison of signal constellations for digital modulation techniques. | |
| **Unit-IV** | **12 hrs** |
| **Optimal reception of digital signal:** Introduction, baseband signal receiver, probability of error for the baseband signal, optimum receiver for baseband and bandpass signals, optimum filter transfer function, matched filter and its probability of error, coherent system of signal reception (correlation receiver).<br>**Error calculations for digital modulation techniques:** Probability of error for BPSK, effect of imperfect phase synchronization and imperfect bit synchronization on probability of error in AWGN channel, probability of error calculations for QPSK, QASK and FSK schemes, use of signal space for calculation of error probability, relationship between bit error rate (BER) and symbol error rate (SER). | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Principles of Communication Systems | Goutam Saha , Herbert Taub , Donald Schilling | Tata McGraw Hill Education Private Limited, 3rd Edition, 2008 |
| 2. Communication Systems | Simon Haykin, Michael Moher | John Wiley & Sons Publication, 5th Edition, 2009 |
| 3. Digital Communications | Bernard Sklar | Pearson Education Limited, 2014 |
| 4. Modern Analog and Digital Communication | Bhagwandas Pannalal Lathi, Zhi Ding | Oxford University Press, 2010 |
| 5. Digital Communication System | John G. Proakis, Masoud Salehi | McGraw-Hill, 2008 |

## PCEC-612
## EMF & Transmission Lines

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

The objective of the course is to study the basic concepts, theories, principles related to electrostatics, electromagnetics and transmission lines.

**Course Outcomes**

1. Understand and analyze the static and time-varying electric and magnetic fields.
2. Interpret and apply Maxwell's equations to analyze EM waves.
3. Understand basic concepts of electromagnetic waves transmission through conductors and dielectrics medium.
4. Analyze basic transmission line parameters, such as reflection coefficient, standing wave ratio and impedance.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 2 | 0 | 1 | 3 | 3 |
| CO3 | 3 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 0 | 3 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |

### Unit-I — 12 hrs

**Introduction:** Review of vector theory, gradient, divergence and curl, coordinate system: rectangular, cylindrical, spherical and their transformations.

**Static electric field**: Force between point charges, Coulomb`s law, electric field intensity, superposition of electric fields, electric scalar potential, charge density, gradient of potential, electric flux, electric flux density or displacement density, Gauss's law, application of Gauss's law, energy in capacitor, divergence theorem, Poisson's equation and Laplace's equation, current density, continuity equation, current and field in boundary.

### Unit-II — 12 hrs

**Static magnetic field:** Magnetic induction and Faraday's law, magnetic flux density, magnetic field strength, current density in a conductor, Ampere`s law, Stokes's theorem, energy stored in magnetic field, force on moving charge and current element, Biot-savart law, magnetic vector potential, boundary relation in magnetic fields.

**Time varying fields:** Maxwell equation from Faraday`s law, displacement current, Maxwell 's equation from Ampere's law, equation of continuity for time varying fields, Maxwell`s equations in integral and differential forms for free space, conditions at boundary surface.

### Unit-III — 12 hrs

**Wave transmission**: EM wave in a homogeneous medium, Maxwell`s equations, wave equations in free space, uniform plane wave propagation, intrinsic impedance, wave equations for conducting medium, sinusoidal time variations, conductors and dielectrics, linear, elliptical and circular polarization, reflection of plane waves at interfaces, normal and oblique incidences, reflection coefficient, Brewster angle, group velocity, phase velocity, power and energy relations, Poynting vector, waves between parallel planes, TE, TM and TEM waves.

| **Unit-IV** | **12 hrs** |
|---|---|
| **Transmission lines**: Introduction, basic principles, termination of lines with load, voltage and current distribution, characteristic impedance, propagation constant, attenuation constant, phase constant, reflection coefficient, VSWR, open and short-circuited transmission lines and their impedances, stub matching, types of high frequency transmission lines, smith charts. | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Elements of Electromagnetics | M Sadiku | Oxford University Press |
| 2. Electromagnetics | J A Edminister | Schaum's Series |
| 3. Electromagnetics | Kraus | McGraw Hill |
| 4. Electromagnetic Fields and Waves | K D Parsad | Parkash Publications |
| 5. EM waves & Radiating | Jordan, Balmain | Prentice Hall |
| 6. Electromagnetic | W H Hayt | McGraw Hill |

# OEEC-611A
# Linear Integrated Circuits

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 3 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The aim of this course is to introduce the basic building blocks of linear integrated circuits and acquire knowledge of fundamental characteristics of op-amps. The course analyzes op-amps with and without feedback and determines the negative feedback affects the performance of op-amps. It also includes learning of linear and non-linear applications of operational amplifiers and studies various applications using 555 timer and PLL.

**Course Outcomes**

1. Understand the basic concepts and parameters of op-amps.
2. Analyze different op-amp configurations and their frequency responses.
3. Design and analyze linear and non-linear circuits, active filters, wave generator circuits and detectors.
4. Explain Op-amp based specialized ICs.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 3 | 2 | 1 | 0 | 1 | 2 | 0 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 3 | 3 |

**Unit-I** — **12 hrs**

**Introduction**: Introduction, emitter coupled differential amplifier, DC and AC analysis, cascaded differential amplifier stages, level translator.
**Operational amplifiers (Op-amp):** Basic op-amp and its schematic symbol, block diagram of a typical op-amp, integrated circuits and their types, IC package types, pin identification and temperature range, overview of typical set of data sheets, characteristics and performance parameters of op-amp, equivalent circuit of an op-amp, ideal op-amp and its characteristics, ideal voltage transfer curve.
**Op-Amp parameters**: Input offset voltage, input bias current, input offset current, total output offset voltage, thermal drift, variation of op-amp parameters with supply voltage and temperature, noise, common mode configuration and common mode rejection ratio, slew rate

**Unit-II** — **12 hrs**

**Op-Amp configurations and frequency response**: Open loop configurations: differential, inverting & non-inverting. negative feedback configurations: block diagram representation of feedback configurations, voltage-series feedback amplifier, voltage shunt feedback amplifier, differential amplifiers with one op-amp, two op-amps and three op-amps. frequency response, compensating networks, frequency response of internally compensated op-amps, frequency response of non-compensated op-amps, closed loop frequency response.

**Unit-III** — **12 hrs**

**Applications of op-amps:** DC and AC amplifiers, peaking amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, V to I and I to V converter, log and antilog amplifier, integrator and differentiator.
**Active filters:** First order and second order filter, higher order low-pass filter, second order high pass filter, band pass filter, wide band-pass filter. band reject filter, all-pass filter.

**Wave generator:** Square wave generator, triangular wave generator, saw tooth wave generator and voltage-controlled oscillator, comparator, zero crossing detector, Schmitt trigger, window detector, V to F and F to V converters, A to D and D to A converters, peak detector.

| Unit-IV | 12 hrs |
|---|---|

**Specialized IC applications**: IC 555, pin configuration, block diagram, application of 555 as monostable and astable multivibrator, operating principles & applications of 565PLL.
**Voltage regulators:** Fixed voltage regulators, adjustable voltage regulators, switching regulators.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Op Amps & Linear Integrated circuits | .Ramakant Gayakwad | Pearson Education |
| 2. Fundamental of Microelectronics | B Razavi | Wiley India |
| 3. Linear Integrated Circuits | D. Roy Choudhary | New Age International |
| 4. Design with Operational Amplifiers and Analog Integrated Circuits | Sergio Franco | Tata Mc-Graw Hill |

## OEEC-611B
## Digital Electronics

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**: The aim of this course is to introduce basic postulates of Boolean expressions and analyze the design of combinational circuits, sequential circuits, digital logic families, semiconductor memories and programmable logic devices.

**Course Outcomes**:
1. Understand various logic gates and design simple combinational circuits.
2. Design and analyze sequential digital circuits.
3. Identify and distinguish digital logic families.
4. Elaborate the concept of semiconductor memories and programmable logic devices.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 1 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 3 | 3 |
| CO4 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 2 | 3 | 3 |

### Unit-I — 12 hrs

**Introduction:** Representation of logic, logic variables, Boolean algebra, Boolean expressions and minimization of Boolean expression using K-map (up to six variables), review of logic gates, design and implementation of adder, subtractor, multiplexer, de-multiplexer, encoder, decoder, digital comparators, code converters.

### Unit-II — 12 hrs

**Flip-flops**: Latches, S-R flip-flop, JK flip-flop, race around condition, master slave flip-flop, D & T type flip-flop, excitation table of flip-flops, conversion of flip-flops.

### Unit-III — 12 hrs

**Counters & shift registers**: Design with state equations, ripple counters, design of modulo-n ripple counter, pre-settable counters, up-down counter, decade counter, design of synchronous and asynchronous counters, design of shift registers with shift-left, shift-right & parallel load facilities, universal shift registers.

### Unit-IV — 12 hrs

**Digital logic families**: Characteristics of digital circuits: fan in, fan-out, power dissipation, propagation delay, noise margin, transistor-transistor logic (TTL), types of TTL gates, tristate logic & its applications, emitter coupled logic (ECL), CMOS, comparison of characteristics of TTL, ECL, and CMOS, interfacing of logic families.

**Semiconductor memories**: Memory organization, ROM, PROM, EPROM, EEPROM, RAM, Static RAM, dynamic RAM cell, memory cell, reading & writing operation in RAM.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Digital Design | Morris Mano | PHI, 4th edition |
| 2. Digital System Principles & Applications | R J Tocci | PHI |
| 3. Digital Integrated Electronics | Taub Schilling | Tata McGraw Hill Education |
| 4. Integrated Electronics | Millman & Halkias | Tata McGraw Hill Education |
| 5. Digital Computer Electronics | Malvino Brown | Tata McGraw Hill Education |
| 6. Modern Digital Electronics | R P Jain | Tata McGraw Hill |

## OEEC-611C
## Electronic Measurements and Instrumentation

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

Aim of the course is to study the basics of unit, dimensions and standards. It also gives deep insight to PMMC instrument and bridges. It discusses as to how the analog data is converted to digital and vice versa. It also discusses the CRO and concept of signal generator and analyzer.

**Course Outcomes**

1. Explain various types of errors introduced in measurements.
2. Understand the working of PMMC and other instruments.
3. Understand bridge theory, working of A/D and D/A converters and their applications.
4. Describe the working of CRO, signal generators and analyser's and apply for measurements.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 0 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 2 | 1 |
| CO2 | 0 | 3 | 3 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 2 | 2 | 1 |
| CO3 | 0 | 3 | 3 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 1 | 2 | 2 | 1 |
| CO4 | 0 | 3 | 3 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 2 | 3 |

**Unit-I** — **12 hrs**

**Unit, dimensions and standards**: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, other unit systems, dimension and standards. measurement errors: gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, measurement error combination, basics of statistical analysis. PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohm meter.

**Unit-II** — **12 hrs**

**Electronic Meters**: Digital voltmeter systems, digital multimeter, digital frequency meter system, voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter.

**Unit-III** — **12 hrs**

**Analog to digital converter**: Transfer characteristics, A/D conversion technique: simple potentiometer and servo method, successive approximation method ramp type, integrating and dual slope integrating method. D/A converter: transfer characteristic, D/A conversion technique, digital mode of operation, performance characteristics of D/A convertors.

**Unit-IV** — **12 hrs**

**CRO**: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency, and phase by CRO, oscilloscope probes, oscilloscope specifications and performance.
**Signal generator, analyzer and recorders:** sine wave, non-sinusoidal signal and function generators, frequency synthesis techniques and digital signal generators, spectrum analyzer and distortion, concept of ECG, EMI, EMC, and EEG etc, X-Y recorders, plotters.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Electronic Instrumentation and Measurements | David A. Bell | 2nd Ed., PHI , New Delhi,2008 |
| 2. Electronic Measurements and instrumentation. | Oliver and Cage | TMH, 2009 |

## OEEC-612A
## Principle of Communication Engineering

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

The main focus of the course is on understanding the importance and theories of communication systems. The students will study the various analog and digital communication techniques, generation, detection, transmission and reception methods.

**Course Outcomes**

1. Gain knowledge about the fundamental concepts communication systems.
2. Analyse AM, SSB, FM and PM transmission and reception circuits.
3. Analyze the performance of amplitude and frequency modulated systems and design of PAM, PWM and PPM systems.
4. Acquire knowledge about the basic concepts of digital modulation and demodulation techniques.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 | 0 | 1 | 0 | 2 | 1 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 3 | 3 |
| CO3 | 1 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 1 | 1 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 1 | 1 | 2 | 0 | 2 | 0 | 1 | 1 | 0 | 1 | 2 | 3 | 3 |

### Unit-I — 12 hrs

**Introduction:** Communication, information, message and signals, electromagnetic spectrum, classification of signals, periodic and non-periodic signals, analog and digital signals, deterministic and random signals, elements of a communication system, modulation and its types, need for modulation.

**Amplitude modulation:** Definition, expression of AM wave, modulation index, frequency spectrum, bandwidth, power contents of sidebands and carrier.

### Unit-II — 12 hrs

**Angle modulation:** Concepts of angle modulation, theory of frequency modulation, mathematical analysis of FM, spectra of FM signals, narrow band FM, wide band FM, phase modulation, phase modulation obtained from frequency modulation, comparison of AM, FM and PM.

Generation of AM and FM waves: Basic principle of AM generation, basic principle of FM generation, varactor diode modulator. DSB-SC, SSB, their comparison and areas of applications.

### Unit-III — 12 hrs

**Pulse modulation:** Sampling process, sampling theorem, natural sampling, flat top sampling, sampling rate, aliasing, basic idea about PAM, PWM and PPM and typical applications, reconstruction of message, pulse code modulation (PCM), block diagram of PCM system, quantization.

### Unit-IV — 12 hrs

**Elements of digital communication:** Block diagram of digital communication system, digital representation of analog signals, advantages and disadvantages of digital communication system,

**Digital carrier modulation techniques**: Introduction, amplitude shift keying (ASK), ASK spectrum, ASK modulator, frequency shift keying (FSK), PSK.

**Digital carrier demodulation techniques:** Coherent ASK detector, non-coherent ASK detector, non-coherent FSK detector, coherent FSK detector.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Communication Systems (Analog and Digital) | Sanjay Sharma | S.K. Kataria & Sons |
| 2. Electronic Communication Systems | Kennedy | Tata McGraw Hill |
| 3. Electronic Communications | Roddy and Coolen | Prentice Hall of India |
| 4. Principles of Communication Systems | Taub and Schilling | Tata McGraw Hill |

## OEEC-612B
## Optical Electronics

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The main objective of this course is to familiarize with the basics of semiconductor optoelectronics and various optical devices i.e. optical sources, modulators, photo detectors, display devices. Students will also study the modern optoelectronics integrated systems.

**Course Outcomes**

1. Use principles of physics to analyze the fundamental concepts of various optoelectronic components.
2. Describe the characteristics of Optoelectronic devices.
3. Familiarize with tools and processes used in fabricating optoelectronic components.
4. Utilize knowledge to Implement optoelectronic communication systems.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 1 | 0 | 0 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 0 | 1 | 2 | 1 | 0 | 1 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 0 | 3 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 0 | 3 | 3 | 2 | 2 |

**Unit-I** — **8 hrs**

**Elements of light and solid-state physics**: Wave nature of light, polarization, interference, diffraction, light source, review of quantum mechanical concept, review of solid-state physics, generic optical systems and fundamental building blocks, basics of semiconductor optoelectronics, elemental and compound semiconductor, electronic properties and optical processes in semiconductors.

**Unit-II** — **14 hrs**

**Optical sources and modulator**: Emission and absorption of radiation, absorption of radiation, population inversion, optical feedback, threshold conditions-laser losses, line shape function, population inversion and pumping threshold conditions, laser modes, classes of laser, single mode operation, frequency stabilization, VCSEL, mode locking, Q switching, laser applications, high power applications of lasers, LEDs electro-optic effect, electro-optic switch and modulator, Kerr modulators, MZM modulators, electro-absorption modulator.

**Unit-III** — **14 hrs**

**Photo detectors**: Principle of optical detection, detector performance parameters, thermal detectors, photon devices, solar cell.

**Display devices**: Luminescence, photoluminescence, cathode luminescence, cathode ray tube, electro luminescence, injection luminescence and light emitting diodes, plasma displays, display brightness, LCD, numeric displays.

**Unit-IV** — **12 hrs**

**Optoelectronic integrated circuits:** Introduction, hybrid and monolithic integration, application of optoelectronic integrated circuits, integrated transmitters and receivers, guided wave devices.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Semiconductor Optoelectronic Devices | Pallab Bhattacharya | Pearson Education Inc |
| 2. Photonics - Optical Electronics in Modern Communications | A. Yariv and P. Yeh, | Oxford University Press |
| 3. Opto Electronics – As Introduction to materials and devices | Jasprit Singh | McGraw-Hill International |
| 4. Opto Electronics – An Introduction | J. Wilson and J. Haukes | Prentice Hall, 1995 |

## OEEC-612C
## MATLAB Programming

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The aim of this course is to introduce the students to the MATLAB programming language for numerical computations and its application in engineering and technology.

**Course Outcomes**

1. Understand basic commands, manage contents and develop programs in MATLAB.
2. Perform mathematical modeling in MATLAB.
3. Evaluate, analyze and plot results.
4. Utilize programming skills to enhance learning and performance in engineering.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 1 | 3 | 2 | 2 | 3 | 1 | 2 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 1 | 0 | 1 | 3 | 2 | 2 | 3 | 3 | 2 |

**Unit-I** — **12 hrs**

**Interactive computation:** Basics of MATLAB, MATLAB windows, input-output, file types, general commands, working with arrays of numbers, creating and plotting simple plots, creating, saving and executing script and function files, language specific features, and advanced data objects.

**Unit-II** — **12 hrs**

**Matrices and vectors manipulation:** Matrices and vectors input, indexing, matrix manipulation, creating vectors, matrix and array operations, arithmetic operations, relational operations, logical operations, elementary math functions, matrix functions and character strings.

**Unit-III** — **12 hrs**

**Linear algebra, interpolation and data analysis:** Solving a linear system, Gaussian elimination, finding eigen values & eigenvectors, matrix factorization, polynomial curve fitting, least squares curve fitting, interpolation, data analysis and statistics, MATLAB applications in linear algebra, curve fitting and interpolation, data analysis and statistics.

**Unit-IV** — **12 hrs**

**Graphics manipulation:** Basic 2-D plots, style options, labels, title, legend, and other text objects, axis control, zoom-in and zoom-out, modifying plots, overlay plots, specialized 2-D plots and introduction to 3-D plots.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Getting Started with MATLAB | Rudra Pratap, | Oxford University Press |
| 2. MATLAB Programming | Y. Kirani Singh, B. B. Chaudhuri | PHI |
| 3. MATLAB and Its Applications in Engineering | Raj Kumar Bansal | Pearson Education India |
| 4. MATLAB by Example | Abhishek Kr Gupta, | Finch Publications |

## PEEC-611A
## Pulse and Digital Switching Circuits

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

| | |
|---|---|
| **Course Objectives** | The course describes various linear wave shaping circuits, switching characteristics of diode, transistor and non-linear wave shaping circuits. The design of multivibrator circuits, Schmitt trigger circuit using transistors, blocking oscillator circuits and the design operation of time base circuits is also explained. |
| **Course Outcomes** | 1. Acquire knowledge of wave shaping circuits and switching characteristics of diode and transistors.<br>2. Analyze different types of multivibrator and their design procedures.<br>3. Introduce time base generator circuits, blocking oscillator circuits.<br>4. Design linear and non-linear wave shaping circuits |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 3 | 2 | 0 | 0 | 1 | 2 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 0 | 1 | 0 | 2 | 1 | 1 | 3 | 2 |
| CO3 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 0 | 2 | 1 | 1 | 2 | 3 |

### Unit-I — 12 hrs

**Linear wave shaping**: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square, ramp and exponential inputs, high pass RC circuit as differentiator and low pass RC circuit as integrator, attenuators, RL and RLC circuits and their response for step input, ringing circuit.

**Non-linear wave shaping**: Diode clippers, transistor clippers, clipping at two independent levels, emitter coupled clipper, diode comparators, applications of voltage comparators, clamping operation, clamping circuits using diode with different inputs, clamping circuit theorem, practical clamping circuits, effect of diode characteristics on clamping voltage.

### Unit-II — 12 hrs

**Switching characteristics of devices**: Diode as a switch, diode switching times, temperature variation of saturation parameters, design of transistor as a switch, transistor switching times, transistor in saturation.

**Bistable multivibrators**: Stable states of a bistable multivibrator, design and analysis of fixed bias and self-biased bistable multivibrator, direct connected binary circuit, Schmitt trigger circuit using transistors, emitter coupled bistable multivibrator.

### Unit-III — 12 hrs

**Monostable and astable multivibrators**: Monostable multivibrator, design and analysis of collector coupled, and emitter coupled monostable multivibrator, triggering of monostable multivibrator, astable multivibrator, collector coupled and emitter coupled astable multivibrator.

### Unit-IV — 12 hrs

**Time base generators**: General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators – basic principles, transistor Miller time base generator, transistor Bootstrap time base generator, current time base generators, methods of linearity improvements.

**Blocking oscillator circuits**: Triggered transistor blocking oscillator, an astable transistor blocking oscillator, applications of blocking oscillators.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Pulse, Digital and Switching Waveforms 3rd Edition, 2008. | Millman and Taub | Tata McGraw-Hill |
| 2. Microelectronic Circuits, 7th Edition 2014 | Sedra and Smith | Oxford University Press |
| 3. Pulse and Digital Circuits, 2006 | Motheki S. Prakash Rao | Tata McGraw-Hill |
| 4. Fundamental of Microelectronics, 2nd Edition 2009 | B.Razavi | John-Wiley |

## PEEC-611B
## MEMS

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

The course aims to give the students a basic knowledge about state-of-the-art MEMS including technology, device architecture, design and modelling, scalability, figures of merit and RF IC novel functionality and performance. Reliability and packaging are also considered as key issues for industrial applications.

**Course Outcomes**

1. To gain basic knowledge about MEMS and its various micro system products.
2. Student will acquire knowledge about different factors and properties of materials used in design of MEMS.
3. To understand basic idea fluid mechanics in micro and macro scales.
4. To attain knowledge about various levels of packaging of microsystems.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 1 |
| CO2 | 2 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 1 | 1 | 0 | 0 | 3 | 1 | 3 | 2 | 1 | 2 | 1 | 1 |
| CO4 | 2 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 2 |

**Unit-I** — **12 hrs**

**MEMS and microsystems**: MEMS and micro system products, evaluation of micro fabrication, Microsystems and microelectronics, applications of microsystems, working principles of Microsystems, micro sensors, micro actuators, MEMS and micro actuators, micro accelerometers.

**Scaling laws in miniaturization:** Introduction, scaling in geometry, scaling in rigid body dynamics, the trimmer force scaling vector, scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection.

**Unit-II** — **12 hrs**

**Materials for MEMS and microsystems**: Substrates and wafers, silicon as a substrate material, ideal substrates for MEMS, single crystal Silicon and wafers crystal structure, mechanical properties of Si, Silicon compounds; $SiO_2$, SiC, $Si_3N_4$ and polycrystalline silicon, silicon piezo-resistors, gallium arsenide, quartz, piezoelectric crystals, polymers for MEMS, conductive polymers.

**Engineering mechanics for microsystems design:** Introduction, static bending of thin plates, circular plates with edge fixed, rectangular plate with all edges fixed and square plates with all edges fixed. Mechanical vibration, resonant vibration, micro accelerometers, design theory and damping coefficients. thermo mechanics, thermal stresses. fracture mechanics, stress intensity factors, fracture toughness and interfacial fracture mechanics.

**Unit-III** — **12 hrs**

**Basics of fluid mechanics in macro and mesco scales**: Viscosity of fluids, flow patterns Reynolds number. basic equation in continuum fluid dynamics, laminar fluid flow in circular conduits, computational fluid dynamics, incompressible fluid flow in micro conducts, surface tension, capillary effect and micro pumping, fluid flow in sub micrometer and nanoscale, rarefied gas, Knudsen and Mach number and modeling of micro gas flow, heat conduction in multilayered thin films, heat conduction in solids in sub micrometer scale, thermal conductivity of thin films - heat conduction equation for thin films.

| Unit-IV | 12 hrs |
|---|---|
| **Micro system packaging and applications of MEMS**: Micro system packaging, general considerations, the three levels of microsystems packaging, die level, device level and system level, essential packaging technologies, die preparation, surface bonding wire bonding and sealing, three-dimensional packaging, assembly of microsystems, selection of packaging materials.<br>**The MEMS switch and its design consideration:** The MEM resonator and its design considerations, micromachining-enhanced planar microwave passive elements. | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. MEMS and Microsystems Design and Manufacture | Tai-Ran Hsu | Tata McGraw Hill |
| 2. Fundamentals of Micro fabrication | Mark Madou | CRC Press |
| 3. Micro sensors: Principles and Applications | J. W. Gardner | John Willey ,2009 |
| 4. Semiconductor Sensors | S. M. Sze | Tata McGraw Hill |
| 5. An Introduction to Microelectromechanical Systems Engineering | Nadim Maluf and Kirt Williams | Artech, $2^{nd}$ Edition, 2004 |
| 6. Introduction to Microelectromechanical Microwave Systems | Hector J. De Los Santos | Artech, $2^{nd}$ Edition, 2004 |

## PEEC-611C
## Information Theory and Coding

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The aims of this course are to introduce the principles and applications of information theory. The course will study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies; how these are used to calculate the capacity of a communication channel, with and without noise; how discrete channels and measures of information generalize to their continuous forms; complexity, compression, and efficient coding of text, and audio-visual information coding schemes; including error detecting and correcting codes, block coding, convolutional coding, Viterbi decoding algorithm, Trellis coded modulation and information security: cryptographic coding.

**Course Outcomes**

1. Learn the concept of Information and to calculate the information content of a random variable from its probability distribution
2. Understand the physical significance of entropy and to imbibe a clear-cut idea about the various entropies associated with a communication system
3. Gain comprehensive understanding about capacity, efficiency and redundancy of a communication channel
4. Perform bit error analysis for digital modulation techniques.
5. Devise efficient coding techniques of communication channels.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 1 | 2 | 2 | 3 |
| CO2 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 0 | 0 | 2 | 2 | 0 | 1 | 1 | 0 | 1 | 2 | 2 | 2 |
| CO4 | 0 | 3 | 0 | 3 | 0 | 2 | 0 | 1 | 0 | 0 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 0 | 2 | 0 | 0 | 3 | 3 | 1 | 2 | 0 | 2 | 2 | 3 | 3 |

**Unit-I** — **12 hrs**

**Information theory**: Concept of amount of information -units, entropy -marginal, conditional and joint entropies -relation among entropies, mutual information, information rate, channel capacity, redundancy and efficiency of channels.
**Discrete channels**: Symmetric channels, binary symmetric channel, binary erasure channel, cascaded channels, repetition of symbols, binary symmetric channel, Shannon theorem, continuous channels – capacity of band limited Gaussian channels, Shannon-Hartley theorem, trade-off between band width and signal to noise ratio, capacity of a channel with infinite band width, optimum modulation system.

**Unit-II** — **12 hrs**

**Source coding**: Encoding techniques, purpose of encoding, instantaneous codes, construction of instantaneous codes, Kraft's inequality, coding efficiency and redundancy, noiseless coding theorem, construction of basic source codes – Shannon-Fano algorithm, Huffman coding, arithmetic coding, ZIP coding.
**Source coding, text, audio and speech**: Text: Adaptive Huffman coding, arithmetic coding, LZW algorithm audio: perceptual coding, masking techniques, psychoacoustic model, MEG audio layers I, II, III, Dolby AC3 speech: channel vocoder, linear predictive coding.
**Source coding, image and video**: Image and video formats – GIF, TIFF, SIF, CIF, QCIF, image compression: READ, JPEG, video compression: principles-I, B, P frames, motion estimation, motion compensation, H.261, MPEG standard.

| Unit-III | 12 hrs |
|---|---|
| **Codes for error detection and correction**: Parity check coding, linear block codes, error detecting and correcting capabilities, generator and parity check matrices, standard array and syndrome decoding.<br>**Block codes**: Definitions and principles: Hamming weight, Hamming distance, minimum distance decoding - single parity codes, hamming codes, repetition codes - linear block codes, cyclic codes - syndrome calculation, encoder and decoder – CRC. | |
| **Unit-IV** | **12 hrs** |
| **Convolution codes:** Code tree, trellis, state diagram, structural properties, encoding – decoding: sequential search and Viterbi algorithm – principle of turbo coding, soft-decision decoding, and Viterbi decoding algorithm.<br>**Advanced coding techniques and cryptography**: BCH codes, trellis coded modulation, introduction to cryptography, overview of encryption techniques, symmetric cryptography, DES, IDEA, asymmetric algorithms, RSA algorithm. | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Information Theory, Coding and Cryptography, | Ranjan Bose | Tata McGraw Hill |
| 2. Applied Coding and Information Theory for Engineers | Richard B. Wells | Pearson |
| 3. Coding and Information Theory, | R. W. Hamming | Prentice Hall, 2nd edition, |
| 4. Information Theory and Reliable Communication, | R. G. Gallager, | Wiley |
| 5. The Theory of Information and Coding. | R.J. McEliece | Addison –Wesley |
| 6. Introduction to information Theory | M. Mansuripur | Prentice Hall |
| 7. Principles of communication | Taub & Schilling | McGraw Hill |
| 8. Elements of Information Theory | Thomas Cover & Joy Thomas | John Wiley & Sons |

**PCEC-613**
**Analog & Digital Communication Lab**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 4 | 2 |

| | |
|---|---|
| **Course Objectives** | This lab includes hardware kits as well software simulator to analyze different analog communication systems. The main objective is to analyze the performance of AM, FM modulation systems in time and frequency domain, to study and design the circuits for transmission and reception of AM, FM and pulse modulation systems. |
| **Course Outcomes** | 1. Design and analyze AM and FM modulation circuits on hardware as well as on MULTISIM simulator.<br>2. Understand transmission and reception of AM and FM systems.<br>3. Design and analyze various pulse modulation systems on hardware as well as on MULTISIM simulator.<br>4. To understand various transmission and reception methods and their comparison. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | 0 | 1 | 3 | 2 | 1 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 0 | 1 | 3 | 2 | 1 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 0 | 1 | 3 | 2 | 1 | 3 | 3 | 2 |

**List of Experiments (Hardware):**

**PART-A**

1. To measure the modulation index of AM signal using the sine wave method and trapezoidal
2. method.
3. To setup the circuit of AM modulator using transistor.
4. To setup the circuit of envelop detector for AM demodulation.
5. To study the DSB/ SC AM signal and its demodulation using product detector circuit.
6. To study the generation and detection of FM signals.
7. To study the AM transmitter circuit and observe the waveforms at test points.
8. To study the FM transmitter circuit and observe the waveforms at test points.
9. To study the AM receiver circuit and observe the waveforms at test points.
10. To study the sampling process and time division multiplexing.
11. To study the pulse amplitude modulation and demodulation circuits.
12. To study the pulse width modulation and demodulation circuits.
13. To study the pulse code modulation and demodulation circuits.

**Software (using MULTISIM)**

1. To study the spectrum of pulses using spectrum analyzer.
2. To measure the modulation index of AM signal using the sine wave method and trapezoidal method.
3. To observe the amplitude spectrum and measure the bandwidth of AM signal.
4. To setup the circuit of AM modulator using transistor.
5. To setup the circuit of envelop detector for AM demodulation.
6. To setup the circuit of DSB/SC AM and DSB-FC AM using product modulator/multiplier.
7. To study the FM wave generated from FM source in MULTISIM and measure the modulation index by approximate method.
8. To observe the amplitude spectrum and measure the bandwidth of FM signal.
9. To generate FM signal using voltage-controlled oscillator on MULTISIM and observe the waveforms on CRO.

10. To generate pulse amplitude modulation (PAM) signal and observe its waveform.
11. To generate PWM signal using 555 timer IC and observe its waveform.
12. To generate PPM signal and observe its waveform.

**PART-B**

**Hardware**

1. To study time division multiplexing system.
2. to study pulse code modulation and demodulation.
3. To study delta modulation and demodulation and observe effect of slope overload.
4. To study pulse data coding techniques for various formats.
5. To study amplitude shift keying modulator and demodulator.
6. To study frequency shift keying modulator and demodulator.
7. To study phase shift keying modulator and demodulator.

**Software**

1. To generate BASK signal and observe the frequency spectrum on MULTISIM software.
2. To generate BPSK signal and observe the frequency spectrum on MULTISIM software.
3. To generate BFSK signal and observe the frequency spectrum on MULTISIM software.
4. To setup the model for BPSK baseband modulation for scatter plot to observe the constellation on MATLAB/SIMULINK software.
5. To setup the model for QPSK baseband modulation for scatter plot on to observe the constellation on MATLAB/SIMULINK software.
6. To setup the model for BFSK baseband modulation for scatter plot on to observe the constellation on MATLAB/SIMULINK software.
7. To setup the BPSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.
8. To setup the QPSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.
9. To setup the BFSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.

| PCEC-621<br>Linear Integrated Circuits | | | | |
|---|---|---|---|---|
| | **L** | **T** | **P** | **Credits** |
| | **2** | **1** | **0** | **3** |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |
| **Course Objectives** | The aim of this course is to introduce the basic building blocks of linear integrated circuits and acquire knowledge of fundamental characteristics of op-amps. The course analyzes op-amps with and without feedback and determines the negative feedback affects the performance of op-amps. It also includes learning of linear and non-linear applications of operational amplifiers and studies various applications using 555 timer and PLL. | | | |
| **Course Outcomes** | **1.** Understand the basic concepts and parameters of op-amps.<br>**2.** Analyze different op-amp configurations and their frequency responses.<br>**3.** Design and analyze linear and non-linear circuits, active filters, wave generator circuits and detectors.<br>**4.** Utilize Op-amp based specialized ICs. | | | |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 3 | 2 | 1 | 0 | 1 | 2 | 0 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 3 | 3 | 3 |

| Unit-I | 12 hrs |
|---|---|

**Introduction**: Introduction, emitter coupled differential amplifier, DC and AC analysis, cascaded differential amplifier stages, level translator.
**Operational amplifiers (Op-amp):** Basic op-amp and its schematic symbol, block diagram of a typical op-amp, integrated circuits and their types, IC package types, pin identification and temperature range, overview of typical set of data sheets, characteristics and performance parameters of op-amp, equivalent circuit of an op-amp, ideal op-amp and its characteristics, ideal voltage transfer curve.
**Op-Amp parameters**: Input offset voltage, input bias current, input offset current, total output offset voltage, thermal drift, variation of op-amp parameters with supply voltage and temperature, noise, common mode configuration and common mode rejection ratio, slew rate

| Unit-II | 12 hrs |
|---|---|

**Op-Amp configurations and frequency response**: Open loop configurations: differential, inverting & non-inverting. negative feedback configurations: block diagram representation of feedback configurations, voltage-series feedback amplifier, voltage shunt feedback amplifier, differential amplifiers with one op-amp, two op-amps and three op-amps. frequency response, compensating networks, frequency response of internally compensated op-amps, frequency response of non-compensated op-amps, closed loop frequency response.

| Unit-III | 12 hrs |
|---|---|

**Applications of op-amps:** DC and AC amplifiers, peaking amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, V to I and I to V converter, log and antilog amplifier, integrator and differentiator.
**Active filters:** First order and second order filter, higher order low-pass filter, second order high pass filter, band pass filter, wide band-pass filter. band reject filter, all-pass filter.
**Wave generator:** Square wave generator, triangular wave generator, saw tooth wave generator and voltage-controlled oscillator, comparator, zero crossing detector, Schmitt trigger, window detector, V to F and F to V converters, A to D and D to A converters, peak detector.

| Unit-IV | 12 hrs |
|---|---|
| **Specialized IC applications**: IC 555, pin configuration, block diagram, application of 555 as monostable and astable multivibrator, operating principles & applications of 565PLL.<br>**Voltage regulators:** Fixed voltage regulators, adjustable voltage regulators, switching regulators. | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Op Amps & Linear Integrated circuits | Ramakant Gayakwad | Pearson Education |
| 2. Fundamental of Microelectronics | B Razavi | Wiley India |
| 3. Linear Integrated Circuits | D. Roy Choudhary | New Age International |
| 4. Design with Operational Amplifiers and Analog Integrated Circuits | Sergio Franco | Tata Mc-Graw Hill |

## PCEC-622
## Fibre Optics Communications

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

To be familiar with the operating principles of fibre optics characteristics and optical components for fibre communication systems. Analyzation of various nonlinear effects in optical fibre and performance of Optical sources and detector. Describe the hardware i.e. optical sources, detectors and amplifiers of fibre optic communication systems and familiar with the installation of fibre optics communication network for real time application.

**Course Outcomes**

1. Learn basics of optical fiber and other components for optical communication system.
2. Analyze the various nonlinearities in optical communication system.
3. Appreciate the long-haul communication achieved by using optical amplifier.
4. Describe the various optical network topologies.
5. Use the appropriate state-of-the-art engineering references and resources needed to find the best solutions to optical system design problems.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 3 | 3 | 0 | 2 | 1 | 0 | 0 | 1 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 0 | 1 | 2 | 0 | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 0 | 1 | 1 | 2 | 0 | 0 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 0 | 3 | 3 | 1 | 1 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 0 | 1 | 2 | 0 | 3 | 3 | 2 | 3 |

**Unit-I** — **12 hrs**

**Introduction to fiber optic**: Historical of fiber optics, block diagram of fiber optical communication, key elements of optical fiber system. standard for optical communication.
**Optical fibers**: Basic optical law and definitions, fiber characteristics and transmission, Types of fibers single mode and multimode, step index and graded index, numerical aperture, modes.

**Unit-II** — **12 hrs**

**Attenuation and dispersion**: Attenuation causes and measurement of attenuation, absorption, bending losses, dispersion (intermodal and intermodal), group velocity dispersion, dispersion induced pulse broadening, higher order dispersion, dispersion slope,
**Nonlinear effects**: Stimulated Raman scattering, stimulated Brillouin scattering, cross phase and self-phase modulation, four wave mixing

**Unit-III** — **12 hrs**

**Optical source**: Energy bands, intrinsic and extrinsic material, P-n junction, direct and indirect band gaps, LED, structure, material, quantum efficiency, power and modulation, LASER diodes, principle of operation, laser diode rate equations, quantum efficiency, structure and modulation.
**Optical receivers:** Principle of PIN photo detector and avalanche photodiode, photo detector noise, detector response time, RAPD, avalanche multiplication noise, temperature effects, comparison of photo detectors.

| Unit-IV | 12 hrs |
|---|---|
| **Optical amplification**: Introduction to optical amplifier, characteristics of semiconductor optical amplifiers (SOAs), Erbium doped fibre amplifiers (EDFAs) and Raman amplifier and their gain characteristics and gain saturation.<br>**Optical networking**: fibre optics topologies, fibre distributed data interface (FDDI) structure, synchronous optical network (SONET) and SDH, SONET Ring, networking components. | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Fiber-Optic Communication Systems | G. P. Aggarwal | J. Wiley & Sons. 2nd Ed., 1997 |
| 2. Optic Communication Systems | Mynbaev | Pearson education, 2001, |
| 3. Optical Fiber Communication | Gerd Keiser | McGraw Hill, 5th edition 2013 |
| 4. Optical Fiber Communication | Senior | PHI |

# OEEC-621A
## Microprocessor & Applications

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The objective of this course is to introduce the architecture and learn programming of the microprocessor 8085 and learning about communication interfaces and various applications basic and advanced microprocessors.

**Course Outcomes**

1. Acquire the knowledge of hardware features, architecture of 8085.
2. Write basic assembly language program in 8085.
3. Understand design of memory systems and develop programs for communications and peripherals interfacing.
4. Describe basic functioning of advanced microprocessors.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 3 | 2 | 3 |

**Unit-I** — **12 hrs**

**Introduction:** Digital computing, computer languages, from large chip computers to single chip microcomputers, microcomputers organization, and 4-bit microprocessors.
**8-bit microprocessor architecture**: Microprocessor architecture & its operations, memory, input/output, interfacing devices MPU, 8085 based microcomputer, instruction classification, instruction format, instruction timings, 8080 a MPU, overview of 8085/8080a instruction set.

**Unit-II** — **12 hrs**

**Programming using 8085 microprocessors**: Data transfer instructions, arithmetic operations, logic operations, branch operations, programming techniques using looping counting & indexing, dynamic debugging, time delays, counters, stack, subroutines, conditional call, and return instructions, advanced subroutine concepts.

**Unit-III** — **12 hrs**

**Interrupts**: The 8080A interrupts the 8085 interrupts, restart instructions, additional I/O concepts & processes.
**Parallel input/output and interfacing applications**: Basic interfacing concepts, interfacing output displays, interfacing input keyboards, and memory mapped I/O, interfacing memory, interfacing D /A& A/D converters.

**Unit-IV** — **12 hrs**

**General purpose programmable peripheral devices**: Introduction to 8155/8156,8255 a programmable peripheral interface, 8253 programmable interval timers, 8259 a programmable interrupt controller, SID & SOD lines, 8251 USART.
**Microprocessor applications:** Temperature controller, traffic light controller, stepper motor control, comparison of 8-bit, 16-bit and 32-bit microprocessors, introduction to Pentium processors.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Microprocessor Architecture-Programming & Applications with 8085/8080A | Ramesh S Gaonkar | 5th Edition, Penram International Publishing |
| 2. Introduction of Microprocessors & Microcomputers | Ram B | 4th Edition, Dhanpat Rai Publisher (P) Ltd. |
| 3. Microprocessor Interfacing Technique | Rodnay Zaks and Austin Lesea | 1st Indian Edition, BPB Publication |
| 4. An introduction to Intel family of Microprocessors | James L Antonakes | 3rd Edition, Pearson Education |
| 5. Microprocessor Principles and Applications | Charles M Gilmore | 2nd Edition, McGraw Hill |

**OEEC-621B**
**VLSI Technology**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**: The objective of the subject VLSI Technology is to discuss the design and fabrication process of thick film, thin film and hybrid IC's. It also aims to understand each and every step of fabrication from crystal growth to photolithography to manufacturing and to have a deep knowledge of fabrication process flow and learning design and fabrication of MOSFET.

**Course Outcomes**

1. Understand the basics of fabrication process, its requirements and challenges.
2. Understand different techniques involved in VLSI fabrication.
3. Process integration for NMOS, CMOS and bipolar circuits.
4. Learn latest trends in VLSI technology.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 3 | 2 | 1 | 3 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 0 | 3 | 3 | 3 | 3 |

**Unit-I** — **14 hrs**

**Introduction to VLSI technology**: Clean room and safety requirements, wafer cleaning process and wet chemical etching techniques, impurity incorporation: solid state diffusion modelling and technology, ion Implantation modeling, technology and damage annealing, characterization of impurity profiles.

**Oxidation**: Kinematics of silicon dioxide growth for, thick thin and ultrathin films, oxidation technologies in VLSI and ULSI, characterization of oxide films, high k and low k dielectrics for ULSI.

**Unit-II** — **12 hrs**

**Lithography**: Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI, Mask generation.

**Chemical vapor deposition techniques (CVD)**: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films, epitaxial growth of silicon: modeling and technology

**Unit-III** — **12 hrs**

**Metal film deposition**: Evaporation and sputtering techniques, failure mechanisms in, metal interconnects and multi-level metallization schemes.

**Plasma and rapid thermal processing**: PECVD, Plasma etching and RIE techniques, RTP techniques for annealing, growth and deposition of various films for use in ULSI.

**Unit-IV** — **10 hrs**

**Process integration**: Process integration for NMOS, CMOS and bipolar circuits.

**Advance MOS technology**: Introduction and latest trends in VLSI technology.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. The Science and Engineering of Microelectronic Fabrication | Stephen A. Campbell | Oxford University Press, 2012 |
| 2. VLSI Technology 2nd edition | Sze | McGraw-Hill Book Company, New Delhi, 1988 |
| 3. VLSI Fabrication Principles | Sorab K. Gandhi | John Wiley, 1994 |

## OEEC-621C
## Nanotechnology

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

| | |
|---|---|
| **Course Objectives** | It gives an understanding of the fundamentals of nanotechnology, gives a general introduction to different classes of nanomaterials. Basic knowledge on various synthesis and characterization techniques involved in Nanotechnology will be imparted. Students will be familiarized with nanotechnology potential. |
| **Course Outcomes** | 1. Understand basic principle of nanotechnology and its importance.<br>2. Acquire knowledge of nano-particle synthesis and their physical properties.<br>3. Develop simple nanoscale models to interpret the behaviour of physical systems.<br>4. Describe various semiconductor nanowire methods. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 3 |
| CO2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 0 | 0 | 2 | 1 | 3 |
| CO3 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 0 | 0 | 2 | 2 | 3 |
| CO4 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 1 | 3 |

### Unit-I — 12 hrs

**Introduction:** An overview, insights and intervention into the nano world, societal implications & ethical issues in nano science and nanotechnology
**Applications:** Applications of nanotechnology in different areas of food, agriculture, textile and medical sciences

### Unit-II — 12 hrs

**Semiconductor nano particles synthesis**: Cluster compounds, quantum-dots from MBE and CVD, wet chemical methods, reverse micelles, electro-deposition, pyrolytic synthesis, self-assembly strategies.
**Semiconductor nano particles- size–dependent physical properties**: Melting point, solid-state phase transformations, excitons, band-gap variations-quantum confinement.

### Unit-III — 12 hrs

**Semiconductor nano particles–applications**: Optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, surface-trap passivation in core-shell nanoparticles, carrier injection.
**Doping:** Electroluminescence, barriers to nanoparticle lasers, doping nanoparticles, Mn-Zn-Se phosphors, light emission from indirect semiconductors, light emission form Si Nanodots.

### Unit-IV — 12 hrs

**Semiconductor nanowires**: Fabrication strategies, quantum conductance effects in semiconductor nanowires, porous silicon, nanobelts, nanoribbons, nano springs.
**Physical methods:** Inert gas condensation, arc discharge, RF-plasma, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Encyclopedia of Nanotechnology | Hari Singh Nalwa | Springer Inc. |
| 2. Springer Handbook of Nanotechnology | Bharat Bhusan | Springer Inc. |
| 3. Introduction to Nanotechnology | Poole Jr., C.P., Owens, F.J | Wiley Inc. |
| 4. A Textbook of Nanoscience and Nanotechnology | B S Murthy | Springer Inc. |

## OEEC-622A
## Biomedical Electronics

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

To familiarize constructional and functional details of man-instrument system including underlying principle of electro-physiological signal measurement and analysis, constructional and functional details of the different biomedical equipment as well as understanding signal processing techniques for extracting information of physiological parameters.

**Course Outcomes**

1. Understand linkages between the life sciences and engineering techniques to have fair understanding about anatomy and physiology of human body.
2. Familiarize with constructional and functional details of man-instrument system including underlying principle of electro-physiological signal measurement and analysis.
3. Conceptualize underlying technology with regard to constructional and functional details of biomedical equipment.
4. Conceptualize signal processing techniques in extracting information about malfunctioning of physiological systems of human body.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 0 | 0 | 3 | 3 | 3 | 3 | 1 | 1 | 0 | 1 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 3 | 0 | 1 | 1 | 2 | 0 | 1 | 3 | 3 | 3 |

**Unit-I** — **10 hrs**

**Biomedical instrumentation**: Man-instrument system, physiological systems of human, transducers for biomedical applications, sources of bioelectric potentials, resting and action potentials, propagation of action potentials, bioelectric potential, electrode theory, bioelectric potential electrodes, biochemical transducers,

**Unit-II** — **14 hrs**

**Biomedical recording systems:** Basic recording system, general considerations for signal conditioners, preamplifiers, biomedical signal analysis techniques, signal processing techniques, amplifier and driver stage, writing systems, inkjet recorders, potentiometric recorders, digital recorders, electrocardiograph, vector cardiograph, phonocardiograph, electroencephalograph, electromyography, oximeters, blood flow meters, spirometry and pulmonary function measurements.

**Unit-III** — **12 hrs**

**Modern imaging systems:** Basics of diagnostic radiology, digital radiography, constructional and operational details of X-ray machine, X-ray computed tomography, nuclear medical imaging system, magnetic resonance imaging system, ultrasonic imaging system and thermal imaging system.

**Unit-IV** — **12 hrs**

**Biotelemetry**: Physiological parameters adaptable to biotelemetry, components of biotelemetry system, implantable units, applications in patient care and monitoring, wireless telemetry, single channel telemetry system, multi-channel wireless telemetry system, multi-patient telemetry, implantable telemetry system, analog physiological signal transmission over telephone lines and telemedicine.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Biomedical Instrumentation and Measurements | Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer | Pearson Prentice Hall2006 |
| 2. Introduction to Biomedical Equipment Technology | Joseph J. Carr and John M. Brown | Pearson Education India, 2001 |
| 3. Handbook of Biomedical Instrumentation | R. S. Khandpur | Tata-McGraw Hill Education, 2003 |

**OEEC-622B**
**Control System Engineering**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The aim of this course is to understand the basic elements of control system and its illustrative examples, concept of servomechanism. This course will contain physical modeling of electric-mechanical system, finding the transfer function using block diagram reduction and signal flow graphs and analysis of steady state and transient state. To understand the concept of stability using various techniques such as Routh's Hurwitz criterion, root locus technique, Nyquist, bode plots and state space analysis.

**Course Outcomes**

1. Understand basics of control system theory and its role in engineering design.
2. Explain concept of poles and zeros of a transfer function and their effect on physical behavior of a system.
3. Analyze time domain and frequency domain behavior of systems.
4. Perform state variable analysis of systems and establish relationship between state variable representation and transfer functions.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 3 | 0 | 0 | 0 | 1 | 2 | 0 | 1 | 2 | 3 | 3 |
| CO2 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 3 | 2 |

**Unit-I** — **12 hrs**

**Introduction**: Introduction to control systems, servomechanism, open loop control system, closed loop control system with block diagrams and illustrative examples, AC and DC servomotors, stepper motor, concept of transfer function, characteristic equations, physical system modeling, formulation of equations for linear electrical, mechanical, thermal, hydraulic and pneumatic systems, electrical-mechanical analogies. signal flow graphs, block diagram simplification for linear systems.

**Unit-II** — **12 hrs**

**System response:** Time domain and frequency domain response of the first and second order systems. time domain specifications, steady state error and coefficients, type and order of system with P, PI, PD and PID controller, relation between time and frequency response for second order systems.

**Unit-III** — **14 hrs**

**Stability analysis**: Pole-zero location and stability, Routh-Hurwitz criterion, root locus, log. magnitude versus phase angle plot, bode plots, Nyquist criterion for stability, necessity of compensation, lead, lag and lead-lag compensation networks.

**Unit-IV** — **10 hrs**

**State variable analysis**: State space representation of continuous time systems, state equations, transfer function from state variable representation, solution of state equations, controllability and observability, state space representation of discrete time systems.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Modern Control Engineering | Ogata K | Prentice Hall, 5th Edition 2010 |
| 2. Automatic Control Systems | Kuo BC | Prentice Hall, 9th Edition 2014 |
| 3. Modern Control Systems Engineering, | Nagrath I J and Gopal M | New age international, 3rd Edition, 2014. |
| 4. Linear Control System | B S Manke | Khanna Publishers, 12th edition |

## OEEC-622C
## Electronic System Design

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

Students will be introduced to active and passive components specifications required for design an electronic circuit. Designing of various power supply circuits. Selection of components will be explained. Problems in the transistor amplifier and how to use op amp to solve these problems will be explained. This is necessary and essential in understanding the design of heat sink, and importance of grounding. It will impart practical knowledge of electronic system design.

**Course Outcomes**

1. Explain and identify the devices which can be used in applications like power supply, amplifiers etc.
2. Design and develop linear and variable power supply.
3. Address design challenges for amplifiers using transistor and op-amps.
4. Analyze and design different base drive circuits.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 0 | 2 | 3 | 1 | 0 | 0 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 2 | 2 |

**Unit-I** — **14 hrs**

**Practical circuit design issues and techniques:** Passive components, understanding and Interpreting data sheets and specifications of various passive and active components. design of electronic circuits by using these types of components, understanding and interpreting data sheets and specifications of various CMOS and TTL logic devices. CMOS/TTL interfacing issues, benefits and challenges on migration of 5V to 3.3V low voltage supplies.

**Unit-II** — **12 hrs**

**Power supply design techniques:** Regulated and unregulated power supply, conditions for proper operation of Zener regulator, transistor series voltage regulator, transistor Shunt voltage regulator, short circuit protection, foldback protection circuit, IC voltage regulators, fixed voltage regulators, adjustable voltage regulators design, dual voltage regulators design, differences between linear voltage power supply and SMPS.

**Unit-III** — **12 hrs**

**Amplifiers design challenges and techniques**: Basic amplifiers design, single stage amplifier, how transistor amplifies? Transistor audio power amplifier, small signal and large signal amplifier, difference between voltage and power amplifiers, operational amplifiers, circuit analysis using operational amplifier in different configurations.

**Unit-IV** — **10 hrs**

**Cooling and grounding of electronic system:** Heat transfer approach to thermal management, mechanisms for cooling, basic thermal calculations, heat sink selection, and heat sink design. Safety grounds, signal grounds, high frequency ground methods, low frequency grounding methods, chassis grounding.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Electronic Instrument Design, 1st edition | Kim R. Fowler | Oxford University Press. |
| 2. Digital Design Principles& Practices, 3rd edition | John F. Wakerly | Prentice Hall |
| 3. Practical Analog Design Techniques | Adolofo Garcia and Wes Freeman | Seminar Materials |
| 4. The Art of Electronics | Paul Horowitz | Cambridge University Press, 2011 |

**PEEC-621A**
**Control System Engineering**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The aim of this course is to understand the basic elements of control system and its illustrative examples, concept of servomechanism. This course will contain physical modeling of electric-mechanical system, finding the transfer function using block diagram reduction and signal flow graphs and analysis of steady state and transient state. To understand the concept of stability using various techniques such as Routh's Hurwitz criterion, root locus technique, Nyquist, bode plots and state space analysis.

**Course Outcomes**

1. Understand basics of control system theory and its role in engineering design.
2. Explain concept of poles and zeros of a transfer function and their effect on physical behavior of a system.
3. Analyze time domain and frequency domain behavior of systems.
4. Perform state variable analysis of systems and establish relationship between state variable representation and transfer functions.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 2 | 0 | 3 | 3 |
| CO2 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 3 | 2 | 0 | 3 | 2 |

**Unit-I** — **12 hrs**

**Introduction**: Introduction to control systems, servomechanism, open loop control system, closed loop control system with block diagrams and illustrative examples, AC and DC servomotors, stepper motor, concept of transfer function, characteristic equations, physical system modeling, formulation of equations for linear electrical, mechanical, thermal, hydraulic and pneumatic systems, electrical-mechanical analogies. signal flow graphs, block diagram simplification for linear systems.

**Unit-II** — **12 hrs**

**System response:** Time domain and frequency domain response of the first and second order systems. time domain specifications, steady state error and coefficients, type and order of system with P, PI, PD and PID controller, relation between time and frequency response for second order systems.

**Unit-III** — **12 hrs**

**Stability analysis**: Pole-zero location and stability, Routh-Hurwitz criterion, root locus, log. magnitude versus phase angle plot, bode plots, Nyquist criterion for stability, necessity of compensation, lead, lag and lead-lag compensation networks.

**Unit-IV** — **12 hrs**

**State variable analysis**: State space representation of continuous time systems, state equations, transfer function from state variable representation, solution of state equations, controllability and observability, state space representation of discrete time systems.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Modern Control Engineering | Ogata K | Prentice Hall, 5th Edition 2010 |
| 2. Automatic Control Systems | Kuo BC | Prentice Hall, 9th Edition 2014 |
| 3. Modern Control Systems Engineering, | Nagrath I J and Gopal M | New age international, 3rd Edition, 2014. |
| 4. Linear Control System | B S Manke | Khanna Publishers, 12th edition |

# PEEC-621B
# Telecommunication Switching Systems and Networks

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The aim of this course is to study the basics of switching systems and telecommunication transmission, designing of multistage networks, signaling techniques, different networks, charging and routing plans. The course emphasis on different technologies used for design of switching systems such as electronic space division switching and time division switching.

**Course Outcomes**

1. Understand the operation of telephone system and assess the need for voice digitization.
2. Explain the working principle of switching systems involved in telecommunication switching.
3. Design multi-stage switching structures involving time and space switching stages.
4. Analyze the signalling techniques and develop the numbering and charging plan.
5. Perform quantitative measurement of telecommunication traffic to develop and implement an efficient communication network.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | 3 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 2 | 3 |
| CO3 | 3 | 2 | 0 | 0 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 0 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 2 | 1 |
| CO5 | 3 | 2 | 0 | 0 | 1 | 3 | 3 | 1 | 0 | 0 | 3 | 3 | 2 | 2 |

**Unit-I** — **12 hrs**

**Telecommunications transmission**: Basic switching system, simple tele-phone communication.
**Switching systems**: Stronger switching systems, cross bar switching, electronic switching – space division switching, time division switching –time division space switching, time division time switching, time multiplexed space switching, time multiplexed time switching, combination switching.

**Unit-II** — **12 hrs**

**Speech digitization & transmission**: Quantization noise, companding, differential coding, vocoders, pulse transmission, **Coding schemes:** Line coding, NRZ and RZ codes, Manchester coding, AMI coding, Walsh codes, TDM.

**Unit-III** — **12 hrs**

**Traffic engineering**: Grade of service and blocking probability telephone networks, subscriber loops, switching hierarchy and routing, transmission plans and systems, signalling techniques, in channel, common channel.
**Control of switching systems:** Call processing functions, common control, and stored program control (For all type of switching systems).

**Unit-IV** — **12 hrs**

**Telephone networks and signalling**: Introduction, subscriber loops systems, switching hierarchy, transmission and numbering plans, common channel signalling principles, CCITT signalling systems.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Telecommunications Switching, Traffic and Networks | Flood J E | Pearson education Asia, (2001). |
| 2. Telecommunication Switching Systems and Networks | Viswanathan T | PHI, India, (2003). |
| 3. Signaling in Telecommunication Networks | Bosse J G van, Bosse John G | Wiley, John & Sons, (1997). |
| 4. Switching in IP Networks: IP Switching, Tag Switching, and Related Technologies | Bruce S. Davie, Paul Doolan, Yakov Rekhtor | Elsevier Science & Technology Books, (1998) |
| 5. Switching and Traffic Theory for Integrated Broadband Networks | Joseph Yu Hui | Kluwer Academic Publishers, (1990). |

**PEEC-621C**
**MOS Device Physics and Modelling**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The course introduces active and passive components specifications required for design an electronic circuit. It includes designing of various power supply circuits, selection of components, problems in the transistor amplifier and how to use op amp to solve these problems. The course emphasis on designing of heat sink, importance of grounding and also imparting practical knowledge of electronic system design.

**Course Outcomes**

1. Analyze current distribution in the devices like transistors, MOS devices.
2. Derive models for the behavior of the electrical devices based on fundamental physics.
3. Apply different SPICE transistor models for circuit analyses.
4. Compute terminal voltage and current characteristics for MOS transistors using SPICE Transistor model.
5. Extract various device parameters like effective channel length, threshold voltage, and drain and source series resistances.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 3 | 2 |
| CO3 | 3 | 2 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 1 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 2 | 2 |

**Unit-I** — **12 hrs**

**Introduction:** Circuit design, MOSFET modelling, and model parameters, interconnects

**Unit-II** — **12 hrs**

**MOS transistor structure and its operation**: Characteristics, scaling theory, hot carrier effects, parasitic elements, MOSFET circuit models, modelling of hot carrier and short channel effects.

**Unit-III** — **12 hrs**

**MOS capacitor:** MOS capacitor with zero and nonzero basic-V curves, anomalous C-V curves, non-uniform doped substrate.

**Unit-IV** — **12 hrs**

**SPICE MOSFET models**: Introduction, basic concept LEVEL 1 model equations, LEVEL 2 model equations, LEVEL 3 model equations and LEVEL 4 model's equations.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Fundamental of Modern VLSI Design | Yuan Taur, Tak H Ning | Cambridge University Press, 2011 |
| 2. CMOS Digital Integrated Circuits | Sung-Mo Kang | Tata McGraw Hill |
| 3. Operation and Modelling of the MOS Transistor | Yannis Tsividis | Oxford University Press |

**PCEC-623**
**Linear Integrated Circuit Lab**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

| | |
|---|---|
| **Course Objectives** | This lab includes complete analytical as well as designing circuits using op-amp. It includes design of various applications using op-amp as integrator, differentiator, log, antilog and wave generation circuits. |
| **Course Outcomes** | 1. Examine the performance of op-amp in inverting as well as in non-inverting modes.<br>2. Design of various applications using op-amp.<br>3. Design different wave generating circuits using op-amp.<br>4. Design of 555 timer and PLL circuit. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 0 | 0 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 2 |

**List of Experiments:**

1. Design and analyze RC-circuit as low pass and high pass using active filters.
2. Design and analyze RC-circuit as low pass and high pass using passive filters.
3. Verify the differential amplifier configurations.
4. Measure the performance parameters of an op-amp.
5. Application of op-amp as inverting and non-inverting amplifier.
6. Verify the frequency response of an op-amp.
7. Use the op-amp as summing, scaling & averaging amplifier.
8. Use the op-amp as instrumentation amplifier.
9. Design and analyze differentiator and integrator using op-amp.
10. Application of op-amp as log and antilog amplifier.
11. Application of op-amp as saw tooth wave generator.
12. Application of op-amp as Schmitt Trigger.
13. Design and analyze multivibrator circuits using 555.
14. To examine the operation of a PLL and to determine the free running frequency, the capture range and the lock in range of PLL.

**PCEC-624**
**Fiber Optics Communication Lab**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The aim of this course is to study and understand the practical aspects of advanced communication system and optical fiber. It also gives the insight into various optical nonlinearities in optical communication and their mitigation. Finally, it will provide platform for the student to design and evaluation of modern optical communication networks, wireless communication network and OFDM.

**Course Outcomes**

1. Able to understand various losses occurs in optical communication system and their mitigation.
2. Enables the implementation of optical fiber communication link.
3. Ability to model and analyze the optical communication system for higher data rate.
4. Capable to integrate wireless technology with optical communication technology.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 3 | 3 | 1 | 0 | 1 | 3 | 2 | 1 | 2 |
| CO2 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 1 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 3 | 2 | 1 | 2 |
| CO4 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 3 |

**List of Experiments:**

1. To study the effect characteristics of Mach-Zender modulator in Opti-system.
2. Designing of an intensity modulator using Lithium Niobate Mach-Zehnder modulator in Opti-system.
3. To establish a point-to-point optical communication link on Opti-System and optical kit.
4. Characterization of laser diode and photodetector using simulator/light runner.
5. Characterization of the electrical parameter of the intensity modulator using Opti-System.
6. Measurement of attenuation in optical fiber using Opti-System simulator and light runner.
7. Measurement of dispersion in optical fiber using Opti-System simulator and light runner.
8. Minimization of the effect of dispersion in optical communication link.
9. Evaluation of power budget of an optical fiber link using Opti-System simulator and light runner.
10. Designing of a DWDM point-to-point link using Opti-system.
11. To study the effect of channel spacing and operating bit rate in DWDM optical network.
12. To study the effect of four-wave mixing in DWDM network in Opti-system.
13. To study the effect of cross-phase modulation in DWDM network in Opti-system.
14. Designing of an all-optical wavelength convertor using Opti-system.
15. Experimental study of SMF cutting and splicing.
16. Demonstration of SMF connection.
17. Designing of external metal deposition-based PCF-SPR sensor model.
18. Modelling of spectroscopy-based sensing setup for liquid analytes.

| TPID-621<br>Industrial Training (4 weeks) | | | | |
|---|---|---|---|---|
| | **L** | **T** | **P** | **Credits** |
| | **0** | **0** | **40** | **2 (S/US)** |
| **Course Objectives** | The main objective of industrial training is to familiarized students with industrial working environment and enhance their knowledge skills towards developing a holistic perspective to understand various practical issues and latest trends in the field. The students will be able to troubleshoot various engineering faults related to their respective fields. They will be able to learn ethical management practices. | | | |
| **Course Outcomes** | After successful completion of industrial training, the students should be able to<br>1: implement the technical skills as an individual and in team.<br>2: correlate the theoretical concepts with the real-life industrial environment.<br>3: achieve a long-term goal of transforming themselves into an optimum blend of theoretical and practicing engineers.<br>4: express their work effectively through verbal and written communication. | | | |

**Mapping of Course Outcomes with Program Outcomes**

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

## PCEC-711
## Digital Signal Processing

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The aim of this course is to acquire knowledge of discrete time systems, Z-transform, discrete Fourier transform (DFT) and fast Fourier transform (FFT) methods. Implementation and designing of FIR and IIR filters and realization of their structures. The concept of multirate signal processing and sample rate conversion will also be discussed.

**Course Outcomes**

1. Analyze linear time invariant systems.
2. Compute Z-transform, DFT and FFT of discrete time signals.
3. Understand the concepts of multirate signal processing.
4. Design digital filters using standard techniques.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 1 | 2 | 0 | 0 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |

**Unit-I** — **10 hrs**

**Introduction**: Advantages of digital signal processing over analog signal processing and its applications; basic elements of digital signal processing systems, concept of frequency in discrete time sinusoidal and harmonically related complex- exponential signals, review of discrete-time signals and systems, analysis of discrete-time systems, discrete-time systems described by difference equation, correlation of discrete-time signals.

**Unit-II** — **16 hrs**

**Z-transform**: Introduction to Z- transform and inverse Z-transform, region of convergence, properties of Z transform, analysis and characteristics of LTI systems using Z- transforms.
**Discrete Fourier transform (DFT):** Introduction to DFT, inverse DFT, DFT as a linear transform, relationship of DFT with other transforms, properties of DFT, circular convolution, use of DFT in linear filtering, filtering of long sequences. efficient computation of the DFT, fast Fourier transform algorithm using decimation in time and decimation in frequency techniques.

**Unit-III** — **16 hrs**

**Implementation of discrete time system:** Structures for the realization of discrete-time systems, structure for FIR & IIR systems, fixed point and floating-point representations, effects of coefficient unitization, effect of round off noise in digital filters, limit cycles.
**Design of digital filters:** General consideration, linear phase FIR filters, design methods for FIR filters using windows, IIR filter design by impulse invariance, bilinear transformation and matched Z-transformation.

**Unit-IV** — **06 hrs**

**Multirate signal processing:** Introduction, interpolation and decimation.
**Wavelet theory:** Short time Fourier transform (STFT), Continious wavelet transform (CWT), Discrete wavelet transform (DWT) and Haar wavelet.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Discrete Time Signal Processing, 3rd Edition 2014 | Oppenheim A V & Sehafer R W | Prentice Hall |
| 2. Digital Signal Processing, 4th Edition 2006 | Proakis J G & Manolakis D G | Pearson |
| 3. Signal & Systems, 2nd Edition 2009 | Oppenheim A V, Willsky A S & Young I T | Wiley Eastern Ltd N. Delhi |
| 4. Digital Signal Processing, 4th Edition 2013 | S.K Mitra | Tata Mc-Graw Hill |

## PCEC-712
## Antenna and Wave Propagation

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

The aim of course is to understand radiation principles, antenna fundamentals and their basic parameters. Various antennas, arrays and their special features and applications will also be discussed. The wave propagation will enable the students to learn the atmospheric electrical structure and its propagation properties.

**Course Outcomes**

1. Understand radiation principles and various antenna parameters.
2. Describe the atmospheric and terrestrial effects on radio wave propagation.
3. Gain knowledge of wire radiators, various special antennas and their applications.
4. Synthesize antenna arrays and analyze their radiation patterns.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 0 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 0 | 1 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 2 | 3 | 2 |

**Unit-I** — **12 hrs**

**Basic antenna parameters**: Radiation mechanism, radiation patterns, antenna beam area, antenna beam width, radiation intensity, gain, directive gain, power gain, directivity (D), antenna bandwidth, effective height, reciprocity theorem, self-impedance, mutual impedance, radiation resistance, front to back ratio, radiation power density.
**Radiation principles**: Retarded vector potential, isotropic radiators, near field and far field concept, radiation from a half wavelength dipole, power radiated by a current element and its radiation resistance.

**Unit-II** — **12 hrs**

**Wire radiators**: Voltage and current distribution, asymptotic current distribution in dipole, analysis of linear wire elements, Hertz dipole antenna, monopole radiators, resonant and non-resonant antennas.
**Special antennas**: Aperture antennas, E & H -plane horn antennas, pyramidal horn, lens and reflector antenna, frequency independent antennas, log periodic antenna, antenna measurements, microstrip antennas & their advantages, antenna for receiving and transmitting TV signals e.g. Yagi-Uda and turnstile antennas.

**Unit-III** — **12 hrs**

**Antennas array:** Introduction, linear uniform arrays of isotropic sources, principles of pattern multiplication. broadside arrays, end fire arrays, array pattern synthesis, uniform array, binomial array, Chebyshev arrays.

**Unit-IV** — **12 hrs**

**Propagation of radio waves**: Structure of ionospheric region, different modes of propagation: ground waves, space waves, space wave propagation over flat and curved earth, optical and radio horizons, surface waves and troposphere waves, wave propagation in the ionosphere, critical frequency, maximum usable frequency (MUF), skip distance, virtual height, radio noise of terrestrial and extra-terrestrial origin, effect of earth's curvature, duct propagation, troposphere scatter propagation.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Antennas | Kraus | Mc Graw Hill |
| 2. Antennas | Balanis | Mc Graw Hill |
| 3. Antenna and Wave Propagation | K D Parsad | Parkash Publications |
| 4. Electromagnetic Waves and Radiating Systems | K. G Balmain,<br>E. C Jordan | PHI |

## PEEC-711A
## Microelectronics

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The objective of the subject microelectronics is to discuss the design and fabrication process of thick film, thin film and hybrid IC's. It also aims to understand each and every step of fabrication from crystal growth to photolithography to manufacturing and to have a deep knowledge of fabrication process flow and learning design and fabrication of MOSFET.

**Course Outcomes**

1. Understand the physical and electrical properties of semiconductor materials and their use in microelectronic circuits.
2. Gain knowledge about fabrication process and challenges.
3. Describe various VLSI fabrication tools and techniques.
4. Process integration for NMOS, CMOS and bipolar circuits.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 0 | 0 | 1 | 0 | 1 | 3 | 0 | 2 | 2 |
| CO2 | 3 | 1 | 3 | 2 | 3 | 0 | 3 | 1 | 0 | 0 | 2 | 0 | 2 | 3 |
| CO3 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 0 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 3 | 0 | 1 | 2 |

**Unit-I** — **10 hrs**

**Introduction:** Course introduction, modern semiconductor IC fabrication industrial/academic landscape, classification, scaling thick film, thin film and hybrid integrated circuits, crystal structures.

**Unit-II** — **10 hrs**

**Crystal growth**: Bridgeman and Czochralski techniques, clean room basics- environment, infrastructure, advanced MOS cleaning, gettering etc.
**Oxidation:** Surface passivation using oxidation, dry oxidation, wet oxidation, kinetics of Silicon dioxide growth for, thick thin and ultrathin films, Oxidation technologies in VLSI and ULSI, characterization of oxide films, High k and low k dielectrics for ULSI.

**Unit-III** — **14 hrs**

**Lithography:** Photo reactive materials, types of photoresists, pattern generation and mask-making, pattern transfer, lithography process steps.
**Diffusion and ion implantation:** Interstitial diffusion, substitutional diffusion, interstitially diffusion, diffusion equation, Fick`s first law and second law, ion implant distribution, penetration range, nuclear stopping, electronics stopping, implantation damage and annealing.
**Epitaxy and thin film deposition:** Historical development and basic concepts, chemical vapour deposition (CVD), atmospheric pressure chemical vapour deposition (APCVP), vapour phase epitaxy (VPE), liquid phase epitaxy (LPE), molecular beam epitaxy (MBE),

**Unit-IV** — **14 hrs**

**Etching:** Historical development and basic concepts, wet etching, selectivity, isotropy and etch bias, common wet etchants, orientation dependent etching effects. **Metal film deposition**: Evaporation and sputtering techniques, Failure mechanisms in, metal interconnects and multi-level metallization schemes.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. The Science and Engineering of Microelectronic Fabrication | Stephen A. Campbell | Oxford University Press |
| 2. Fundamentals of Semiconductor Fabrication | S. M. Sz | Wiley, 2003 |
| 3. Introduction to Microelectronic Fabrication | Richard C Jaeger | Prentice Hall, 2002 |

## PEEC-711B
## Optoelectronics Devices and Circuits

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The objective of this course is to get familiar with the design concept of optoelectronics devices and circuits by using different design technologies used for design of optoelectronics devices. Implementation approach of optoelectronics devices in modern communication system. To study the design and evaluation of modern optoelectronics integrated systems.

**Course Outcomes**

1. Use principles of physics to analyze the fundamental concepts of various optoelectronic components.
2. Describe the characteristics of optoelectronic devices.
3. Familiarize with tools and processes used in fabricating optoelectronic components.
4. Utilize knowledge to implement optoelectronic communication systems.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 3 | 3 | 0 | 2 | 1 | 0 | 2 | 3 | 0 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 0 | 1 | 2 | 2 | 3 | 0 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 0 | 1 | 1 | 2 | 2 | 3 | 0 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 0 | 1 | 3 |

**Unit-I** — **10 hrs**

**Introduction:** Semiconductors, optical waves, photon generation, optoelectronics, need of optoelectronics, advantages, applications-network, military, civil, industrial, sensors etc.

**Unit-II** — **14 hrs**

**Optoelectronic sources**: Introduction, basic concepts, optical emission from semiconductor, semiconductor injection laser & its various structures, injection laser characteristics, threshold condition, wavelength tunable lasers, LED power and efficiency, heterojunction, LED structure designs, characteristics, modulation response of an LED.

**Optoelectronic detectors:** Introduction, device types, basic principal of optoelectronic detection, absorption, quantum efficiency, responsivity, wavelength cut-off, types of photodiodes with and without internal gain, mid-infrared photodiode, phototransistors, photo conducting detectors, noise considerations

**Unit-III** — **16 hrs**

**Passive network components & sensors:** Introduction, couplers/splitters, WDM multiplexers, demultiplexers, filters, isolators, circulators, attenuators, electro-optic modulators, acousto-optic modulators and their application areas, optical sensors: classification-point, distributed, intensity, phase & spectral. smart structures & applications

**Optical amplifiers and integrated optics:** Introduction, semiconductor optical amplifiers (SOA), erbium-doped fiber amplifiers (EDFA), fiber Raman amplifiers (FRA), application areas of optical amplifiers, some integrated optical devices, OEICs, optical bi-stability and digital optics, optical computation.

**Unit-IV** — **12 hrs**

**Optoelectronic integrated circuits:** Introduction, hybrid and monolithic integration, application of opto electronic integrated circuits, integrated transmitters and receivers, guided wave devices.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Semiconductor Optoelectronic Devices | Pallab Bhattacharya | Pearson Education Inc |
| 2. Photonics - Optical Electronics in Modern Communications | A. Yariv and P. Yeh, | Oxford University Press |
| 3. Opto Electronics – As Introduction to materials and devices | Jasprit Singh | McGraw-Hill International |
| 4. Opto Electronics – An Introduction | J. Wilson and J. Haukes | Prentice Hall, 1995 |

**PEEC-711C**
**Computer Communication &Networks**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**: Aim of the course is to study the basics of computer networks, transmission media and network topologies. Emphasis will be laid on covering the basic layers used in TCP/IP model.

**Course Outcomes**:

1. Understand the basics of TCP/IP models and different types of network.
2. Identify the issues and challenges in the architecture of a computer network.
3. Realize protocols at different layers of a network hierarchy.
4. Gain expertise in some specific areas of networking.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 0 | 3 | 3 | 2 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 2 | 1 | 2 |
| CO3 | 1 | 3 | 3 | 2 | 0 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 0 | 1 | 1 | 1 | 2 | 0 | 2 | 3 | 2 | 2 |

**Unit-I** — **12 hrs**

**Introduction to computer networks**: Basics of computer networks, need and evolution of computer networks, introduction to network topology, difference between wired networks and wireless networks, classification of computer networks- LAN, MAN, PAN, WAN. internet, intranet and extranet, OSI and TCP/IP models, comparison of OSI and TCP/IP.

**Unit-II** — **12 hrs**

**Physical layer**: Data and signals, digital and analog transmission, bandwidth utilization, transmission media and switching.

**Unit-III** — **14 hrs**

**Data link layer and network layer**: Introduction to data link layer, error detection and correction, data link control, medium access control, ethernet, and other networks, network layer protocols, unicast and multicast routing.

**Unit-IV** — **12 hrs**

**Transport layer and application layer**: Process to process delivery: TCP and UDP, application layer protocols, FTP, HTTP.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Data Communication and Networking | B.A. Forouzan | 4th Ed., Tata McGraw-Hill. |
| 2. Computer Networks | A.S Tanenbaum | 4th Ed., Pearson Education. |
| 3. Data and Computer Communication | W. Stallings | 8th Ed., Prentice-Hall |

## PEEC-712A
## Microwave & Radar Engineering

| | L | T | P | Credits |
|---|---|---|---|---|
| | **3** | **0** | **0** | **3** |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

**Course Objectives**

The aim of this course is to understand the basic concepts and application areas of microwave and radar. This course enables students to have fundamental understanding of microwave components and circuits and to learn the principle of transmission lines and waveguides. The students will also study about various types of radar systems, radar transmitter-receiver circuits and various scanning radars.

**Course Outcomes**

1. Understand fundamentals of microwave and radar systems. Study wide range of microwave components, devices and their characteristics
2. Acquire knowledge of microwave and radar devices and their characteristics.
3. Analyze the performance characteristics of microwave and radar systems.
4. Describe various scanning and tracking techniques used in radar.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 1 | 2 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 0 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 0 | 2 | 3 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 1 |

**Unit-I** — **12 hrs**

**Microwave components and tubes**: Introduction to microwaves, microwave frequency spectrum, wave guides-basic concepts and properties, ferrite devices, faraday rotation, isolators, circulators, detector mounts, magic tee, frequency meter, cavity resonator, microwave filters, directional couplers, loop directional couplers, two-hole directional coupler, phase shifters, attenuators, introduction to S parameters, microwave tubes- Problem with conventional tubesat microwave frequencies, two cavity klystrons, multi cavity klystron, reflex klystron, , magnetrons, travelling wave tube.

**Unit-II** — **12 hrs**

**Microwave devices and measurements:** Transistors, varactor diodes, step recovery diode, tunnel diode, Gunn diode, avalanche diode, IMPATT diode, TRAPPAT diode, PIN diodes, parametric amplifier, General measurement setup with microwave bench, measurement devices, power measurement, attenuation measurement, measurement of VSWR, measurement of impedance, measurement of Q of a cavity resonator, and set up for S parameter measurement.

**Unit-III** — **12 hrs**

**Introduction to radar systems** Basic principle, block diagram, operation and applications of radar, radar range equation, CFARs pulse repetition frequency and range ambiguities, **Doppler radar:** Doppler effect, moving target indicator (MTI) radar, delay line cancellers, blind speeds, multiple or staggered pulse repetition frequencies, range gated doppler filters, block diagram of digital signal processor, pulse doppler radar, non-coherent MTI; basic CW radar, FMCW radar, multiple frequency CW radar: block diagram and operation for the measurement of range

| Unit-IV | 12 hrs |
|---|---|
| **Radar Systems**: Radar transmitters, basic configurations: self-excited power oscillator, master oscillator power amplifier (MOPA), comparison of tubes for radar transmitters, modulators, pulse forming network, block diagram of radar receiver, mixers, duplexers, displays<br>**Tracking and scanning**: tracking with radar, sequential lobbing, conical scanning, block diagram and operation, simultaneous lobing or monopulse tracking radar, amplitude comparison monopulse radar, block diagram and description for one angular coordinate and two (angular azimuth and elevation) coordinates, phase comparison monopulse radar. | |

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Microwave and Radar Engineering | M Kulkarni | Umesh Publications, Delhi |
| 2. Foundation of Microwave Engg | R. E. Collin | Tata McGraw Hill |
| 3. Introduction to Radar Systems | Skolnik, M. | Tata McGraw-Hill, 2001 |
| 4. Microwaves | K C Gupta | New Age International |
| 5. Elements of Electronic Navigation Systems | N. S. Nagaraja | Tata McGraw-Hill, 2000 |
| 6. Introduction to Radar Engineering | Sen & Bhattachrya | PHI |

## PEEC- 712B
## Computer Architecture and Organisation

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

The course introduces foundation of computer organization and architecture, hardware-software interface, hierarchical memory system including cache memory, associative memory and virtual memory. The course familiarizes the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations, and concepts of the parallel processing.

**Course Outcomes**

1. Recognize the architectures of processors used in computing systems.
2. Familiarize with computer instruction set and execution unit.
3. Identify trade−offs in designing of computer processor including memory.
4. Evaluate quantitative performance of computer systems and memory.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 3 | 2 |
| CO2 | 2 | 3 | 3 | 3 | 0 | 1 | 2 | 1 | 2 | 0 | 0 | 3 | 3 | 2 |
| CO3 | 2 | 0 | 0 | 3 | 0 | 3 | 3 | 1 | 1 | 0 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 0 | 0 | 1 | 1 | 2 | 0 | 1 | 3 | 2 | 2 |

**Unit-I** — **10 hrs**

**Introduction**: Evolution of computer, hardware, software and firmware, computer architecture, types of computer, different types of buses.
**Data representation**: Signed number representation, fixed and floating-point representations, character representation.

**Unit-II** — **14 hrs**

**Computer instruction set**: Introduction, opcode encoding, addressing modes, instruction types, data transfer, arithmetic, logical, program and system control, reduced instruction set computers, RISC vs CSIC, basic parallel processing techniques: instruction level, thread level and process level.

**Unit-III** — **14 hrs**

**Execution unit**: Introduction, general register and combinational shifter design, flag register, computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, booth multiplier, carry save multiplier, division - non-restoring and restoring techniques, floating point arithmetic, ALU design, bit slice processor, coprocessors.
**CPU control unit design**: Introduction, basic concepts, hardwired and micro-programmed design approaches, case study - design of a simple hypothetical CPU.

**Unit-IV** — **14 hrs**

**Memory organization**: Introduction, memory interleaving, characteristics of memory systems, main memory design, concept of hierarchical memory organization, cache memory: cache size vs block size, mapping functions, replacement algorithms, write policy, associative memory, virtual memory and memory management concepts.
**Peripheral devices and their characteristics**: Input-output subsystems, basic concepts programmed I/O, standard vs memory mapped I/O, I/O transfers - program controlled, interrupt driven and DMA, software interrupts and exceptions.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Computer Organization and Embedded Systems | Carl Hamachar, Zvonco Vranesic and Safwat Zaky | 5th Edition, McGraw-Hill, 2002 |

## PEEC-712C
## Industrial Electronics

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

The course aims to equip the student with the basic understanding of the operating characteristics of power semiconductor devices and fundamentals of power converter circuits including ac/dc rectifiers, dc/ac inverters, dc/dc converters and ac/ac converters.

**Course Outcomes**

1. Acquire knowledge about fundamental concepts and techniques used in power electronics.
2. Learn the characteristics of power semiconductor switches.
3. Analyze single phase and three phase power converter circuits and their applications.
4. Understand the use of power converters in commercial and industrial applications.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 3 | 3 | 3 | 2 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| CO2 | 2 | 2 | 1 | 2 | 2 | 0 | 2 | 1 | 2 | 0 | 0 | 2 | 1 | 1 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 0 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 0 | 3 | 3 | 2 | 2 |

**Unit-I** — **16 hrs**

**Introduction**: Concept of power electronics, applications of power electronics, power electronic systems, power semiconductor devices, types of power electronic converters, power electronic modules.

**Semiconductor switching devices**: Review of thyristor, two transistor model of SCR and V-I characteristics, thyristor turn-on methods, thyristor ratings and protection, gate characteristics, series and parallel connections of SCR, other members of thyristor family-DIAC, TRIAC, GTO, power MOSFET, firing circuits for thyristors, thyristor commutation techniques.

**Unit-II** — **12 hrs**

**Power rectification**: Principle of phase control, classification of rectifiers, single phase and three-phase rectifiers, semi converters, full converters, freewheeling diodes, transformer utility factor, effect of source impedance on the performance of rectifier, dual converters.

**Unit-III** — **12 hrs**

**Inverters**: Introduction, single phase voltage source inverters, current source inverters, force-commutated thyristor inverters, voltage control in single phase inverters, PWM inverters, series inverters, single phase parallel inverters.

**Unit-IV** — **14 hrs**

**Choppers**: Principles of chopper operation, control strategies, types of chopper circuits, thyristor chopper circuits.

**Cyclo-converters:** Principle of cyclo-converter operation, step-up and step down cyclo-converter, three phase half wave cyclo-converters, output voltage equation for a cyclo-converter.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Power Electronics-Circuits, Devices and Applications | M H Rashid | PHI, 2nd Edition (1998). |
| 2. Industrial Electronics | G K Mithal | Khanna Publishers, Delhi, 18th Edition (1998). |
| 3. Industrial Electronics | S N Biswas | Dhanpat Rai and Company, Delhi, 3rd Edition (2000). |
| 4. Power Electronics | P S Bhimbra, | Khanna Publishers, Delhi, 3rd Edition (2002). |
| 5. Power Electronics | M D Singh, Khanchandani K B | TMH, 6th reprint (2001). |

## OEEC-711A
## Digital Systems

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

**Course Objectives**

This course provides a modern introduction to logic design and the basic building blocks used in digital system. The course deals with sequential circuits, random access memories, and modern logic devices such as field programmable logic gates. State machines will then be discussed and illustrated through case studies of more complex systems using programmable logic devices. The course has an accompanying lab component that integrates hands-on experience with modern computer-aided design software including logic simulation, minimization and an introduction of the use of hardware description language (VHDL/ Verilog HDL). The hands-on assignments will make use of the Xilinx ISE tool chain for the design and implementation of a variety of projects.

**Course Outcomes**

1. Analyze and design sequential and combinational systems.
2. Assess the performance of a given digital circuit with Mealy and Moore configurations.
3. Perform static timing analysis of the digital circuits/systems.
4. Design the digital system using VHDL and Compare the performance of a given digital circuits/systems with respect to their speed, number of IC's.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 3 | 0 | 0 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 3 | 0 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 3 | 0 | 2 | 3 |

**Unit-I** — **12 hrs**

Design of combinational circuits and implementation using multiplexers, decoders, ROM, PLA and PAL.

**Unit-II** — **12 hrs**

**Synchronous sequential circuits**: The finite state machine, design of single multimode and ring counters, Mealy state diagram, Moore state diagram, state transition tables, state reduction techniques, state assignments, synthesis of sequential circuits.
**ASM modules:** The algorithm state m/c, ASM charts, ASM tables, linking of ASM modules.

**Unit-III** — **12 hrs**

**Asynchronous sequential circuits**: Races, hazards, asynchronous, state diagrams, primitive flow tables, state reductions and row merging, design of asynchronous state.
**Programmable logic devices**: Introduction to CPLDs and FPGAs

**Unit-IV** — **12 hrs**

**Introduction to VHDL**: Overview of digital design with VHDL, basic language elements, data objects, classes and data types, operators, overloading, logical operators, VHDL representation of digital design entity and architectural declarations, introduction to behavioural, dataflow and structural models, applications of VHDL to FPGA design.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. An Engineering Approach to Digital Design | Fletcher William, I | 3rd Indian reprint, PHI, (1994). |
| 2. Digital Design | Morris Mano M | 3rd Edition, Pearson Education (2002). |
| 3. VHDL-Analysis and Modeling of Digital Systems | Navabi Z | McGraw Hill. |
| 4. Fundamentals of Logic Design | Charles H. Roth Jr | 4th Edition, Jaico Publishers (2002). |
| 5. VHDL for Programmable Logic | Skahill Kevin | 1st Indian Reprint, Pearson Education (2004). |
| 6. Verilog HDL: A Guide to Digital Design and Synthesis | Samir Palnitkar | 2nd Edition, Prentice Hall PTR |

**OEEC-711B**
**Microcontroller and Embedded System**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

| | |
|---|---|
| **Course Objectives** | This course provides the knowledge about microcontrollers and embedded systems and emphasizes on the basic working of a microcontroller system and its programming language. |
| **Course Outcomes** | 1. Acquire knowledge about microcontroller, architecture and embedded processors.<br>2. Develop programming skills of microcontroller.<br>3. Understand communication protocols.<br>4. Design and develop embedded systems for real time applications. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 1 | 2 | 2 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 1 | 3 | 2 | 3 |
| CO4 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 1 | 3 | 0 | 2 | 2 | 3 | 2 |

**Unit-I** — **12 hrs**

**Introduction:** Overview of 8051 microcontroller families and embedded system. 4bit microcontroller, 8-bit microcontroller, 16 bit microcontroller, 32 bit microcontroller.

**Unit-II** — **12 hrs**

**8051 microcontrollers**: Pin description and architecture of 8051 microcontroller, arithmetic, logic and single bit instructions, addressing modes. I/O instructions, memory read/write-only instructions, stack operations, conditional and un-conditional instructions, basic programming concepts.

**Unit-III** — **12 hrs**

**Embedded system design**: Processor embedded into a system, embedded hardware units and devices in a system, embedded software in a system, and embedded system on chip. complex system design and processors, design process in embedded system, formalization of system design, design process and design example. classification of embedded system, skill required for an embedded system designer.

**Unit-IV** — **12 hrs**

**Communication devices and protocols**: I/O types and examples, serial communication devices, parallel devices port, sophisticated interfacing features in device design. serial bus communication protocol, parallel bus devices protocol-parallel communication network using ISA, PCI, PCI-X and advanced buses.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. The 8051 Microcontroller and Embedded Systems | M.Mazidi, JG Maizidi | Pearson Education |
| 2. Embedded Systems | Raj Kamal | Tata McGraw Hill |
| 3. The 8051 Microcontroller | Kenneth J. Ayala | Pearson Education |

**OEEC-711C**
**Wireless Communication**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | **50** |
| | **End Semester Examination Marks** | | | **50** |

| | |
|---|---|
| **Course Objectives** | The aim of this course is to study the basics of cellular systems, impart knowledge about the fading effects. The emphasis will be to analyze different modulation techniques used for mobile communication and understand the concepts of CDMA and GSM wireless communication standards. |
| **Course Outcomes** | **1.** Understand the concept of cellular system.<br>**2.** Distinguish between different types of fading in wireless communication.<br>**3.** Analyze various modulation techniques used in wireless communication.<br>**4.** Differentiate between different multiple access techniques and understand the basic principles of various wireless communication standards. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 0 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 3 | 2 | 3 | 2 |
| CO2 | 1 | 2 | 3 | 3 | 1 | 2 | 0 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 0 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 3 | 3 | 3 | 2 |

**Unit-I** — **12 hrs**

**Introduction to wireless communication systems**: Concept of cellular communication system, basics of wireless cellular system, mobile unit, base station, mobile switching centre, frequency reuse, channel assignment strategies, co-channel interference, determining the frequency reuse distance, hand-off strategies, interference and system capacity, trunking efficiency, improving capacity of cellular system, cell splitting and sectoring.

**Unit-II** — **12 hrs**

**Mobile radio propagation**: Introduction to radio wave propagation, free space propagation model, basic propagation mechanisms, reflection, diffraction, scattering, outdoor propagation models, indoor propagation models, signal penetration into buildings, types of small-scale fading, fading effects due to Doppler spread and delay spread, diversity techniques.

**Unit-III** — **12 hrs**

**Modulation techniques**: Introduction to linear modulation techniques, minimum shift keying, Gaussian minimum shift keying, spread spectrum modulation techniques, DS-SS, and FH-SS systems, performance of modulation schemes, power spectrum and error performance in fading channels.

**Unit-IV** — **12 hrs**

**Wireless communication standards**: Introduction to GSM, GSM services and features, system architecture, radio subsystem and channel types. cellular code division multiple access (CDMA) systems: principle, power control, effects of multipath propagation on code division multiple access and introduction to third generation wireless networks, long term evolution (LTE) and standards.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Wireless Communications | T.S Rappaport | Pearson Education, 2003. |
| 2. Principles of Mobile Communication | Gordon L. Stuber | Springer International Ltd., 2001. |
| 3. Wireless Communications | Andrea Goldsmith | Cambridge University Press, 2007 |

## PCEC-713
## Digital Signal Processing Lab

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

**Course Objectives**

This lab aims to get familiar the students about the software MATLAB and its use to verify various mathematical function i.e convolution, correlations as well as to design of various digital time causal systems. Later on, Students will learn how to design Low Pass, High Pass, Band Pass and FIR filter with the help of Matlab.

**Course Outcomes**

1. Design of Discrete time causal system.
2. Verify various mathematical operations with the help of MATLAB.
3. Design of digital FIR and IIR filters using different approaches and their associated structures.
4. Design a filtering algorithm for the real time application.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 1 | 0 | 0 | 1 | 3 | 2 | 1 | 1 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 1 | 3 | 2 | 1 | 1 | 2 | 2 |
| CO3 | 2 | 3 | 3 | 3 | 2 | 1 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 1 | 2 |

**List of Experiments:**

1. Write a program in Matlab to generate standard sequences.
2. Write a program in Matlab to compute power density spectrum of a sequence.
3. To write a Matlab program to verify correlation and autocorrelation.
4. Write a program in Matlab to verify linear convolution.
5. Write a program in Matlab to verify the circular convolution.
6. To write a Matlab programs for pole-zero plot, amplitude, phase response and impulse response from the given transfer function of a discrete-time causal system.
7. Write a program in Matlab to find frequency response of different types of analog filters.
8. Write a program in Matlab to design FIR filter (LP/HP) through Rectangular Window technique.
9. Write a program in Matlab to design FIR filter (LP/HP) through Triangular Window technique.
10. Write a program in Matlab to design FIR filter (LP/HP) through Kaiser Window technique.
11. Write a program in Matlab to find the FFT.
12. Implementation of low-pass, high pass and band-pass filter on some chosen signal.

**PCEC-714**
**Antenna and Microwave Lab**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 4 | 2 |

| | |
|---|---|
| **Course Objectives** | This lab aims to get familiarize the students about the various communication antennas used in microwave range. It includes their design, gain, directivity, VSWR and various other characteristics. Further in this lab students will attain the knowledge about operation of various Plane-Tee. |
| **Course Outcomes** | 1. Evaluate gain, directivity and other antenna parameters.<br>2. Measure the impedance matching characteristics of antennas.<br>3. Analyze the performance waveguide components.<br>4. Design an efficient antenna for RF and microwave frequency range. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 3 | 2 | 0 | 1 | 3 | 2 | 1 | 2 | 1 | 3 |
| CO2 | 2 | 2 | 3 | 3 | 3 | 2 | 0 | 1 | 3 | 2 | 1 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 2 |

**List of Experiments:**

1. To understand the working of the Motorized antenna trainer.
2. To investigate the properties of a Yagi antenna comprising a dipole and a parasitic element.
3. To know the form of a Yagi antenna and examine multi element antenna. To see how gain and directivity increase as element numbers increase.
4. To investigate the gain, and directivity of the log Periodic antenna over a wide frequency range.
5. To plot the radiation pattern of a directional antenna.
6. To measure antenna parameters (directivity, gain, beam width, half power beam width, front to back ratio) with polar plot of dipole antenna.
7. To measure antenna parameters of monopole antenna.
8. To measure antenna parameters of patch array antenna.
9. Identification of different waveguide components.
10. Study of the characteristics of klystron tube and to determine its electronic tuning range.
11. By use of slotted waveguide, to observe how the load impedance affects the VSWR.
12. To measure the VSWR of the antenna.
13. To determine the frequency & wavelength in a rectangular waveguide working on $TE_{10}$ mode.
14. To be familiar with the operation of directional coupler.
15. To determine the standing wave-ratio and reflection coefficient.
16. To be familiar with the operation of E Plane-Tee.
17. To be familiar with the operation of H Plane-Tee.
18. To be familiar with the operation of Magic-Tee.
19. Measurement of the gain of horn antenna – using Method of the two antennas.
20. To measure antenna parameters of horn (E, H, Pyramidal) & open waveguide antenna.
21. To measure antenna parameters of conical horn antenna.
22. To setup a satellite communication link.

**PREC-711**
**Project Stage I and Seminar**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 4 | 2 |

**Course Objectives**

To guide the students in such a way so that they carry out a work on a topic as a forerunner to the full-fledged project work to be taken subsequently in 7th semester. The project work shall consist of substantial multidisciplinary component

**Course Outcomes**

Upon completion of the project, the students will be able to

1. Select a suitable project making use of the technical and engineering knowledge gained from previous courses with the awareness of impact of technology on the society and their ethical responsibilities.
2. Collect and disseminate information related to selected project.
3. Identify the modern tools required for the implementation of the project.
4. Form a team and distribute the work among themselves.
5. Communicate technical and general information by means of oral as well as written presentation skills with professionalism.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 3 |
| CO2 | 1 | 3 | 2 | 2 | 3 | 0 | 0 | 3 | 3 | 2 | 2 | 0 | 1 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 0 | 2 | 3 |
| CO4 | 2 | 1 | 0 | 2 | 3 | 3 | 0 | 1 | 3 | 3 | 2 | 3 | 3 | 2 |
| CO5 | 1 | 1 | 2 | 3 | 2 | 0 | 0 | 3 | 3 | 3 | 2 | 0 | 1 | 2 |

## PEEC-721A
## Wireless Sensor Networks

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

This course is introduced to learn the architecture of wireless sensor networks and various routing protocols. The emphasis is also given to study the tools required in wireless sensor networks.

**Course Outcomes**

1. Understand architecture and address the challenges for wireless sensor networks.
2. Analyze and simulate different routing protocols.
3. Understand different topologies of wireless sensor networks.
4. Design sensor networks using software tools.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 0 | 0 | 3 | 1 | 1 | 1 | 1 | 0 | 2 | 3 | 3 | 2 |

**Unit-I** — **12 hrs**

**Overview of wireless sensor networks:** Introduction to wireless sensor networks, adhoc networks, difference between adhoc networks and wireless sensor networks, challenges for wireless sensor networks, enabling technologies for wireless sensor networks.

**Unit-II** — **12 hrs**

**Architectures and networking sensors:** Single-node architecture - hardware components, energy consumption of sensor nodes, network architecture - sensor network scenarios, optimization goals and figures of merit, mac protocols for wireless sensor networks.

**Unit-III** — **12 hrs**

Routing protocols: Issues in designing routing protocols, classification of routing protocols, energy-efficient routing, unicast, broadcast and multicast.

**Unit-IV** — **12 hrs**

**Sensor network platforms and applications:** applications of sensor networks, sensor node hardware – Berkeley Motes, programming challenges, execution environments like NS2, MATLAB.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Protocols and Architectures for Wireless Sensor Networks | Holger Karl & Andreas Willig | John Wiley,2005 |
| 2. Wireless Sensor Networks- An Information Processing Approach" | Feng Zhao & Leonidas J. Guibas | Elsevier,2007 |
| 3. Wireless Sensor Networks Technology, Protocols, And Applications", John Wiley, 2007. | Kazem Sohraby, Daniel Minoli, & TaiebZnati, | John Wiley, 2007. |

## PEEC-721B
## Satellite Communication

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

This course provides fundamental knowledge about orbital theory and satellite link design. Students will understand the role of various modulation, multiplexing and multiple access techniques used in satellite communication networks. Study of various satellite services also presented in this course.

**Course Outcomes**

1. Identify the characteristics of common orbits used by communications and other satellites and assess launch methods and technologies.
2. Acquire knowledge about various multiplexing techniques used in satellite communication.
3. Identify the systems required by a communications satellite to function and the trade-offs encountered in the design of a system.
4. Assess the analog and digital technologies used for satellite communications networks and applications of those networks.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 2 | 3 | 1 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 0 | 1 | 3 | 2 | 2 |
| CO3 | 1 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 0 | 2 | 2 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 0 | 1 | 1 | 2 | 0 | 2 | 3 | 2 | 2 |

**Unit-I** — **12 hrs**

**Introduction:** Origin and brief history of satellite communication, satellite frequency bands for communication, current state of satellite communication.

**Orbital theory:** Orbital mechanism, locating the satellite in the orbit with respect to earth, look angle determination, azimuth and elevation angle calculations.

**Unit-II** — **12 hrs**

**Satellites and satellite link design:** Satellite subsystems, attitude and orbit control system, telemetry, tracking and command (T&C), communications subsystems, transponders, satellite antennas, satellite link design: basic transmission theory, noise figure and noise temperature, design of downlinks, satellite systems using small earth stations, uplink design, design of satellite link for specified (C/N).

**Unit-III** — **12 hrs**

**Modulation, multiplexing, multiple access techniques**: FM modulation, analog FM transmission by satellite, S/N ratio for satellite FM video transmission; digital transmission, baseband and bandpass transmission of digital data, digital modulation: BPSK, QPSK; multiplexing: FDM, TDM; access techniques: FDMA, TDMA, CDMA.

**Unit-IV** — **12 hrs**

**Propagation effects and satellite services**: Quantifying attenuation and depolarization, atmospheric absorption, cloud attenuation, rain and ice effects, prediction of rain attenuation. VSAT technology, direct broadcast satellite (DBS) for TV and radio, satellite navigation and GPS system, mobile satellite services.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Satellite Communications | Timothy Pratt, Charles W. Bostian, Jeremy Allnutt | John Wiley & Sons, 2002 |
| 2. Satellite Communications Systems: Systems, Techniques and Technology | Gerard Maral, Michel Bousquet | John Wiley & Sons Ltd, 2002 |
| 3. Communication satellite systems | J Martin | Prentice Hall publication, 1978 |
| 4. Satellite Communication | Dennis Roddy | McGraw-Hill, 4th Edition 2006. |

**PEEC-721C**
**VLSI Circuits**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | Sessional Marks | | | 50 |
| | End Semester Examination Marks | | | 50 |

| | |
|---|---|
| **Course Objectives** | The course aims to present the principles and techniques of CMOS based digital circuit design, connecting digital circuits, logic design, and digital components with the fundamental device physics, processing techniques and transistor level characteristics of Silicon integrated circuits, both in theoretical and practical aspects. |
| **Course Outcomes** | **1.** Understand and appreciate the basic physics of MOS transistor, and importance of various design parameter.<br>**2.** Analyze the DC and static behavior of basic CMOS logic circuits.<br>**3.** Understand the basics of CMOS fabrication process, its requirements and challenges.<br>**4.** Calculate and optimize the performance metrics of CMOS circuits. |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 2 | 1 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 0 | 1 | 1 | 2 | 1 | 3 | 2 | 2 | 3 |

**Unit-I** — **16 hrs**

Introduction to CMOS circuit, Circuit & System representation Behavioral representation, structural representation. Physical representation MOS transistor theory. NMOS and PMOS enhancement transistor. Threshold voltage, body effect. MOS device design equation. Basic DC equation, second order effects, MOS Capacitor. Current mirrors and current steering circuits

**Unit-II** — **16 hrs**

The complementary CMOS inverter-DC characteristics, Static load MOS inverters. Pseudo NMOS inverter, Tristate inverter. Comparison of bipolar devices, diodes, BICMOS inverters, Pass transistors

**Unit-III** — **8 hrs**

Review of silicon semiconductor technology and basic CMOS technology-n-well and p-well process. Interconnect and circuit, Twin-tub process, layout design rules and latch-up, latch-up triggering and prevention

**Unit-IV** — **8 hrs**

Circuit characterization and performance estimation resistance and capacitance estimation, Switching characteristics, CMOS gate transistor sizing, power dissipation. Basic physical design of simple logic gates. CMOS logic structure

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Design of Analog CMOS Integrated Circuits | Behzad Razavi | McGraw-Hill |
| 2. Microelectronics Circuits | Sedra & Smith | Oxford University Press |
| 3. Principles of CMOS VLSI Design | Neil H.E Weste | John Wiley, 1994 |
| 4. CMOS Digital Integrated Circuits | Sung-Mo Kang | McGraw-Hill, 2003 |

## PEEC-722A
## Wireless Communication

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

The aim of this course is to study the basics of cellular systems, impart knowledge about the fading effects. The emphasis will be to analyze different modulation techniques used for mobile communication and understand the concepts of CDMA and GSM wireless communication standards.

**Course Outcomes**

1. Understand the concept of cellular system.
2. Distinguish between different types of fading in wireless communication.
3. Analyze various modulation techniques used in wireless communication.
4. Differentiate between different multiple access techniques and understand the basic principles of various wireless communication standards.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 3 | 2 |
| CO2 | 2 | 2 | 3 | 3 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 2 | 3 |
| CO4 | 2 | 2 | 0 | 0 | 1 | 2 | 2 | 1 | 0 | 0 | 3 | 2 | 3 | 3 |

### Unit-I — 12 hrs

**Introduction to wireless communication systems**: Concept of cellular communication system, basics of wireless cellular system, mobile unit, base station, mobile switching centre, frequency reuse, channel assignment strategies, co-channel interference, determining the frequency reuse distance, hand-off strategies, interference and system capacity, trunking efficiency, improving capacity of cellular system, cell splitting and sectoring.

### Unit-II — 12 hrs

**Mobile radio propagation**: Introduction to radio wave propagation, free space propagation model, basic propagation mechanisms, reflection, diffraction, scattering, outdoor propagation models, indoor propagation models, signal penetration into buildings, types of small-scale fading, fading effects due to Doppler spread and delay spread, diversity techniques.

### Unit-III — 12 hrs

**Modulation techniques**: Introduction to linear modulation techniques, minimum shift keying, Gaussian minimum shift keying, spread spectrum modulation techniques, DS-SS, and FH-SS systems, performance of modulation schemes, power spectrum and error performance in fading channels.

### Unit-IV — 12 hrs

**Wireless communication standards**: Introduction to GSM, GSM services and features, system architecture, radio subsystem and channel types. cellular code division multiple access (CDMA) systems: principle, power control, effects of multipath propagation on code division multiple access and introduction to third generation wireless networks, long term evolution (LTE) and standards, introduction to 5G technology.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Wireless Communications | T.S Rappaport | Pearson Education, 2003. |
| 2. Principles of Mobile Communication | Gordon L. Stuber | Springer International Ltd., 2001. |
| 3. Wireless Communications | Andrea Goldsmith | Cambridge University Press, 2007 |

## PEEC-722B
## Electronic Measurements and Instrumentation

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

Aim of the course is to study the basics of unit, dimensions and standards. It also gives deep insight to PMMC instrument and bridges. It discusses as to how the analog data is converted to digital and vice versa. It also discusses the CRO and concept of signal generator and analyzer.

**Course Outcomes**

1. Explain various types of errors introduced in measurements.
2. Understand the working of PMMC and other instruments.
3. Understand bridge theory, working of A/D and D/A converters and their applications.
4. Describe the working of CRO, signal generators and analyser's and apply for measurements.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 0 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 2 | 1 |
| CO2 | 0 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 2 | 2 | 1 |
| CO3 | 0 | 3 | 2 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 1 | 2 | 2 | 1 |
| CO4 | 0 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 2 | 3 |

**Unit-I** — **12 hrs**

**Unit, dimensions and standards**: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, other unit systems, dimension and standards. measurement errors: gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, measurement error combination, basics of statistical analysis. PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohm meter.

**Unit-II** — **12 hrs**

**Electronic Meters**: Digital voltmeter systems, digital multimeter, digital frequency meter system, voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter.

**Unit-III** — **12 hrs**

**Analog to digital converter**: Transfer characteristics, A/D conversion technique: simple potentiometer and servo method, successive approximation method ramp type, integrating and dual slope integrating method. D/A converter: transfer characteristic, D/A conversion technique, digital mode of operation, performance characteristics of D/A convertors.

**Unit-IV** — **12 hrs**

**CRO**: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, oscilloscope probes, oscilloscope specifications and performance.
**Signal generator, analyser and recorders:** sine wave, non-sinusoidal signal and function generators, frequency synthesis techniques and digital signal generators, spectrum analyzer and distortion, concept of ECG, EMI, EMC, and EEG etc, X-Y recorders, plotters.

**RECOMMENDED BOOKS**

| Title | Author | Publisher |
|---|---|---|
| 1. Electronic Instrumentation and Measurements | David A. Bell | 2nd Ed., PHI, New Delhi, 2008 |
| 2. Electronic Measurements and instrumentation. | Oliver and Cage | TMH, 2009 |

**PEEC 722C**
**Neural Networks and Fuzzy Logic**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |
| | **Sessional Marks** | | | 50 |
| | **End Semester Examination Marks** | | | 50 |

**Course Objectives**

The course will cover a variety of contemporary approaches to neural networks and fuzzy logic for various applications and introduce the underlying principles. Fundamental concepts of neural networks and fuzzy logic are covered in detail. After taking this course, the student will be ready to understand the structure, design and training of neural network and fuzzy logic based systems and will be competent enough to apply these algorithms for the solution of a wide variety of problems in engineering

**Course Outcomes**

1. Understand the principle of artificial intelligence and its realization using artificial neural networks.
2. Describe the working of multilayer feed-forward artificial neural network as universal problem solver.
3. Understand the concept of fuzzy logic.
4. Apply fuzzy logic system to solve real-world problems.

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 0 | 0 | 0 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 1 | 3 | 0 | 0 | 3 | 2 | 1 | 2 | 3 | 3 | 3 |

| Unit-I | 14 hrs |
|---|---|

**Neural network fundamentals**: Artificial intelligence, human brain, neural networks, neuron physiology, artificial neuron model, artificial neural network, artificial neural network architecture, network topologies, ANN parameters, learning methods, supervised learning, unsupervised learning, reinforced learning, competitive learning, delta rule, gradient descent rule, hebbian learning, Rosenblatt's perceptron, ADALINE and MADALINE Networks.

| Unit-II | 12 hrs |
|---|---|

**Back-propagation networks**: Back-propagation network architecture, perceptron model, perceptron learning procedure, single layer artificial neural network, multilayer perceptron model, back-propagation learning, mathematical analysis, learning rate and momentum.

| Unit-III | 10 hrs |
|---|---|

**Fuzzy logic**: Fuzzy set theory, fuzzy versus crisp, crisp sets, operations on crisp sets, fuzzy set, membership functions fuzzy set operators, crisp relation, cartesian product, operations on relations, fuzzy relations, fuzzy cartesian product, operations on fuzzy relations.

| Unit-IV | 12 hrs |
|---|---|

**Fuzzy systems**: Propositional logic, propositional logic inference, predicate logic, predicate logic formula, predicate logic inference, fuzzy quantifiers, fuzzy inference, fuzzy rule-based system, defuzzification methods and fuzzy cruise-controller design.

| RECOMMENDED BOOKS | | |
|---|---|---|
| **Title** | **Author** | **Publisher** |
| 1. Understanding Neural Networks and Fuzzy Logic | Stamatios V. Kartalopoulos | Prentice Hall of India Private Limited, New Delhi, 2000 |
| 2. Fuzzy Systems Design | Riza C. | Chand Publishers |
| 3. Neural Networks, Fuzzy Logics and Genetic Algorithms (Synthesis and Applications). | S. Rajasekaran, G.A. VijaylakshmiPai | PHI Learning Private Limited, 2011 |

**PREC-721**
**Project Stage II**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 12 | 6 |
| **Course Objectives** | An ability to write technical documents and give oral presentations related to the work completed and improve personality development and communication skills. Train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental, and social contexts and to set them for future recruitment by potential employers. Identify and apply appropriate well-rehearsed note-taking interactive and time management strategies to their academic studies. Develop audience-centred presentations meeting concrete professional objectives and integrating ethical and legal visual aids. Identify and critically evaluate the quality of claims, explanation, support, and delivery in public and professional discourse, and understand the factors influencing a speaker's credibility. | | | |
| **Course Outcomes** | **1.** Refine and complete the selected project making use of the technical and engineering knowledge which meets the expected outcome.<br>**2.** Work with the modern tools required for the implementation of the project.<br>**3.** Achieve the results within in the stipulated time.<br>**4.** Communicate technical and general information by means of oral as well as written presentation skills with professionalism.<br>**5.** Acquire problem solving, system integration, project management and documentation skills. | | | |

**Mapping of Course Outcomes with Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 0 | 3 | 3 |
| CO3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 2 | 3 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 3 |

**INID-721**
**Internship in Industry**

| | L | T | P | Credits |
|---|---|---|---|---|
| | 0 | 0 | 40 | 6 |

**Course Objectives**

The objective of internship is to provide possible opportunities to learn, understand and sharpen the real time technical /managerial skills required at the job and to get familiarize and provide "hands on" training experience with the requisite simulation, design, and analytical tools and techniques. It also focusses on student to achieve a long-term goal of transforming themselves into a brilliant blend of theoretician and practicing engineer, understand the social, economic, and administrative considerations that influence the working environment of industrial organizations and to make the students able to present work in written, oral or formal presentation formats.

**Course Outcomes**

1. Correlate the theoretical concepts with the real-life industrial environment.
2. Implement strategies like time management, multi-tasking in an industrial setup.
3. Gather and analyze the scientific information.
4. Communicate their work effectively through writing and presentation.

**Mapping of Course Outcomes with Program Outcomes**

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