# FACULTY OF ENGINEERING

## Scheme of Instruction & Examination

## (AICTE Model Curriculum)

## and

## Syllabi

## B.E. III and IV Semesters

## of

## Four Year Degree Program

## in

## ELECTRONICS & COMMUNICATION ENGINEERING

(With effect from the Academic Year 2021-2022)
(As approved in Faculty Meeting held on xxxxx)

Issued by

**Dean, Faculty of Engineering**

**Osmania University, Hyderabad – 500 007**

**19.05.2022**

**SCHEME OF INSTRUCTION & EXAMINATION**
**B.E. III- Semester**
**(ELECTRONICS AND COMMUNICATION ENGINEERING)**

| S. No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Course** | | | | | | | | | | |
| 1 | HS 102 EG | Effective Technical Communication in English | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 2 | HS 103 CM | Finance and Accounting | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 3 | ES 303 EC | Digital Electronics | 3 | 1 | - | 4 | 30 | 70 | 3 | 4 |
| 4 | ES 304 EC | Probability Theory and Stochastic Processes | 3 | 1 | - | 4 | 30 | 70 | 3 | 4 |
| 5 | PC 401 EC | Electronic Devices | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 6 | PC 402 EC | Network Theory | 3 | 1 | - | 4 | 30 | 70 | 3 | 4 |
| **Practical/Laboratory Course** | | | | | | | | | | |
| 7 | PC 451 EC | Electronic Devices and Circuits Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 8 | PC 452 EC | Electronic Workshop | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| **Total** | | | **18** | **3** | **4** | **25** | **230** | **520** | | **23** |

**PC:** Professional Course **HS:** Humanities and Social Sciences **ES:** Engineering Science

**L:** Lecture **T:** Tutorial **P:** Practical **D:** Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

**EG:** English **CM:** Commerce
**EC:** Electronics and Communication Engineering

**Note:**

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

## EFFECTIVE TECHNICAL COMMUNICATION IN ENGLISH

**HS 102 EG**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

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|---|
| 1.Features of technical communication |
| 2.Types of professional correspondence and Techniques of report writing |
| 3. Basics of manual writing and Aspects of data transfer and presentations. |

**Outcomes:** On successful completion of the course, the students would be able to

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|---|
| 1.Handle technical communication effectively |
| 2.Use different types of professional correspondence |
| 3.Use various techniques of report writing |
| 4.Acquire adequate skills of manual writing |
| 5.Enhance their skills of information transfer and presentations |

| |
|---|
| **UNIT – I** |
| ***Definition and Features of Technical communication*:** Definition and features of technical communication(precision, relevance, format, style, use of visual aids), Differences between general writing and technical writing, Types of technical communication (oral and written) |
| **UNIT – II** |
| ***Technical Writing-I (Official correspondence):*** Emails, IOM, Business letters, Business proposals. |
| **UNIT – III** |
| ***Technical writing-II (Reports):*** Project report, Feasibility report, Progress report, Evaluation report. |
| **UNIT – IV** |
| ***Technical writing- III (Manuals):*** Types of manuals, User manual, Product manual, Operations manual. |
| **UNIT – V** |
| ***Information Transfer and Presentations:*** Non-verbal (bar diagram, flow chart, pie chart, tree diagram) to verbal (writing), Verbal (written) to non-verbal, Important aspects of oral and visual presentations. |

**Suggested Readings:**


| | |
|---|---|
| 1. | Raman, Meenakshi & Sharma, Sangeeta. (2015). "*Technical Communication: Principles and Practice",* 3/e, New Delhi. |
| 2. | Rizvi,Ashraf, M. (2017), "*Effective Technical Communication",* 2/e,Tata McGraw Hill Education. New Delhi. |
| 3. | Tyagi, Kavita &Misra, Padma. (2011). "*Advanced Technical Communication",* New |

| | |
|---|---|
| | Delhi, PHI Learning. |
| 4. | Sharma, R. C., & Mohan, Krishna. (2017). "*Business Correspondence and Report Writing: A Practical Approach to Business & Technical Communication",*4/e, Tata McGraw Hill Education. New Delhi. |

## FINANCE AND ACCOUNTING

**HS 103 CM**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

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|---|
| 1.To provide basic understanding of Financial and Accounting aspects of a business unit |
| 2.To provide understanding of the accounting aspects of business and financial statements |
| 3. To provide inputs necessary to evaluate the viability of projects and the skills necessary to analyse the financial statements |

**Outcomes:** On successful completion of the course, the students would be able to

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|---|
| 1. Evaluate the financial performance of the business unit. |
| 2. Take decisions on selection of projects. |
| 3. Take decisions on procurement of finances. |
| 4. Analyse the liquidity, solvency and profitability of the business unit. |
| 5. Evaluate the overall financial functioning of an enterprise. |

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| **UNIT – I** |
| ***Basics of Accounting***: Financial Accounting–Definition- Accounting Cycle–Journal - Ledger and Trial Balance-Cash Book-Bank Reconciliation Statement (including Problems) |
| **UNIT – II** |
| ***Final Accounts***: Trading Account-Concept of Gross Profit- Profit and Loss Account-Concept of Net Profit-Balance Sheet (including problems with minor adjustments) |
| **UNIT – III** |
| ***Financial System and Markets***: Financial System-Components-Role-Considerations of the investors and issuers- Role of Financial Intermediaries. Financial Markets-Players- Regulators and instruments - Money Markets Credit Market- Capital Market (Basics only) |
| **UNIT – IV** |
| ***Basics of Capital Budgeting techniques***: Time Value of money- Compounding- Discounting- Future Value of single and multiple flows- Present Value of single and multiple Flows- Present Value of annuities-Financial Appraisal of Projects– Payback Period, ARR- NPV, Benefit Cost Ratio, IRR (simple ratios). |
| **UNIT – V** |
| ***Financial statement Analysis***: Financial Statement Analysis- Importance-Users-Ratio Analysis-liquidity, solvency, turnover and profitability ratios. |

**Suggested Readings:**

| | |
|---|---|
| 1 | Satyanarayana. S.V. and Satish. D., "*Finance and Accounting for Engineering*", Pearson Education. |
| 2 | Rajasekharan, "*Financial Accounting*", Pearson Education. |
| 3 | Sharma.S.K. and Rachan Sareen, "*Financial Managemen*", Sultan Chand. |
| 4 | Jonathan Berk, "*Fundamentals of Corporate Finance*", Pearson Education. |
| 5 | Sharan, "*Fundamentals of Financial Management*", Pearson Education. |

## DIGITAL ELECTRONICS

**ES 303 EC**

*Instruction: 3+1 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 4*

**Objectives:**

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| 1. To learn the principles of digital hardware and support given by it to the software. |
| 2. To explain the operation and design of combinational and arithmetic logic circuits. |
| 3. To design hardware for real world problems |

**Outcomes:** On successful completion of the course, the students would be able to

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| 1. Understand the deign process of digital hardware, use Boolean algebra to minimize the logical expressions and optimize the implementation of logical functions. |
| 2.Understand the number representation and design combinational circuits like adders, MUX etc. |
| 3. Design Combinational circuits using PLDS and write Verilog code for basic gates and combinational circuits. |
| 4. Analyse sequential circuits using flip-flops and design registers, counters. |
| 5.Represent a sequential circuit using Finite State machine and apply state minimization techniques to design a FSM |

| **UNIT – I** |
|---|
| ***Design Concepts:*** Digital Hardware, Design process, Design of digital hardware. Introduction to logic circuits – Variables and functions, Logic gates and networks. Boolean algebra, Synthesis using gates, Design examples. Optimized implementation of logic functions using K-Map and Quine-McCluskey Tabular method. |
| **UNIT – II** |
| ***Number representation:*** Addition and Subtraction of signed and unsigned numbers. ***Combinational circuit building blocks:*** Adders and Subtractors, Multiplexers. Demultiplexers, Parity Checkers and Generators, Decoders. Encoders. Code converters, BCD to 7-segment converter, Arithmetic comparator circuits. Verilog modeling of simple combination circuits. |
| **UNIT – III** |
| ***Design of combinational circuits using Programmable Logic Devices (PLDs):*** General structure of a Programmable Array Logic (PAL), Programmable Logic Arrays (PLAs), Structure of CPLDs and FPGAs, 2-input and 3-input lookup tables (LUTs). |
| **UNIT – IV** |
| ***Sequential Circuits:*** Basic Latch, Gated SR Latch, gated D Latch, Master-Slave edge triggered flip-flops, T Flip-flop, JK Flip-flop, Excitation tables. Registers and Counters. Verilog modeling of simple sequential circuits. |
| **UNIT – V** |

***Synchronous Sequential Circuits*:** Basic Design Steps, Finite State machine(FSM) representation using Moore and Mealy state models, State minimization, Design of FSM for Sequence Generation and Detection, Algorithmic State Machine charts.

**Suggested Readings:**



| | |
|---|---|
| 1 | Moris Mano and Michael D CIletti, "*Digital Design*", Pearson, 4/e, 2008. |
| 2 | Zvi Kohavi, "*Switching and Finite Automata Theory*", 3/e, Cambridge University Press-New Delhi, 2011. |
| 3 | R. P Jain, "*Modern Digital Electronics*",4/e, McGraw Hill Education (India) Private Limited, 2003. |
| 4 | Ronald J.Tocci, Neal S. Widmer &Gregory L.Moss, "*Digital Systems: Principles and Application*", PHI, 10/e, 2009. |
| 5 | Samir Palnitkar, "*Verilog HDL A Guide to Digital Design and Synthesis*", 2/e, Pearson Education, 2006. |

## PROBABILITY THEORY AND STOCHASTIC PROCESSES

**ES 304 EC**

*Instruction: 3+1 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 4*

**Objectives:**

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| 1. To understand fundamentals of probability and Random variables as applicable to Electronic Engg. |
| 2.To learn one Random variable characteristic functions of different variables using their density functions |
| 3.To understand elementary concepts of the Stochastic Processes and their temporal characteristics |

**Outcomes:** On successful completion of the course, the students would be able to

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|---|
| 1. understand different types of Random variables, their density and distribution functions |
| 2. learn one Random variable characteristic functions of different variables using their density functions |
| 3. extend the bi-variate distributions and the operations on them. |
| 4. understand elementary concepts of the Stochastic Processes in the Temporal domain. |
| 5. analyse the frequency domain information of Stochastic Processes |

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| **UNIT – I** |
| ***Concepts of Probability and Random Variable***: Probability introduced through Set Theory and Operations – Definitions and Axioms, Causality versus Randomness, Borel Field, Probability Space – Discrete and Continuous, Events - Definition and independent events, Joint Probability, Conditional Probability, Repeated Trials, Combined Experiments, Bernoulli Trials, Bernoulli's Theorem, Total Probability, Baye's Theorem.<br>**Random Variable:** Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables. |
| **UNIT – II** |
| ***Distribution & Density Functions and Operations on One Random Variable:*** Distribution and Density functions and their Properties - Binomial, Poisson, Uniform, Gaussian, Gamma, Rayleigh and Conditional Distribution, Methods of defining Conditional Event, Conditional Density, Properties. Expected Value of a Random Variable, Function of a Random Variable g(x) and its distribution, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality (no proof), Characteristic Function, Moment Generating Function; Transformations of Random Variables |
| **UNIT – III** |
| ***Two Random Variables and operations*** Bi-variate Distributions, One Function of Two Random Variables, Two functions of two random variables, Joint Distribution and Density Function and their properties, Joint Moments, Joint Characteristic Functions, Conditional Distributions (Point & Interval), Conditional Expected Values. Central Limit Theorem (no |

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| proof); Engineering application (theoretical discussion) – Mutual information, Channel Capacity and Channel Coding. |
| **UNIT – IV** |
| ***Stochastic Processes – Temporal Characteristics:*** Introduction to stationarity (First and Second order; WSS; SSS), statistical independence, Time averages and ergodicity, random processes and independence, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties,Covariance and its Properties. Linear System Response of Mean and Mean-squared Value. Introduction to Gaussian and Poisson Random Processes. |
| **UNIT – V** |
| ***Stochastic Processes – Spectral Characteristics:*** Power Spectral Density and its properties; Relationship between Power Spectrum and Autocorrelation Function; Relationship between Cross-Power Spectrum and Cross-Correlation Function; White and colored noise, response to linear systems and stochastic inputs, concept of Markov Processes. |

**Suggested Readings:**


| | |
|---|---|
| 1 | Henry Stark and John W. Woods, "*Probability and Random Processes with Application to Signal Processing"*, 3/e, Pearson Education, 2014. |
| 2 | Athanasius Papoulis and S. Unnikrishna Pillai, "*Probability, Random Variables and Stochastic Processes"*, 4/e, McGraw Hill, 2006. |
| 3 | Peyton Z. Peebles, "*Probability, Random Variables & Random Signal Principles"*, 4/e, Tata McGraw Hill, 2001 |
| 4 | P. Ramesh Babu, "*Probability Theory and Random Processes*", 1/e, McGraw Hill Education (India) Private Limited, 2015. |
| 5 | Gearge R. Cooper, Clave D.MC Gillem, "*Probability Methods of Signal and System Analysis"*, Oxford, 3/e, 1999. |

# ELECTRONIC DEVICES

**PC 401 EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

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| 1. Study semiconductor physics and Analyze the behavior of Semiconductor diodes in Forward and Reverse bias. Develop Half wave and Full wave rectifiers with L, C Filters. |
| 2.Explain V-I characteristics of Bipolar Junction Transistor in CB, CE & CC configurations and Design DC Biasing techniques, evaluate A.C parameters for BJT in Amplifier Applications |
| 3.Explore V-I characteristics of FETs, MOSFETs and study IC fabrication techniques |

**Outcomes:** On successful completion of the course, the students would be able to

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| 1. Interpret the characteristics and apply diode models to analyze various applications of diodes. |
| 2. Identify the merits and demerits of various filters, formulate and design rectifier circuits with filters Calculate ripple factor, efficiency and percentage regulation of rectifier circuits. |
| 3. Discriminate the BJT configurations to recognize appropriate transistor configuration for any given application and design the biasing circuits with good stability. |
| 4. Analyze, Compare and design of BJT amplifiers with various biasing circuits. |
| 5.Distinguish the working principles of BJT and FET also between FET & MOSFET |

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| **UNIT – I** |
| ***Basics of Semiconductors*:** Energy bands in intrinsic and extrinsic Silicon. Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers, Poisson and continuity equation, Hall Effect<br>***Junction Diode:*** PN Junction formation, Characteristics, biasing–band diagram and current flow, Diode current equation, Breakdown in diodes, Diode as a circuit element, Small signal diode models, Diode switching characteristics, Zener Diode, Zener voltage regulator and its limitation, Schotky diode. |
| **UNIT – II** |
| ***PN Diode Applications:*** Half wave, Full wave and Bridge rectifiers–their operation, performance characteristics and analysis. Filters (L, C filters) used in power supplies and their ripple factor calculations, design of Rectifiers with and without Filters.<br>***Special Diodes**:* Elementary treatment on the functioning of Light Emitting diode, Photodiode and Solar cells. |
| **UNIT – III** |
| ***Bipolar Junction Transistor:*** Transistor Junction formation (collector-base, base-emitter Junctions),Transistor biasing – band diagram for NPN and PNP transistors, current components and current flow in BJT, Ebers moll model, Modes of transistor operation, BJT V- I characteristics in CB, CE, CC configurations, BJT as an amplifier, BJT biasing techniques, operating point stabilization against temperature and device variations, Bias stabilization and |

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| compensation techniques, Biasing circuits design. |
| **UNIT – IV** |
| ***Small Signal Transistors equivalent circuits:*** Small signal low frequency h-parameter model of BJT, Approximate model, Analysis of BJT amplifiers using Approximate model for CB, CE and CC configurations; High frequency - Π model, Relationship between hybrid - Π and h – parameter model. |
| **UNIT – V** |
| ***Junction Field Effect Transistors (JFET):*** JFET formation, operation & current flow, V-I characteristics of JFET, Low frequency small signal model of FETs, Analysis of CS, CD and CG amplifiers.<br>***MOSFETs:*** Enhancement & Depletion mode MOSFETs, current equation, V-I characteristics, DC-biasing |

**Suggested Readings:**


| | |
|---|---|
| 1 | Jacob Millman, Christos C. Halkias, and Satyabrata Jit, "*Electronic Devices and Circuits*", 3/e, McGraw Hill Education, 2010. |
| 2 | G. Streetman and S. K. Banerjee, "*Solid State Electronic Devices*", 7/e, Pearson, 2014. |
| 3 | S. M. Sze and K. N. Kwok, "*Physics of Semiconductor Device*", 3/e, John Wiley& Sons, 2006. |
| 4 | D. Neamen, D. Biswas, "*Semiconductor Physics and Devices*", McGraw-Hill Education. |
| 5 | Robert Boylestad and Louis Nashelsky, "*Electronic Devices and Circuit Theory*", 11/e, Pearson India Publications, 2015. |

## NETWORK THEORY

**PC 402 EC**

*Instruction: 3+1 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 4*

**Objectives:**

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| 1. Concepts of Two Port networks, study about the different two port parameter representations. |
| 2. Concepts about the image impedance on different networks, design of attenuators. |
| 3. Design concepts of equalizers, different filters, network synthesis |

**Outcomes:** On successful completion of the course, the students would be able to

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|---|
| 1.Able to Express given Electrical Circuit in terms of A,B,C,D and Z,Y Parameter Model and Solve the circuits and how they are used in real time applications. |
| 2. Able to learn how to calculate properties of networks and design of attenuators. |
| 3. Able to design of equalizers. |
| 4. Able to design different types of filters using passive elements. |
| 5. Able to synthesize the RL & RC networks in Foster and Cauer Forms.. |

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| **UNIT – I** |
| ***Two Port networks:*** Z, Y, h, g and ABCD parameters, equivalence of two ports networks, T-π transforms, Reciprocity theorem, Interconnection of two port networks and Brune's test for inter connections. |
| **UNIT – II** |
| ***Symmetrical and Asymmetrical Networks:*** Characteristic impedance and propagation constant of symmetrical T and π networks, Image and iterative impedances, Image transfer constant and iterative transfer constant of asymmetrical L, T and π networks. |
| **UNIT – III** |
| ***Constant k- Filters-***Low pass, high pass, band pass and band elimination filter design, m-derived low pass and high pass filter design, Composite filter design and notch filter. |
| **UNIT – IV** |
| ***Attenuators and Equalizers-***Design of symmetrical T, π , Bridge-T and Lattice attenuators, impedance matching networks, Inverse networks, Equalizers, Constant resistance equalizer, full series and full shunt equalizer**.** |
| **UNIT – V** |
| ***Network Synthesis:*** Hurwitz polynomials, positive real functions, Basic Philosophy of Synthesis, L-C Immitance functions, RC impedance functions and RL admittance functions. RL impedance functions and RC admittance functions. Cauer and Foster's forms of RL impedance and RC admittance. Properties of RC, RL Networks**.** |

**Suggested Readings:**


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|---|---|
| 1 | Ryder J.D, "*Network Lines Fields"*, 2/e, Prentice Hall of India,1991. |
| 2 | P.K. Jain and Gurbir Kau, "*Networks, Filters and Transmission Lines",* Tata McGraw-Hill Publishing Company Limited. |
| 3 | A. Sudhakar Shyammohan, "*Circuits Networks: Analysis Synthesis"*, 4/e, Tata McGraw-Hill, 2010. |
| 4 | Van Valkenburg M.E, "*Introduction to Modern Network Synthesis",* Wiley Eastern, 1994. |
| 5 | S.P. Ghosh and A.K. Chakraborty, "*Network Analysis and Synthesis",* McGraw Hill, 1/e, 2009. |

## ELECTRONIC DEVICES AND CIRCUITS LAB

**PC 451 EC**

*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits: 1*

**Objectives:**

| |
|---|
| 1.Study the characteristics of PN diode |
| 2.Learn the characteristics of BJT in CE, CB and CC configurations and Plot the characteristics of FET in CS and CD configurations |
| 3.Observe the parameters of BJT and FET amplifiers and Design biasing circuits |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1.Understand characteristics of Diodes |
| 2. Plot the characteristics of BJT in different configurations. |
| 3. Record the parameters of BJT and FET amplifiers. |
| 4. Understand biasing techniques of BJT. |
| 5. Use the SPICE software for simulating electronic circuits. |

**List of Experiments**

1. V-I Characteristics of Silicon and Germanium diodes and measurement of static and dynamic resistances.
2. Zener diode Characteristics and its application as voltage regulator.
3. Design, realization and performance evaluation of half wave rectifiers without and with filters.
4. Design, realization and performance evaluation of full wave rectifiers without and with filters.
5. V-I Characteristics of BJT in CB configuration.
6. V-I Characteristics of BJT in CE configuration.
7. V-I Characteristics of JFET in CS configuration.
8. Frequency response of Common Emitter BJT amplifier.
9. Frequency response of Common Source FET amplifier.
10. BJT Biasing circuit design.
11. V-I characteristics of UJT
12. Simulate any four experiments using PSPICE

**Note:** A minimum of 10 experiments should be performed

## ELECTRONIC WORKSHOP

**PC 452 EC**
*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits: 1*

**Objectives:**

| |
|---|
| 1.To learn the usage of basic electronic components, equipment and meters used in electronic Laboratories and To learn practical electric AC and DC circuits |
| 2.Verify the truth tables of combinational and sequential circuits |
| 3.Realize combinational and sequential circuits and Design adder / subtractor |

**Outcomes:** On successful completion of the course, the students would be able to

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|---|
| 1. Use the basic electronic components and design circuits. |
| 2. Verify various parameters of the circuits by applying theorems. |
| 3. Understand the pin configuration of ICs and verify the operation of basic gates |
| 4. Design and verify the combinational and logic circuits. |
| 5. Use the SPICE software for simulating circuits. |

**List of Experiments**

**Part A**

1. Study of all types of discrete Active & passive devices, display devices, integrated components, electro mechanical components (switches, sockets, connectors etc.,) electromagnetic components (relays). Study and use of different meters (volt/ammeter, AVO/Multi meter) for the measurement of electrical parameters. Measurement of RLC components using LCR Meter.

2. Soldering and Desoldering

3. PCB design and circuit assembling

4. Study of CRO and its applications.

5. Design and Verification of Superposition and Tellegan's theorem

6. Design and Verification of Thevenin's and Maximum Power Transfer Theorem.

7. Measurement of two-port network parameters.

8. Measurement of Image impedance and Characteristics impedance.

**Part B**

**Implement using digital ICs**

9. Verification of truth tables of Logic gates and realization of Binary to Gray and Gray to Binary code converters.
10. Realization of Half adder/sub and full adder/sub using universal logic gates.
11. Realization of Full adder/Sub using MUX and Decoder
12. Design 2's complement Adder/subtractor using IC 74283 and verify experimentally.
13. Verification of truth tables of Flip Flops and Flip flop conversions form one form to the other.

**Note:** A minimum of 6 experiments in Part-A and 4 experiments in Part-B should be performed. The students may use any commercial / open source SPICE programs available like MULTISIM, PSPICE, TINA, and LAB VIEW for simulation.

**SCHEME OF INSTRUCTION & EXAMINATION**

**B.E. IV- Semester**
**(ELECTRONICS AND COMMUNICATION ENGINEERING)**

| S. No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Course** | | | | | | | | | | |
| 1 | ES 305 EC | Signals and Systems | 3 | 1 | - | 4 | 30 | 70 | 3 | 4 |
| 2 | PC 403 EC | Analog Electronic Circuits | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 3 | PC 404 EC | Computer Organization and Architecture | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 4 | PC 405 EC | Electromagnetic Theory and Transmission Lines | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 5 | PC 406 EC | Pulse and Linear Integrated Circuits | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 6 | PC 407 EC | Electronic Measurements and Instrumentation | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical/Laboratory Course** | | | | | | | | | | |
| 7 | PC 453 EC | Analog Electronic Circuits Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 8 | PC 454 EC | Pulse and Linear Integrated Circuits Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| **Total** | | | **18** | **1** | **4** | **23** | **230** | **520** | | **21** |

**PC:** Professional Course **ES:** Engineering Science

**L:** Lecture **T:** Tutorial **P:** Practical **D:** Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

**EC:** Electronics and Communication Engineering

**Note:**

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

## SIGNALS AND SYSTEMS

**ES 305 EC**

*Instruction: 3+ 1 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 4*

**Objectives:**

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|---|
| 1. Analyze basic concepts related to continuous time signals and systems, mathematical representation of periodic signals. Familiarize with basic operations on signals and mathematical representation of a periodic signals using Fourier and Laplace transform. |
| 2. Analyze basic concepts related to discrete time signals and systems, mathematical representation discrete time signals. |
| 3. Describe the concept of Z- Transform and its properties and illustrate their applications to analyze systems. Define convolution, correlation operations on continuous and discrete time signals. |

**Outcomes:** On successful completion of the course, the students would be able to

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|---|
| 1. Define and differentiate types of signals and systems in continuous and discrete time. |
| 2. Apply the properties of Fourier transform for continuous time signals. |
| 3. Relate Laplace transforms to solve differential equations and to determine the response of the Continuous Time Linear Time Invariant Systems to known inputs. |
| 4. Apply Z-transforms for discrete time signals to solve Difference equations. |
| 5. Obtain Linear Convolution and Correlation of discrete time signals with graphical representation. |

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| **UNIT – I** |
| ***Definitions and classifications***: Classification of signals. Elementary continuous time signals, Basic operations on continuous-time signals.<br>***classification of continuous-time systems:*** Continuous time & discrete time systems, lumped-parameter & distributed –parameter systems, static & dynamic systems, causal & non-causal systems, Time-invariant & time-variant systems, stable & unstable systems. |
| **UNIT – II** |
| ***Representation of Continuous-time signals***: Analogy between vectors and signals, orthogonality and completeness.<br>***Fourier series Analysis of Continuous-time signals*****:** Fourier series – Existence of Fourier series, Trigonometric and Exponential Fourier series, computational formulae, symmetry conditions, complex Fourier spectrum. |
| **UNIT – III** |
| ***Continuous-time Fourier Transform (FT)****:* The direct and inverse FT, existence of FT, Properties of FT, FT of standard signals, properties of FT, The Frequency Spectrum.<br>***Linear Convolution of continuous time signals***: Graphical interpretation, properties of convolution, Correlation between continuous-time signals: Auto and Cross correlation, graphical interpretation, properties of correlation. |

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| ***Laplace Transform (LT) Analysis of signals and systems*****:** The direct LT, Region of convergence, existence of LT, properties of LT. The inverse LT, Solution of differential equations, system transfer function. |
| **UNIT – IV** |
| ***Discrete-time signals and systems****:* Sampling, Classification of discrete-time signals, Basic operations on discrete time signals, Classification of discrete time systems, properties of systems.<br>***Linear Convolution of discrete time signals*****:** Graphical interpretation, properties of discrete convolution.<br>***Fourier analysis of discrete-time signals:*** Discrete-time Fourier transform (DTFT), properties of DTFT, Transfer function, Discrete Fourier transform properties of DFT |
| **UNIT – V** |
| ***Z-Transform analysis of signals & systems*****:** The direct Z transform, Region of convergence, Z-plane and S-plane correspondence. Inverse Z transform, Properties of Z-transforms. Solution to linear difference equations, Linear constant coefficient systems, System transfer function. |

**Suggested Readings:**


| | |
|---|---|
| 1 | B. P. Lathi, "*Linear Systems and Signals",* Oxford University Press, 2/e, 2009. |
| 2 | Alan V Oppenheim, A. S. Wlisky, "*Signals and Systems",* 2/e, Prentice Hall |
| 3 | Rodger E. Ziemer, William H Trenter, D. Ronald Fannin, "*Signals and Systems",* 4/e, Pearson 1998. |
| 4 | Douglas K. Linder, "*Introduction to Signals and Systems",* McGraw Hill, 1999. |
| 5 | P. Ramesh babu, R Ananada Natarajan, "S*ignals and Systems",* SCITECH, 3/e, 2009. |

## ANALOG ELECTRONIC CIRCUITS

**PC 403 EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1.Analyse frequency response of Amplifiers in different frequency ranges and Familiarize with concept and effect of negative feedback. |
| 2.Study positive feedback and Design different types of oscillators. |
| 3.Design Power Amplifiers and calculate their efficiencies and Familiarize with concept of tuned Amplifiers. |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1. Design and analyse low frequency, mid frequency and high frequency response of small signal Single stage and Multistage RC coupled and Transformer Amplifiers using BJT and FET. |
| 2. Identify the type of negative feedback, analyse and design of negative feedback amplifiers. |
| 3.Design Audio Frequency and Radio Frequency oscillators. |
| 4.Distinguish between the classes of Power Amplifiers and their design considerations. |
| 5. Compare the performance of single and double tuned amplifiers. |

| |
|---|
| **UNIT – I** |
| ***Small Signal Amplifiers:*** Classification of amplifiers, mid-frequency, Low-frequency and high frequency analysis of single and multistage RC coupled amplifier with BJT and FET. Analysis of transformer coupled amplifier in mid frequency, Low frequency and high frequency regions with BJT. |
| **UNIT – II** |
| ***Feedback Amplifiers:*** The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances, Voltage and current, series and shunt feedbacks. Stability considerations, Local Versus global feedback. |
| **UNIT – III** |
| ***Oscillators:*** Positive feedback and conditions for sinusoidal oscillations, RC oscillators, LC oscillators, Crystal oscillator, Amplitude and frequency stability of oscillator.<br>***Regulators***: Transistorized series and shunt regulators. |
| **UNIT – IV** |
| ***Large Signal Amplifiers:*** BJT as large signal audio amplifiers, Classes of operation, Harmonic distortion, power dissipation, efficiency calculations. Design considerations of transformer coupled and transform less push-pull audio power amplifiers under Class-A.<br>Class-B, Class C, Class D and Class-AB operations. |
| **UNIT – V** |
| ***RF Voltage Amplifiers*****:** General consideration, Analysis and design of single tuned and double tuned amplifiers with BJT, Selectivity, gain and bandwidth. Comparison of multistage, |

| |
|---|
| single tuned amplifiers and double tuned amplifiers. The problem of stability in RF amplifiers, neutralization & uni-laterisation, introduction to staggered tuned amplifiers. |

**Suggested Readings:**



| | |
|---|---|
| 1 | Jacob Millman, Christos C. Halkias, and Satyabrata Jit, "*Electronic Devices and Circuit"*", 3/e, McGraw Hill Education, 2010. |
| 2 | David A. Bell, "*Electronic Devices and Circuits"*, 5/e, Oxford University Press, 2009. |
| 3 | S Salivahanan, N Kumar, and A Vallavaraj, '*Electronic Devices and Circuits'*, 2/e, McGraw Hill Education, 2007. |
| 4 | Jacob Millman, Christos Halkias, Chetan Parikh, "*Integrated Electronics"*, 2/e, McGraw Hill Education (India) Private Limited, 2011. |
| 5 | Donald L Schilling & Charles Belove, "*Electronics Circuits, Discrete & Integrated",* 3/e, McGraw Hill Education (India) Private Limited, 2002. |

## COMPUTER ORGANIZATION AND ARCHITECTURE

**PC 404 EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. Implement the fixed-point and floating-point addition, subtraction, multiplication & Division. |
| 2. Describe the basic structure and operation of a digital computer and Discuss the different ways of communicating with I/O devices and standard I/O interfaces |
| 3. Analyze the hierarchical memory system including cache memories and virtual memory. Understand issues affecting modern processors. |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1. Perform mathematical operations on fixed and floating point digital data. |
| 2. Illustrate the operation of a digital computer. |
| 3. Understand I/O interfacing of a computer. |
| 4. Interface microprocessor with memory devices. |
| 5 Understand latest trends in microprocessors. |

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|---|
| **UNIT – I** |
| ***Data representation and Computer arithmetic*:** Introduction to Computer Systems, Organization and architecture, evolution and computer generations; Fixed point representation of numbers, digital arithmetic algorithms for Addition, Subtraction, Multiplication using Booth's algorithm and Division using restoring and non-restoring algorithms. Floating point representation with IEEE standards and its arithmetic operations. |
| **UNIT – II** |
| ***Basic Computer organization and Design*:** Instruction codes, stored program organization, computer registers and common bus system, computer instructions, timing and control, instruction cycle: Fetch and Decode, Register reference instructions; Memory reference instructions. Input, output and Interrupt: configuration, instructions, Program interrupt, Interrupt cycle, Micro programmed Control organization, address sequencing, micro instruction format and micro program sequencer. |
| **UNIT – III** |
| ***Central Processing Unit*:** General register organization, stack organization, instruction formats, addressing modes, Data transfer and manipulation, Program control. CISC and RISC: features and comparison. Pipeline and vector Processing, Parallel Processing, Pipelining, Instruction Pipeline, Basics of vector processing and Array Processors. |
| **UNIT – IV** |
| ***Input-output Organization*:** I/O interface. I/O Bus and interface modules, I/O versus Memory Bus. Asynchronous data transfer: Strobe control, Handshaking, Asynchronous serial transfer. Modes of Transfer: Programmed I/O, Interrupt driven I/O, Priority interrupt; Daisy chaining, Parallel Priority interrupt. Direct memory Access, DMA controller and transfer. Input output |

| |
|---|
| Processor, CPU-IOP communication, I/O channel. |
| **UNIT – V** |
| ***Memory Organization:*** Memory hierarchy, Primary memory, Auxiliary memory, Associative memory, Cache memory: mapping functions, Virtual memory: address mapping using pages, Memory management. |

**Suggested Readings:**



| | |
|---|---|
| 1 | Morris Mano, M., "*Computer System Architecture"*, 3/e, Pearson Education, 2005. |
| 2 | William Stallings, "*Computer Organization and Architecture: Designing for performance*", 7/e, Pearson Education, 2006. |
| 3 | John P. Hayes, "*Computer Architecture and Organization"*, 3/e, TMH, 1998. |
| 4 | Govindarajalu, "*Computer Architecture and Organization"*, TMH. |
| 5 | Hebbar, "*Computer Architecture"*, Macmillan, 2008. |

## ELECTROMAGNETIC THEORY AND TRANSMISSION LINES

**PC 405 EC**
*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. Analyse fundamental concepts of vector analysis, electrostatics and magneto statics law and their applications to describe the relationship between Electromagnetic Theory and circuit theory. Formulate the basic laws of static electricity and magnetism and extend them to time varying fields to define the Maxwell's equations in differential and integral form. |
| 2.Derive the wave equations for conducting and di-electric mediums to analyse the wave propagation characteristics of Uniform Plane Waves (UPW) in normal and oblique incidences and analyse fundamental concepts of Transmission lines and to formulate the basic relationship between distortion less transmission lines & applications. |
| 3.To understand the concepts of RF Lines and their characteristics, Smith Chart and its applications, acquire knowledge to configure circuit elements, QWTs and HWTs and to apply the same for practical problems. |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1. Understand the different coordinate systems, vector calculus, coulombs law and gauss law for finding electric fields due to different charges and to formulate the capacitance for different capacitors. |
| 2. Learn basic magneto-statics concepts and laws such as Biot-Savarts law and Amperes law, their application in finding magnetic field intensity, inductance and magnetic boundary conditions. |
| 3. Distinguish between the static and time-varying fields, establish the corresponding sets ofMaxwell's Equations and Boundary Conditions, and use them for solving engineering problems. |
| 4. Determine the Transmission Line parameters to characterize the distortions and estimate the characteristics for different lines. |
| 5. Study the Smith Chart profile and stub matching features, and gain ability to practically use the same for solving practical problems. |

| **UNIT – I** |
|---|
| ***Electrostatics*:** Review of coordinate systems. Coulomb's Law, Electric field due to various Charge distributions and Electric flux density. Gauss's Law and its applications. Work, Potential and Energy, The dipole. Current and Current density, Laplace and Poisson's equations. Calculation of capacitance for simple configurations. |
| **UNIT – II** |

| |
|---|
| ***Magnetostatics*:** Steady magnetic - Biot-Savart's law, Ampere's law. Stoke's theorem, Magnetic flux and magnetic flux density. Scalar and vector magnetic potentials. Electric and Magnetic fields boundary conditions. Maxwell's equations for static and time varying fields. |
| **UNIT – III** |
| ***Electromagnetic Waves:*** Uniform plane waves in free space and in conducting medium, Polarization. Instantaneous, average and complex Power, Poynting theorem, Surface Impedence. ***Reflection and Refraction*:** Normal and Oblique incidence on dielectric and conducting medium. |
| **UNIT – IV** |
| ***Transmission Lines 1:*** Overview of T and π networks. Two wire Transmission lines, Primary and secondary constants. Transmission Line equations. Infinite line and characteristic impedance- Open and short circuit lines and their significance. Distortion less transmission line, Concept of loading of a transmission line, Campbell's formula. |
| **UNIT – V** |
| ***Transmission Lines 2:*** Impedance of a transmission line, RF and UHF lines, transmission lines as circuit elements. Properties of λ/2, λ/4 and λ/8 Lines. Reflection coefficient and VSWR. Matching: Stub matching. Smith chart and its applications. |

**Suggested Readings:**


| | |
|---|---|
| 1 | Matthew N.O. Sadiku, "*Principles of Electro-magnetics*", 6/e, Oxford University Press, 2016. |
| 2 | William H. Hayt Jr. and John A. Buck, "*Engineering Electromagnetics*", Tata McGraw Hill, 2006. |
| 3 | John D. Ryder, "*Networks Lines and Fields*", 2/e, Pearson, 2015. |
| 4 | E.C. Jordan and K.G. Balmain, "*Electromagnetic Waves and Radiating Systems*", 2/e, Pearson, 2015 |
| 5 | K.D. Prasad, "*Antennas and Wave Propagation*", Khanna Publications |

## PULSE AND LINEAR INTEGRATED CIRCUITS

**PC 406 EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1.Discuss the behavior of Linear and non-linear wave shaping circuits. |
| 2. Describe the design of Multivibrators. |
| 3. Explain the functionality of OP-AMP, 555 timer and PLL with applications to Data convertors. |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1. Construct different linear networks and analyse their response to different input signals |
| 2. Understand, Analyse and design multi vibrators and sweep circuits using transistors. |
| 3. Analyse DC and AC characteristics for single/Dual input Balanced/Unbalanced output configurations using BJTs and OP-AMP. |
| 4. Distinguish various linear and nonlinear applications of OP-AMP. |
| 5. Demonstrate the various applications of 555 Timer and analyse the operation of the D/A and A/D converters. |

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| **UNIT – I** |
| **Linear Wave Shaping:** High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator and integrator, attenuators, its applications in CRO probe.<br>**Non-Linear Wave Shaping:** Diode clippers, Transistor clippers, clipping at two independent levels, Comparators, applications of voltage comparators. Clamping operation, clamping circuit taking Source and Diode resistances into account, Clamping circuit theorem. |
| **UNIT – II** |
| **Multivibrators:** Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using transistors.<br>**Time Base Generators:** General features of a time base signal, methods of generating voltage time base waveform. |
| **UNIT – III** |
| **Differential amplifiers**: Classification, DC and AC Analysis of Single/Dual input Balanced and Unbalanced output configurations using BJTs. Level Translator.<br>**Operational Amplifier**: OP AMP Block diagram, ideal Opamp characteristics, Opamp and its features, Opamp parameters and Measurements, Input and Output Offset voltages and currents, Slew rate, CMRR, PSRR. Frequency response and Compensation Techniques. |
| **UNIT – IV** |
| **OPAMP Applications**: Inverting and Non-Inverting Amplifiers, Integrator and differentiator, |

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|---|
| summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop. Log and Anti Log Amplifiers. |
| **UNIT – V** |
| **555 Timer**: Functional Diagram, Monostable, Astable and Schmitt Trigger Applications. Fixed and variable voltage regulators, PLL and its Applications.<br>**Data Converters**: Digital-to-analog converters (DAC): Weighted resistor, inverted R-2R ladder, Analog-to-digital converters (ADC): dual slope, successive approximation, flash, Specifications. |

**Suggested Readings:**


| | |
|---|---|
| 1 | J. Millman and H. Taub, "*Pulse, Digital and Switching Waveforms*" - McGraw-Hill, 1991. |
| 2 | David A. Bell, "*Solid State Pulse circuits*" - PHI, 4/e, 2002. |
| 3 | Ramakanth A. Gayakwad, "*Op-Amps and Linear Integrated Circuits*", Pearson, 4/e, 2018. |
| 4 | D.Roy Chowdhury, Shail B.Jain, "*Linear Integrated Circuits*", 4/e, New Age International (P) Ltd., 2008. |
| 5 | Anand Kumar A, "*Pulse and Digital Circuits*", Prentice-Hall of India private Limited, New Delhi, 2007. |

## ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

**PC 407 EC**
*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. Understand the different standards of measurements. |
| 2. Study different types of transducers, Sensors and their measuring techniques |
| 3. Learn about various types of biomedical instrumentation equipment. |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1. Describe characteristic of an instrument and state different Standards of measurements |
| 2. Identify and explain different types of Transducers |
| 3. Draw and Interpret types of transducers. |
| 4. Design and analyse the digital voltmeters and prioritize the instruments. |
| 5. Identify and classify types of Biomedical instruments. |

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| **UNIT – I** |
| **Electronic Measurement fundamentals:** Accuracy, Precision, Resolution and Sensitivity. Errors and their types. Standards of measurement, classification of standards, IEEE standards. |
| **UNIT – II** |
| **Transducers:** Classification, factors for selection of a transducer, transducers for measurement of velocity, acceleration. Passive electrical transducers- Strain gauges and strain measurement, LVDT and displacement measurement, capacitive transducer and thickness measurement. Active electrical transducers: Piezo electric, photo conductive, photo voltaic and photo emissive transducers. |
| **UNIT – III** |
| **Electronic Sensors:** Characteristics of sound, pressure, power and loudness measurement. Microphones and their types. Temperature measurement, resistance wire thermometers, semiconductor thermometers and thermo couples. |
| **UNIT – IV** |
| **Measuring instruments:** Block diagram, specification and design considerations of different types of DVMs. Spectrum analysers. The IEEE488 or GPIB Interface and protocol. Delayed time base oscilloscope and Digital storage oscilloscope. Introduction to virtual instrumentation, SCADA. Data acquisition system block diagram. |
| **UNIT – V** |
| **Biomedical Instrumentation:** Human physiological systems and related concepts. Bio-potential electrodes Bio-potential recorders – ECG, EEG, EMG, X- ray machines and CT scanners, magnetic resonance and imaging systems, Ultrasonic Imaging systems. |

**Suggested Readings:**


| | |
|---|---|
| 1. | Albert D. Helfric, and William D. Cooper, "*Modern Electronic Instrumentation and Measurement Techniques*", PHI, 2010. |
| 2. | H S Kalsi, "*Electronic Instrumentation*", 3/e, TMH, 2011. |
| 3. | Robert A Witte, "*Electronic Test Instruments: Analog and Digital Measurements*", 2/e, 2002 |
| 4. | Nakra B.C, and Chaudhry K.K., "*Instrumentation, Measurement and Analysis*", TMH, 2004 |
| 5. | Khandpur. R.S., "*Handbook of Bio-Medical Instrumentation*", TMH, 2003 |

## ANALOG ELECTRONIC CIRCUITS LAB

**PC 453 EC**
*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits: 1*

**Objectives:**

| |
|---|
| 1.Design and analyse BJT, FET amplifiers, multivibrators |
| 2.Analyse Oscillator circuits |
| 3.Understand Op-Amp. Applications and filter circuits |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1.Calculate gain and bandwidth of BJT, FET |
| 2.Study multivibrator circuits |
| 3. Study oscillator circuits. |
| 4.Demonstrate filter circuits |
| 5. Demonstrate power amplifier and Op-Amp. Circuits |

**List of Experiments**

1. Two Stage RC Coupled CE BJT amplifier.
2. Two Stage RC Coupled CS FET amplifier.
3. Voltage Series Feedback Amplifier.
4. Voltage Shunt Feedback Amplifier.
5. Current series feedback Amplifier
6. RC Phase Shift Oscillator.
7. Hartley & Colpitt Oscillators
8. Design of Class A and Class B Power amplifiers.
9. Constant-k low pass & high pass filters.
10. m-Derived low pass & high pass filters.
11. Series and Shunt Voltage Regulators
12. RF Tuned Amplifier

SPICE:

13. Two Stage RC Coupled CS FET amplifier.
14. Voltage Series Feedback Amplifier
15. Current Shunt Feedback Amplifier

**Note:** A minimum of 10 experiments should be performed. It is mandatory to simulate any three experiments using SPICE.

**PULSE AND LINEAR INTEGRATED CIRCUITS LAB**

**PC 454 EC**
*Instruction: 2 periods per week* *Duration of SEE: 3*
*hours CIE: 25 marks* *SEE: 50*
*marks*
*Credits: 1*

**Objectives:**

| |
|---|
| 1.To implement high pass and low pass circuit, clipping and clamping circuits and study it`s performance |
| 2.To design and test bi-stable, mono-stable multi-vibrators |
| 3.To study the characteristics of a Schmitt trigger and to build sweep circuits and study it`s performance |

**Outcomes:** On successful completion of the course, the students would be able to

| |
|---|
| 1. Design and analyse linear and non-linear wave shaping circuits. |
| 2. Design and analyse clipping and clamping circuits. |
| 3. Design and analyse multivibrator circuits. |
| 4.Design and analyse Schmitt trigger circuit |
| 5. Develop various applications of OP-AMP |

**List of Experiments**

1. Low Pass and High Pass RC Circuits
2. Two level Clipping Circuit
3. Clamping Circuit
4. Transistor Switching Times
5. Collector Coupled Bistable Multivibrators
6. Collector Coupled Monstable Multivibrators
7. Collector Coupled Astable Multivibrators
8. Schmitt Trigger Circuit
9. Measurement of OPAMP Parameters
10. Inverting and Non-inverting OPAMP Voltage follower
11. Integrator and Differentiator using OPAMP
12. Active filters
13. Astable and Mono stable multi vibrator using NE555 IC
14. Astable and Monostable multivibrator using OPAMP
15. Miller Sweep Circuit
16. UJT Relaxation Oscillator

**Note:** A minimum of 10 experiments should be performed

# FACULTY OF ENGINEERING
## Scheme of Instruction & Examination
## (AICTE Model Curriculum)

## and

## Syllabi

## B.E. V and VI Semesters

## of

## Four Year Degree Programme

## in

## ELECTRONICS & COMMUNICATION ENGINEERING

(With effect from the Academic Year 2022 - 2023)

(As approved in the Faculty Meeting held on 19-05-2022 )

Issued by

**Dean, Faculty of Engineering**

**Osmania University, Hyderabad – 500 007**

**19.05.2022**

## SCHEME OF INSTRUCTION &EXAMINATION
**B.E.V-Semester**

## (ELECTRONICS AND COMMUNICATIONENGINEERING)

| S.No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | ContactHrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Course** | | | | | | | | | | |
| 1 | PC408EC | Digital Signal Processing | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 2 | PC409EC | Microprocessor and Microcontroller | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 3 | PC410EC | Analog Communication | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 4 | PC411EC | Automatic Control Systems | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 5 | PC412EC | Antennas and wave Propagation | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 6 | HS104ME | Industrial Administration and Financial Management | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical/Laboratory Course** | | | | | | | | | | |
| 7 | PC455EC | Microprocessor and Microcontroller Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 8 | PC456EC | Systems and Signal Processing Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 9 | PW701EC | Mini Project | - | - | 2 | 2 | 50 | - | - | 2 |
| **Total** | | | **18** | **-** | **6** | **24** | **280** | **520** | **24** | **22** |

**PC:** Professional Core **HS:** Humanities and Social Sciences **PW**: Project Work

**L:**Lecture **T:**Tutorial **P:**Practical **D:**Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination(Univ.Exam)

**EC:** Electronics and Communication Engineering **ME:** Mechanical Engineering

NOTE:

1. Each contact hour is a Clock Hour.
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

# DIGITAL SIGNAL PROCESSING

PC408EC

*Instruction:3periodsperweek* *Duration of SEE:3 hours*
*CIE:30marks* *SEE:70 marks*
*Credits: 3*
*Prerequisites: Signals and Systems (EC305EC)*

## Course Objectives:

| |
|---|
| 1.To describe the necessity and efficiency of digital signal processing. |
| 2.To discuss various design methods of FIR & IIR filters. |
| 3.Todescribe the concepts of multirate signal processing and identify important features of TMS320C67XX DSP processors. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| |
|---|
| 1.apply the knowledge of FFT Algorithms for computation of DFT. |
| 2.design of FIR filters using various methods. |
| 3.design of IIR filters using various methods. |
| 4.apply decimation and interpolation concepts for the design of sampling rate converters |
| 5.understand TMS320C67XX DSP processors for the design of digital filters. |

| |
|---|
| **UNIT– I** |
| **Discrete Fourier Transform and Fast Fourier Transform:** Discrete Fourier Transform (DFT),Computation of DFT-Linear and Circular Convolution,FFT algorithms:Radix-2case,Decimation in Time and Decimation in Frequency algorithms, in place computation, bit Reversal. |
| **UNIT– II** |
| **Finite Impulse-Response Filters(FIR):** Linear phase filters, Windowing techniques for design of Linear phaseFIRfilters-Rectangular,triangular,Bartlett,Hamming,Hanning,Kaiser windows, Realization of filters, Finite word length effects. |
| **UNIT– III** |
| **Infinite Impulse-Response Filters(IIR):** Introductiontofilters,comparisonbetweenpracticalandtheoreticalfilters, Butterworth and Chebyshev approximation, IIR digital filter design Techniques, Impulse Invariant technique, Bilinear transformation technique, Digital Butterworth & Chebyshev filters, Implementation, Digital filters structures, Comparison between FIR and IIR. |
| **UNIT– IV** |
| **Multirate Digital Signal Processing:** Introduction, Decimation by factor D and interpolation bya factor I, Sampling Rate conversion by a Rational factor I/D. **Implementation of Sampling Rate Conversion:** Multistage implementation of sampling rate conversion, Sampling conversion by an arbitrary factor, Application of Multirate Signal Processing. |
| **UNIT– V** |
| **Introduction to DSP Processors:** Difference between DSP and other microprocessors architectures Importance of DSP Processors- General purpose DSP processorsTMS320C67XX processor, architecture, registers, pipelining, addressing modes and introduction to instruction set. |

**Suggested Reading:**


| | |
|---|---|
| 1 | Alan V. Oppenheim & Ronald W. Schafer, "Digital Signal Processing," PHI, 2nd edition, 2014. |
| 2 | John G. Proakis&Dimtris G. Manolakis, "Digital Signal Processing Principles, Algorithms and Application," PHI, 4th edition, 2012. |
| 3 | Ashok Ambardar, "Digital Signal Processing: A Modern Introduction," Cengage Learning, 2009. |
| 4 | Li Tan, "Digital Signal Processing: Fundamentals and Applications," Elsevier, 2012. |
| 5 | B.Venkataramani& M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application," TMH, 2e 2013. |

# MICROPROCESSOR AND MICROCONTROLLER

PC409EC

*Instruction:3periodsperweek* *Duration of SEE: 3 hours*
*CIE:30mark* *SEE:70marks*
*Credits:3*
*Prerequisites: Computer Organization and Architecture (PC404EC)*

## Course Objectives:

| |
|---|
| 1. To understandarchitectureandprogrammingof8086microprocessorand8051microcontroller. |
| 2. To describeinterfacingofmemory,8255 PPI,and 8251 USARTto8086processoranddifferentiation of 8086and8051intermsofinternalarchitecture, memory and programming. |
| 3. To describeinterfacingandprogrammingofI/Oports,TimersandUARTusing8051 controller and developinterfacingofrealtimedeviceslikeADC,DACandsteppermotorwith8051. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| |
|---|
| 1.explain the architecture of 8086 microprocessor and recognize different types of addressing modes. |
| 2.write assembly language programming using 8086 microprocessor instruction set. |
| 3.interface different peripherals to 8086 microprocessor. |
| 4.explain the architecture of 8051microcontroller and write assembly/C language programming using 8051 microcontroller. |
| 5.interface different peripheral modules to 8051microcontroller. |

| |
|---|
| **UNIT–I** |
| **8086 Microprocessor:** Intel 8086/8088architecture, Segmented memory, Minimum and Maximum modes of operation,Timing diagram, addressing modes, Instruction set,assembly language programming using data transfer, arithmetic, logical and branching instructions. |
| **UNIT–II** |
| **8086 Programming and Interfacing:** Assembler directives,macros,procedures,assembly language programming using string manipulation instructions, 8086 Interrupt structure, I/O and memory interfacing concepts using8086,ICChipPeripherals-8255PPI,8251USART and their interfacing with 8086. |
| **UNIT–III** |
| **8051 Microcontroller:** Internal architecture and pin configuration, 8051 addressing modes,instruction set, bit addressable features. I/O port structures, assembly language programming using data transfer,arithmetic,logical and branch instructions. |
| **UNIT–IV** |
| **8051Timers,SerialPortandInterrupts:** 8051Timers/Counters and its programming, Serial data communication, Serial port and its programming,8051 interrupts, Interrupt vector table, Interrupts programming. |
| **UNIT–V** |
| **8051 Interfacing:** Interfacing of 8051with LCD, ADC, DAC, external memory, stepper motor interfacing. |

**Suggested Reading:**



| | |
|---|---|
| 1. | RayA.KandBhurchandiK.M,“AdvancedMicroprocessorsandPeripherals”,3/e,Tata McGraw Hill Education Pvt Ltd, 2013. |
| 2. | Mazidi M.A,MazidiJ.G andRolinD.Mckinlay,“The8051Microcontroller&EmbeddedSystemsUsingAssemblyandC ”,2/e,PearsonEducation,2008. |
| 3. | DouglasV. Hall,“MicroprocessorsandInterfacingProgrammingandHardware”, 2nd Edition, TataMcGraw-HillpublishingcompanyLimited,NewDelhi,2008. |
| 4. | AyalaK.J,“The8051MicrocontrollerArchitecture,programming&Applications”, PenramInternational, 2007. |
| 5. | Scott Mackenzie and Raphael C. W. Phan. “The 8051 Microcontroller”, 4th Edition, Pearson education, 2008. |

# ANALOG COMMUNICATION

PC410EC

*Instruction:3periodsperweek* *Duration of SEE:3 hours*
*CIE:30marks* *SEE:70 marks*
*Credits: 3*
*Prerequisites: Signals & Systems (ES305EC)*
*Probability Theory and Stochastic Processes (ES304EC)*

## Course Objectives:

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| 1. To understand the concept of modulation. |
| 2. To describe the generation and detection of various analog and pulse modulation techniques. |
| 3. To describe the structures of AM, FM transmitters and Receivers and analyze the noise performance of analog modulation techniques. |

**Course Outcomes:** On successful completion of the course, the students will be able to

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|---|
| 1. understand the need for modulation, transmitter and receiver structures. |
| 2. understand the generation, detection of Amplitude and Angle modulation schemes. |
| 3. compute and compare power and bandwidth requirements of AM, DSB-SC, SSB and FM techniques. |
| 4. understand and compare pulse analog and digital modulation techniques. |
| 5. identify the sources of noise and evaluate the performance of analog communication systems over a noisy channel. |

**UNIT– I**

**Introduction:** Introduction to communication system, Communication channels, Need for modulation.

**Amplitude Modulation:** Definition, Time and Frequency domain description – AM, DSB-SC, Single tone modulation, Power relations in AM, Generation of AM signal– Square-law, Switching modulators, AM demodulation- envelop Detector, Generation of DSB-SC Signal – Balanced, Ring modulators, DSB-SC demodulation – Coherent Detector, COSTAS loop.

**SSB Modulation:** Definition,Time and Frequency domain description, Generation of SSB Signal – Frequency discrimination and phase discrimination methods, Demodulation of SSB – Coherent Detection, Frequency Division Multiplexing, Vestigial Sideband Modulation – Time and Frequency domain description, Generation of VSB signal, Envelop detection of VSB plus carrier, Comparison of all AM techniques, Applications of different AM systems, AM Transmitter, AM super heterodyne receiver, Receiver characteristics.

**UNIT– II**

**Angle Modulation:** Definition, basic concepts, Frequency modulation: Single tone FM, Spectrum analysis of sinusoidal FM wave, Narrow band FM, Wide band FM. Constant average power, Transmission bandwidth of FM wave. Generation of FM - Direct and Indirect (Armstrong's) methods. Detection of FM - Balanced frequency discriminator, Phase Locked Loop. Comparison of FM and AM. FM Transmitter, FM Super heterodyne receiver

**UNIT-III**

| |
|---|
| **Pulse Analog Modulation schemes:** Review of sampling theorem, types of sampling. Types of Pulse Analog and Digital Modulation Schemes, Generation and demodulation of Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM). Time Division Multiplexing. |
| **UNIT– IV** |
| **Pulse Digital Modulation Schemes:** Quantization, Analog to Digital Conversion, PCM, Companding in PCM – mu law, A law. DPCM, DM and ADM. Comparison of PCM, DPCM, DM and ADM. $SNR_Q$ of PCM and DM. |
| **UNIT– V** |
| **Noise:** Definition, Sources of noise, Atmospheric noise, thermal noise, shot noise, Noise in two-port network: noise figure, equivalent noise temperature of Single and cascade stages, noise equivalent bandwidth. Narrow band noise representation<br>**Noise in Analog Communication Systems:** Signal to Noise Ratio (SNR) and Figure of merit calculations in AM, DSB-SC, SSB and FM systems, Pre-Emphasis and De-Emphasis. |

## Suggested Reading:


| | |
|---|---|
| 1 | Simon Haykin, "Communication Systems," 2nd edition, Wiley India, 2011. |
| 2 | H. Taub, D.L. Schilling, "Principles of communication systems", Tata McGraw Hill, 2001. |
| 3 | B.P. Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems", 4th edition, Oxford University Press, 2016. |
| 4 | Leon W Couch II., "Digital and Analog Communication Systems", 6th edition, Pearson Education Inc., 2001. |
| 5 | P. Ramakrishna Rao, "Analog Communication," 1st edition, TMH, 2011. |

## AUTOMATIC CONTROL SYSTEMS

**PC411EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*
*Prerequisites: Signals & Systems (EC305EC)*

### CourseObjectives:

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| 1. To analyze the stability and performance of dynamic systems in both time and frequency domain. |
| 2. To understand the impact of various compensators and controllers on system performance. |
| 3. To provide the knowledge of state variable models and digital control systems. |

**Course Outcomes:** On successful completion of the course, the students will be able to

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| 1. develop the mathematical model of the physical systems and find the transfer function using different approaches. |
| 2. analyze system stability using time domain techniques. |
| 3. analyze system stability using frequency domain techniques. |
| 4. verify the stability of digital control systems. |
| 5. illustrate the control systems via state space models. |

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| **UNIT – I** |
| ***Control System Fundamentals:*** *Classification of control systems including Open and Closed loop systems, Effect of feedback on Control systems, Mathematical modeling of Mechanical systems and their conversion into electrical systems, Transfer function representation, Block diagram representation, Block diagram algebra and reduction and Signal flow graphs and Mason's gain formula.* |
| **UNIT – II** |
| ***Time Response Analysis:*** *Transfer function and types of input. Transient response of first and second order system for step input. Time domain specifications, Characteristic equation of Feedback control systems, Static error coefficients, Error series,* ***Stability:*** *Concept of Stability, Routh-Hurwitz criterion for stability, Root locus technique and its construction* |
| **UNIT – III** |
| ***Frequency Response Analysis:*** *Introduction to Frequency response of the system. Frequency domain Specifications, Bode plots, Stability analysis, Nyquist plot and Nyquist criterion for stability* ***Compensation Techniques:*** *Types of Compensation. Phase Lag, Lead and Lag-Lead compensators. Types of controllers proportional (P), integral (I), derivative (D), PID controller* |
| **UNIT – IV** |
| ***Digital Control Systems:*** *Digital control, advantages and disadvantages, Digital control system architecture. Sample and Hold Circuit. Transfer function of sample data systems. Stability analysis by Jury's test.* |
| **UNIT – V** |

***State Space Representation:*** *Concept of state and state variables. State models of linear time invariant systems, Derivation of Transfer Function from State Model, State transition matrix,*

| |
|---|
| *Solution of state equations. Controllability and Observability.* |

Suggested Reading:



| | |
|---|---|
| 1 | Nagrath, I.J, and Gopal, M., “Control System Engineering”, 5th edition, New Age Publishers, 2009 |
| 2 | NagoorKani, “Control systems Engineering”, Oxford & IBH Publishing Company Private Limited, 2021. |
| 3 | Ogata, K., “Modern Control Engineering”, 5th edition, Pearson India Education Services Pvt. Limited, 2015 |
| 4 | Alan V Oppenheim, A. S. Wlisky, “Signalsand Systems”, Prentice-Hall ofIndia Private Limited, 2008. |
| 5 | A.K.Jairath , “Problems and Solutions of Control Systems” , CBS Publishers, 2022. |

## ANTENNAS AND WAVE PROPAGATION

**PC412EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*
*Prerequisites: Electromagnetic Theory & Transmission Lines (PC405EC)*

### Course Objectives:

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|---|
| 1.To describe the basic principles of antennas and introduce the antenna terminologies. |
| 2.To discuss the working principles of wire antennas, non-resonant antennas, antenna arrays and techniques for measurement of antennas characteristics. |
| 3.To explain the various modes of radio wave propagation. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| |
|---|
| 1.illustrate the basic principles of antennas and learn the antenna terminology. |
| 2.apply the design considerations of different types of wire antennas and make proficient in analytical skills for understanding practical antennas |
| 3.analyse the non-resonant antennas for various ranges of frequencies and get updated with latest developments in the smart antennas. |
| 4.apply the principles and design considerations of antennas as well as antenna arrays, measure standard antenna parameters and obtain awareness about radiation hazards. |
| 5.understand and compare various modes of radio wave propagation used for different applications. |

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| **UNIT – I** |
| **Antenna Fundamentals:** Introduction, principle of radiation, isotropic radiator, basic antenna parameters: radiation pattern, beam area, radiation intensity, beam efficiency, directivity, gain, resolution, antenna apertures, effective length and effective area, Friis transmission equation, fields from oscillating dipole, antenna field zones, antenna polarization, front–to-back ratio, antenna theorems, antenna impedance and antenna temperature. Retarded potential: Lorentz and Coulomb gauge conditions. |
| **UNIT – II** |
| ***Thin Linear Wire Antennas:*** *Introduction, current distributions, radiation from infinitesimal/short dipole or an alternating current element, half-wave dipole and quarter wave monopole, loop antennas-small loop, comparison of far fields of small loop and short dipole, far field pattern of circular loop with uniform current, radiation resistance of loops, slot antennas, helical antennas- helical geometry, helix modes: transmission and radiation, practical design considerations for monofilar helical antenna in axial modes, wideband characteristics of monofilar helical antenna radiating in axial mode, radiation efficiency.* |
| **UNIT – III** |

| |
|---|
| **Non-Resonant Antennas:** Comparison between resonant and non-resonant antennas, Long-wire antennas: V-antenna and Rhombic Antenna, Yagi-Uda Antenna, Folded dipole antennas, Broadband and frequency-independent concept, Log-periodic Antenna, Aperture Antennas- Huygen's principle, Babinets principle, Radiation from Horns and design considerations, Parabolic Reflector and Cassegrain Antennas, Lens Antennas, Micro Strip Antennas- Basic |

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| characteristics, feeding Methods, Design of Rectangular Patch Antennas, Smart Antennas-Fixed weight and Adaptive Beam forming. |
| **UNIT – IV** |
| **Antenna Arrays:** Array of point sources, two element array with equal and unequal amplitudes, different phases, linear n-element array with uniform distribution, Broadside and End fire arrays, Principle of Pattern Multiplication, Effect of inter element phase shift on beamscanning, Binomial array. EFA with Increased Directivity, Derivation of their characteristics and comparison; Effects of Uniform and Non-uniform Amplitude Distributions. ***Antenna Measurements:*** *Introduction, Basic Concepts-Reciprocity, Near and Far fields, Source of Errors, Antenna Test Site. Measurement setup and distance criterion for directional patterns, gain (absolute and comparison methods) and impedance, Radiation Hazards.* |
| **UNIT – V** |
| **Wave Propagation:** Ground, Space and Surface waves, Troposphere refraction and reflection, Duct propagation, Sky wave propagation, Regular and irregular variations in ionosphere Line of sight propagation. |

**Suggested Reading:**


| | |
|---|---|
| 1. | J. D. Kraus, R. J. Marhefka, and Ahmad S. Khan, “Antennas and Wave Propagation”, McGraw-Hill, 4$^{th}$ Edition, 2010. |
| 2. | Constantine A. Balanis, “Antenna Theory: Analysis and Design”, 3$^{rd}$ Edition, John Wiley, 2005. |
| 3. | Edward C. Jordan and Keith G. Balmain, “Electromagnetic Waves and Radiating Systems”, 2$^{nd}$ Edition, PHI, 1968. |
| 4. | Robert E. Collin, “Antennas and Radiowave Propagation”, McGraw-Hill, 1985. |
| 5. | A.R.Harish and M. Sachidananda, “Antennas and Wave Propagation”, Oxford University Press, 2007. |

# INDUSTRIAL ADMINISTRATION AND FINANCIALMANAGEMENT

## HS104ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks Credits: 3*
*Prerequisites: Finance and Accounting (HS103CM)*

## Course Objectives

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|---|
| 1.To understand various types of organizational structures, manufacturing processes and importance of plant layout and the role of scheduling function in optimizing the utilization of resources. |
| 2.To understand the importance of quality, inventory control and concepts like MRP I and MRPII. |
| 3.To understand the nature of financial management and concepts like breakeven analysis, depreciation and replacement analysis. |

**Course Outcomes**

After completing this course, the student will be able to

| |
|---|
| 1.Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems and role of scheduling function in better utilization ofresources. |
| 2.Understand the Fundamental concepts of quality control, process control, material control and appreciate the importance of MRP-I and MRP—H. |
| 3.Know the different terminology used in financial management and understand the different techniques of capital budgeting and various types of costs involved in running an industrial organization. |

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| **UNIT-I** |
| Industrial Organization: Types of various business organisations, organization structures and their relative merits and demerits. Functions of management. Plant Location and Layouts: Factors affecting the location of plant and layout. Types of layouts and their merits and demerits. |
| **UNIT-II** |
| Work Study: Definitions, objectives of method study and time study. Steps in conducting method study. Symbols and charts used in method study. Principles of motion economy. Calculation of standard time by time study and work sampling. Performance rating factor. Types of ratings. Jobs evaluation and performance appraisal. Wages, incentives, bonus, wage payment plans. |
| **UNIT-III** |
| Inspection and Quality Control: Types and objectives of inspection S.Q.C., its principles. Quality control by chan and sampling plans. Quality circles, introduction to ISO. |
| **UNIT-IV** |
| Optimization: Introduction to linear programming and its graphical solutions. Assignment problems.Project Management: Introduction to CPMand PERT. Determination of critical path.Material Management: Classification of materials, Materials planning. Duties of purchase manager.Determination of economic ordering quantities. Types of materials purchase. |
| **UNIT-V** |
| Cost Accounting: Elements of cost(Various costs) types of overheads, Breakeven analysis and its applications. Depreciation. Methods of calculating depreciation fund. Nature of financial |

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| management. Time value of money. Techniques of capital budgeting and methods. Cost of Capital, Financial leverage. |

## Suggested Reading:


| | |
|---|---|
| 1. | Pandey I M, “Elements of Financial Management”, Vikas Publications House New Delhi 1994 |
| 2. | Khanna O P, “Industrial Engineering and Management”, Dhanpat Rai &Sons. |
| 3. | Marshall/Bansal, "Financial Engineering”, PHI. |
| 4. | Keown,"Financial Management”, 9th edition, PHI. |
| 5. | Chandra Bose, “Principles of Management &Administration”, PHI. |

## MICROPROCESSOR AND MICROCONTROLLER LAB

**PC455EC**

*Instruction:2periodsperweek* *Duration of SEE: 3hours*
*CIE:25marks* *SEE:50marks*
*Credits: 1*

### Course Objectives:

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|---|
| 1. Apply assembly language programs on 8086 trainer kit in standalone/serial mode. |
| 2. Classify interface modules into input/outputandmemoryinterfaceswith8086. |
| 3. Develop and execute the assembly languageprogrammingconceptsof8051microcontroller and for various interface modules. |

**Course Outcomes:**On successful completion of the course, the students will be able to

| |
|---|
| 1.apply different addressing modes and model programs using 8086 Instruction set. |
| 2.explain the usage of string instructionsof8086for string manipulation, and comparison. |
| 3.develop interfacing applications using 8086 processor. |
| 4.develop different programs using C cross compilers for 8051microcontroller. |
| 5.develop interfacing applications using 8051microcontroller. |

### List of Experiments

### PART-A

1. Use of 8086 trainer kit and execution of programs. (Instruction set for simple Programs using 4to5 lines of instruction code under different addressing modes for data transfer, manipulation, and arithmetic operations).
2. Branching operations and logical operations in a given data.
   i) Transfer byte and word data from source to destination memory.
   ii) Count even and odd numbers from given array often bytes.
   iii) Find Largest and Smallest number from given array of words.
   iv) Sort the given array in ascending order, descending order.
3. Multiplication and Division
   i) Use MUL and IMUL for Unsigned and signed multiplication on 8bit and16 bit sets.
   ii) Use DIV and IDIV for Unsigned and signed division on 8bit and16 bit datasets.
   iii) Obtain given decimal number to unpacked BCD ex: 123410 as01,02,03,04and store in memory using DIV.
   iv) Find Factorial of a given number using multiplication instructions.
4. Single byte, multi byte Binary and BCD addition and subtraction.
5. Code conversions.
   i) BCD Unpacked to Packed BCD code.
   ii) ASCII code to BCD code.
   iii) BCD to ASCII code.
6. String Searching and Sorting.(Using string instructions)
   i) Find number of repetitions of a character in a string.
   ii)Find and replace a character in the given string.
   iii) Convert Case of a given string.

iv) Find whether given string is palindrome or not.

## PARTB

**[Experimentsfor8051usinganyC-CrossCompiler&appropriatehardware]**

1.Familiarityand useof8051/8031 microcontroller trainer, and execution of programs.
2.Instructionsetforsimpleprograms(using4to5linesofinstructioncode).
3.Timer andcounteroperations&programmingusing8051.
4.SerialcommunicationsusingUART.
5.Programmingusinginterrupts.
6.Interfacing8051 with DAC to generate waveforms.
7. Interfacingtrafficsignalcontrolusing8051.
8.Programtocontrolstepper motorusing8051.
9. ADC interfacingwith8051.
10. SerialRTCinterfacingwith8051.
11. LCDinterfacingwith8051.

**NOTE**:1. At least ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and 5 from Part B is compulsory.
3. In Part-B, perform the experiments using assembler simulators like edsim51/Keil software.

## SYSTEMS ANDSIGNALPROCESSINGLAB

**PC456EC**

*Instruction:2periodsperweek* *Duration of SEE: 3 hours*
*CIE:25marks* *SEE:50 marks*
*Credits: 1*

### Course Objectives:

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|---|
| 1. To develop C & MATLAB programs for operation of sequences. |
| 2. To implement the algorithms of DFT,IDFT,FFTand IFFT on discrete time signals |
| 3. To design and obtain the frequency response of various digital filters. |

**Course Outcomes:**On successful completion of the course, the students will be able to

| |
|---|
| 1.develop MATLAB files for the verification of system response. |
| 2.design and analyze the digital filters using MATLAB |
| 3.verify the functionality of FFT algorithms. |
| 4.experiment with multirate techniques using MATLAB & CCS |
| 5.design and implement the digital filters on DSP processor |

### PART-A

**Listof Signal ProcessingExperiments**

**Perform the following programs using MATLAB Simulator**

1. Introduction to MATLAB and signal generation.
2. Perform Linear Convolution.
3. Perform Circular Convolutions.
4. Perform DFT and FFT algorithm
5. Perform FIR filters design using different window functions.
6. Perform IIR filters design: Butterworth and Chebyshev, LPF, HPF, BPF & BSF filter.
7. Perform Interpolation and Decimation.
8. Implementation of multi-rate systems.

### PART-B

**List of DSP Processor Experiments**

**Implement the following experiments using DSK (TMS320C67XX)**

1. Introduction to DSP processors and Study of procedure to work in real-time.
2. Implement Solution of difference equations
3. Implement Impulse Response.
4. Implement Linear Convolution.
5. Implement Circular Convolution.
6. Implement Fast Fourier Transform Algorithms.
7. Design of FIR (LP/HP) USING windows: (a) Rectangular (b) Triangular(c)Hamming windows.
8. Design of IIR(HP/LP) filters.

### NOTE:

1. Atleast ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and Part B is compulsory.
3. For Section-A‘MATLAB with different toolboxes like signal processing.

4. Blockset and SIMULINK/MATHEMATICA/any popular software can be used.

## MINI PROJECT

**PW701EC**

*Instruction: 2 periods per week* *Duration of SEE: NA*
*CIE: 50 marks* *SEE: NA*
*Credits: 2*

### Course Objectives:

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|---|---|
| 1. | To conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis. |
| 2. | To provide training in soft skills and also train them in presenting seminars and technical report writing. |
| 3. | To design, implement and test the prototype/algorithm in order to solve the conceived problem. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| | |
|---|---|
| 1. | get practical experience of software design and development, and coding practices within Industrial/R&D Environments. |
| 2. | gain working practices within Industrial/R&D Environments |
| 3. | prepare reports and deliver effective presentation. |
| 4. | demonstrate effective written and oral communication skills |
| 5. | innovate in various engineering disciplines and nurture their entrepreneurial ideas. |

### Guidelines for Mini Project

1. The mini-project is a team activity having maximum of 3 students in a team. This is electronic product design work with a focus on electronic circuit design.

2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.

3. Mini Project should cater to a small system required in laboratory or real life.

4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.

5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.

6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.

7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

## SCHEME OF INSTRUCTION & EXAMINATION

**B.E.VI-Semester**

(ELECTRONICS AND COMMUNICATIONENGINEERING)

| S.No. | Course Code | Course Title | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hrs/Wk | CIE | SEE | Duration inHrs | |
| **Theory Course** | | | | | | | | | | |
| 1 | PC413EC | Digital Communication | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 2 | PC414EC | VLSI Design | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 3 | PC415EC | Data Communication and Computer Networks | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 4 | PE5XXEC | Professional Elective-I | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 5 | PE5XXEC | Professional Elective-II | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 6 | OE6XXYY | Open Elective-I | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical/Laboratory Course** | | | | | | | | | | |
| 7 | PC458EC | Communication Systems Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 8 | PC459EC | Digital Integrated Circuits Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 9 | PC460EC | Data Communication and Computer Networks Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| *10 | *PW701EC | *Summer Internship | - | - | - | - | *50 | | - | *2 |
| **Total** | | | **18** | **-** | **6** | **24** | **255** | **570** | **27** | **21** |

**PC:** Professional Core **PE:** Professional Elective
**OE**: Open Elective **PW:** Project Work
**L:**Lecture **T:**Tutorial **P:**Practical
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination(Univ.Exam)
**EC:** Electronics and Communication Engineering

Note:

1. Each contact hour is a clock hour.
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary,to enable the student to complete the experiment.
3. *The students have to undergo a Summer Internship of four to six weeks duration after VI semester and credits will be awarded in VII semester after evaluation.

| Professional Elective-I | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1 | PE501EC | Digital Image and Video Processing |
| 2 | PE502EC | Advanced Microcontrollers |
| 3 | PE503EC | Python Programming and Applications |
| 4 | PE504EC | Neural Networks |

| Professional Elective-II | | |
|---|---|---|
| **S.No.** | **Course Code** | **Course Title** |
| 1 | PE505EC | FPGA Architectures |
| 2 | PE506EC | Advanced Digital Signal Processing |
| 3 | PE507EC | CMOS Analog IC Design |
| 4 | PE508EC | IoT system Design and Applications |

| Open Elective-I | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1 | OE611AE | Basics of Automobile Engineering(Not for Mech./Prod./Automobile Engg. students) |
| 2 | OE601CE | Disaster Mitigation(Not for Civil Engg. Students) |
| 3 | OE601CS | Operating Systems(Not for CSE Students) |
| 4 | OE602CS | OOP using Java(Not for CSE Students) |
| 5 | OE601EE | Electrical Energy Conservation and Safety(Not for EEE & EIE Students) |
| 6 | OE602EE | Reliability Engineering(Not for EEE&EIE Students) |
| 7 | OE601EG | Soft Skills & Interpersonal Skills |
| 8 | OE601IT | Database Systems(Not for IT Students) |
| 9 | OE602IT | Data Structures(Not for IT Students) |
| 10 | OE601LW | Cyber Law and Ethics |
| 11 | OE611ME | Industrial Robotics (Not for Mech./Prod./Automobile Engg. students) |
| 12 | OE602MB | Human Resource Development and Organizational Behaviour |
| 13 | OE601EC | Principles of Electronic Communication(Not for ECE students) |
| 14 | OE602EC | Digital System Design using Verilog HDL(Not for ECE Students) |

# DIGITAL COMMUNICATION

PC413EC

*Instruction:3periodsperweek* *Duration of SEE:3 hours*
*CIE:30marks* *SEE:70 marks*
*Credits: 3*
*Prerequisites:Probability Theory and Stochastic Processes (ES304ES)*
*Analog Communication (PC410EC)*

## Course Objectives:

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|---|
| 1. To introduce the concepts of optimum receiver, baseband digital data transmission and analyze the error performance of different digital carrier modulation schemes like ASK, FSK, PSK etc. |
| 2. To familiarize the students with the concepts of information theory, basic source coding and channel coding techniques. |
| 3. To familiarize the students with the concepts of spread spectrum communication with emphasis on DSSS and FHSS. |

**Course Outcomes:**On successful completion of the course, the students will be able to

| |
|---|
| 1. understand the design of optimum receiver and analyze the Performance of Baseband and Band pass Modulation schemes based on Probability of error. |
| 2. apply concepts of Information theory and assess information capacity of various channels. |
| 3. encode the source alphabet using Shannon Fano and Huffman encoding methods. |
| 4. distinguish different types of Error control codes along with their encoding/decoding algorithms. |
| 5. understand generation of PN sequence and analyze the performance of Spread Spectrum communication systems. |

| |
|---|
| **UNIT– I** |
| **Introduction to Digital Communication:** Elements of Digital Communication System, Comparison of Digital and Analog Communication Systems. **Detection and Estimation:** Receiver structure,Detection of signals in the presence of noise - Gaussian error probability, optimum receiver – matched filter, Gram-Schmidt orthogonalization procedure, correlation receiver, Maximum Likelihood decoding. **Base band digital data transmission –** Block diagram, Inter Symbol Interference, Nyquistcriterion for Zero ISI, Eye pattern. |
| **UNIT– II** |
| **Digital Carrier Modulation Schemes** — Description and generation of ASK, FSK, PSK. Signal Constellation, Coherent detection of Binary ASK, FSK, PSK. DPSK. Comparison of digital carrier modulation schemes. **M-arysignaling schemes:** Introduction, QPSK- generation and detection, Signal Constellation, Synchronization methods. |
| **UNIT– III** |
| **Information Theory and Source Coding:** Uncertainty, Information, entropy, information rate.. Discrete memory less channel – Probability relations in a channel, priori & posteriori entropies, Joint entropy, conditional entropy, mutual information, Channel capacity - Binary Symmetric Channel, Binary Erasure Channel, cascaded channels, Shannon-Hartley Theorem – Shannon |

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|---|
| Bound.<br>**Source coding:** Shannon – Fano and Huffman coding. |
| **UNIT– IV** |
| **Channel Coding:** Introduction to error correcting codes,types of transmission errors, need for error control coding.<br>**Linear Block Codes (LBC):** Matrix description of LBC, generation, Syndrome calculation and error detection, Minimum distance of Linear block code, error detection and error correction capabilities, Hamming codes.<br>**Binary cyclic codes (BCC):** Polynomials, Algebraic description of cyclic codes, systematic encoding using generator polynomial and parity check polynomial, syndrome calculation, decoding and error correction using shift registers.<br>**Convolution codes:** Encoding, Decoding using code tree, state diagram. |
| **UNIT– V** |
| **Spread Spectrum Communication:** Advantages of Spread Spectrum, generation and characteristics of PN sequences. Direct sequence spread spectrum and Frequency hopping spread spectrum systems. CDMA, ranging using DSSS. Acquisition and Tracking of DSSS and FHSS signals. |

## SuggestedReading:


| | |
|---|---|
| 1 | Simon Haykin, “Digital Communication”, 4th edition, Wiley India 2011. |
| 2 | Sam Shanmugam K, “Digital and Analog Communication systems”, Wiley 1979. |
| 3 | B.P.Lathi, “Modern digital and analog communication systems”, 3rd edition, Oxford University Press. 1998. |
| 4 | Leon W.Couch II., “Digital and Analog Communication Systems”, 6th edition, Pearson Education inc., New Delhi, 2001. |
| 5 | H. Taub, D.L. Schilling, “Principles of communication systems”, Tata McGraw Hill, 2001. |

# VLSI DESIGN

**PC414EC**

*Instruction: 3 periods per week* *Duration of SEE:- 3hours*
*CIE: 30 marks* *SEE:- 70 Marks*
*Credits: 3*
*Prerequisites: Digital Electronics (ES215EC)*

## Course Objectives:

| | |
|---|---|
| 1. | To explain electrical properties of MOS devices to analyze the behavior of inverters designed with various loads. |
| 2. | To give exposure to the design rules to be followed to draw the layout of any logic circuit and Provide concept to design different types of Combinational and sequential circuits |
| 3. | To describe verilog HDL and develop digital circuits using various modeling styles. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| | |
|---|---|
| 1. | analyze modes of operation of MOS transistor and its basic electrical properties. |
| 2. | draw stick diagrams and layouts for any MOS transistors and calculate the parasitic R&C |
| 3. | familiarize with the constructs and conventions of the verilog HDL programming in gate level and data flow modeling. |
| 4. | generalize combinational and sequential logic circuits in behavioral modeling and concepts of switch level modelling. |
| 5. | analyse the operation of various arithmetic and sequential logic circuits using CMOS transistors |

| |
|---|
| **UNIT I** |
| **Introduction:** Introduction to IC Technology – MOS, PMOS, NMOS, CMOS Fabrication Process. **Basic Electrical Properties**: Basic Electrical Properties of MOS: Ids- Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design. |
| **UNIT –II** |
| **VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates. Basic circuit concepts, Sheet Resistance $R_S$ and its concept to MOS, Area Capacitance Units, Calculations – RC Delays. |
| **UNIT- III** |
| **Introduction to HDLs:** Basic Concepts of Verilog, Data types, system tasks and compiler directives. Gate level modeling: Gate types and gate delays, dataflow modeling: Continuous assignments and Delays. Design of stimulus blocks. Design of Arithmetic Circuits using Gate level/ Data flow modeling –Adders, Subtractors, 4- bit Binary and BCD adders and 8-bit Comparators. |
| **UNIT – IV** |

**Behavioral modeling:** Structured Procedures, Procedural Assignments, Timing Control, Conditional Statements, Sequential and parallel blocks, generate Blocks, Switch level modeling. Behavioral modeling of sequential logic modules: Latches, Flip Flops, counters and shift registers applications Tasks, Functions, Procedural Continuous Assignments, Design of Mealy and Moore FSM models for sequence detector using Verilog. Logic Synthesis, Synthesis Design Flow, Gate level netlist.

| UNIT –V |
|---|
| **Subsystem Design**: Shifters, Carry skip adder, carry select adder , Booth Multiplier, Memory Elements: 6T SRAM cell, 1T DRAM cell.<br>**Sequential Logic Design**: Behavior of Bi-stable elements, CMOS D latch and Edge triggered Flip flops. |

Suggested Reading:



| | |
|---|---|
| 1. | Kamran EshraghianDougles and A. Pucknell, 'Essentials of VLSI circuits and systems', PHI, 2005Edition |
| 2. | Weste and Eshraghian 'Principles of CMOS VLSI Design', Pearson Education, 2ndedition,1999. |
| 3. | John .P. Uyemura, 'Introduction to VLSI Circuits and Systems', JohnWiley, 2003 |
| 4. | John M. Rabaey, 'Digital Integrated Circuits', PHI, EEE, 1997. |
| 5. | Wayne Wolf, 'Modern VLSI Design', Pearson Education, 3rdedition, 1997 |

## DATA COMMUNICATION AND COMPUTER NETWORKS

**PC415EC**

*Instruction: 3 periodsperweek* *Duration of SEE: 3 hours*
*CIE:30 marks* *SEE: 70marks*
*Credits: 3*
*Prerequisites: Digital Electronics(ES215EC)*
*Analog Communication (PC410EC)*

### Course Objectives:

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|---|
| 1. To understand concepts of switched communication networks and functions of each layer of OSI model for layered architecture and introduce TCP/IP suite of protocols. |
| 2. To understand performance of data link layer protocol for flow and error control. |
| 3. To understand different routing protocols, and various networked applications such as DNS, FTP, www architecture and network security. |

**Course Outcomes:**On successful completion of the course, the students will be able to

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|---|
| 1. study function of layers in OSI model and understand various network topologies. |
| 2. understand network layer protocols, IP addressing and internetworking. |
| 3. understand transport layer working with TCP, and UDP. |
| 4. understand functionality of application layer and its protocols |
| 5. understand the importance of network security principles. |

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| **UNIT-I** |
| **Introduction to Data communication:** A Communication Model, The Need for Protocol Architecture and Standardization, Network Types: LAN, WAN, MAN. Network Topologies: Bus, Star, Ring, Hybrid, Line configurations. Reference Models: OSI, TCP/IP. Transmission modes, DTE-DCE Interface, Transmission media- Guided media, Unguided media, Circuit Switching principles and concepts, Virtual circuit and Datagram subnets. |
| **UNIT-II** |
| **Data Link Layer**: Need for Data Link Control, Design issues, Framing, Error Detection and Correction, Flow control Protocols: Stop and Wait, Sliding Window, ARQ Protocols, HDLC. MAC Sub Layer: Multiple Access Protocols: ALOHA, CSMA, LAN- IEEE 802.2, 802.3, Wireless LAN- 802.11, 802.15, 802.16 standards. Bridges and Routers. |
| **UNIT-III** |
| **Network Layer**: Network layer Services, Routing algorithms: Shortest Path Routing, Flooding, Hierarchical routing, Broadcast, Multicast, Distance Vector Routing, and Congestion Control Algorithms. Internet Working: The Network Layer in Internet: IPV4, IPV6, Comparison of IPV4 and IPV6, IP Addressing. |
| **UNIT-IV** |
| **Transport Layer**: Transport Services, Elements of Transport Layer, Connection management, TCP and UDP protocols, ATM AAL Layer Protocol. |
| **UNIT-V** |
| **Application Layer**: Domain Name System, SNMP, Electronic Mail, World Wide Web.<br>**Network Security**: Cryptography Symmetric Key and Public Key algorithms, Digital Signatures, Authentication Protocols. |

**Suggested Reading:**


| | |
|---|---|
| 1. | Behrouz A. Forouzan, “Data Communication and Networking,”3/e, TMH, 2008. |
| 2. | William Stallings, “Data and Computer Communications,” 8/e, PHI, 2004. |
| 3. | Andrew S Tanenbaum, “Computer Networks,” 5/e, Pearson Education, 2011. |
| 4. | Douglas E Comer, “Computer Networks and Internet”, 5/e, Pearson Education Asia, 2009. |
| 5. | Prakash C. Gupta, “Data Communications and Computer Networks”, 2/e, PHI learning, 2013. |

## PROFESSIONALELECTIVE-I

# DIGITAL IMAGE AND VIDEO PROROCESSING

**PE501EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*
*Prerequisites: Digital Signal Processing(PC408EC)*

## Course Objectives:

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| 1. To provide an introduction to the basic concepts and methodologies for Digital Image and Video processing. |
| 2. To acquaint with spatial and transform domain techniques used in Image Enhancement and to gain knowledge about various Image compression and segmentation methods. |
| 3. To study applications of motion estimation in video processing. |

**Course Outcomes:** On successful completion of the course, the students will be able to

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|---|
| 1. develop a foundation that can be used as the basis for higher study and research in the Image and Video processing areas. |
| 2. design various filters for processing of images without destroying fine details like edges and lines. |
| 3. apply image processing techniques for processing and analysis of remotely sensed, Microscope, Radar and Medical images |
| 4. understand the requirement for various image and video compression algorithms. |
| 5. understand and analyze the performance of block matching algorithms in video coding standards. |

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| **UNIT – I** |
| **Fundamentals of Image Processing**: Basic steps in Image Processing, Sampling and Quantization of an image, Relationship between pixels. **Image Transforms**: 2D- Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform and Hoteling Transform. |
| **UNIT – II** |
| **Image Processing Techniques**: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. **Frequency domain methods:** Basics of filtering in frequency domain, Image smoothing, Image sharpening, Selective filtering. |
| **UNIT – III** |
| **Image Compression:** Functional Block diagram of a general image compression system, Various types of redundancies, Huffman coding, Arithmetic coding. **Segmentation:** Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region based segmentation. |
| **UNIT – IV** |
| **Basic concepts of Video Processing**: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image formation, sampling of video signals, filtering operations. |
| **UNIT – V** |

**2-D Motion Estimation**: Optical flow, Pixel Based Motion Estimation, Block Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based MotionEstimation, multi resolution motion estimation. Application of motion estimation in Video coding.

## Suggested Reading:


| |
|---|
| 1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson Education, 2009, 3rd edition. |
| 2. Yao Wang, Joern Ostermann, Ya-quin Zhang, ‘Video processing and Communication’, 1st edition, Prentice Hall International. |
| 3. Vipul Singh, 'Digital Image Processing with MATLAB and Lab view', Elsevier 2013. |
| 4. Anil K Jain, 'Fundamentals of Digital Image Processing', Prentice-Hall of India Private Limited, New Delhi, 1995. |
| 5. M. Tekalp,‘Digital Video Processing’, Prentice Hall International,1995. |

# ADVANCED MICROCONTROLLERS

**PE502EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*
*Prerequisites: Microprocessor & Microcontroller (PC409EC)*

## Course Objectives:

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| *1.* To describe industry standard ARM microcontroller architecture. |
| *2.* To explain ability of programming ARM using Assembly language and Embedded C. |
| *3.* To discuss the Bus Architecture of ARM microcontroller. |

**Course Outcomes:** On successful completion of the course, the students will be able to

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|---|
| 1. illustrate the basic architecture of ARM. |
| 2. analyse the instruction set of ARM and thumb instructions. |
| 3. understand basic Embedded C concepts and multitasking. |
| 4. program and interface the ARM with peripheral devices using Assembly Language and C. |
| 5. understand the advance microprocessor bus architecture (AMBA). |

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| **UNIT – I** |
| **Introduction:**<br>Introduction to advanced microcontrollers, Difference between RISC and CISC architectures, Endianness (Little and Big), Design philosophy of RISC and ARM architectures. History of ARM microprocessor, ARM processor family, Development of ARM architecture.<br>**The ARM Architecture and Programmers' Model:**<br>The Acorn RISC Machine, ARM core data flow model, architectural inheritance, The ARM7 TDMI programmer's model: General purpose registers, CPSR, SPSR, ARM memory map, data format, load and store architecture, Core extensions, Architecture revisions, ARM development tools. |
| **UNIT – II** |
| **ARM Instruction Set:** Data processing instructions, Arithmetic and logical instructions, Rotate and barrel shifter, Branch instructions, Load and store instructions, Software interrupt instructions, Program status register instructions, Conditional execution, Multiple register load and store instructions, Stack instructions, Thumb instruction set, advantage of thumb instructions, Assembler rules and directives. |
| **UNIT – III** |
| **Basics of Embedded C :** Overview of C compiler and optimization, Basic data types, Looping and branching, Register allocations, function calls, pointer aliasing, structure arrangement, bit fields, unaligned data, Division, floating point, Inline functions and inline assembly, Portability issues, Multitasking. |
| **UNIT – IV** |

**Assembly and C Programming for ARM:** Assembly language programs for shifting of data, factorial calculation, swapping register contents, moving values between integer and floating point registers.
C programs for General purpose I/O, general purpose timer, PWM Modulator, UART, I2C Interface, SPI Interface, ADC, DAC.

| UNIT – V |
|---|
| **Advanced Microprocessor Bus Architecture (AMBA):** Advanced Microprocessor Bus Architecture (AMBA), AMBA Bus System, User peripherals, Exception handling in ARM, and ARM optimization techniques. |

## Suggested Reading:



| | |
|---|---|
| 1. | Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide: Designing & Optimizing System Software", Elsevier, 2004. |
| 2. | Muhammad Ali Mazidi, "ARM Assembly Language Programming & Architecture", Kindle Edition, 2013. |
| 3. | William Hohl, Christopher Hinds, "Arm Assembly Language: Fundamentals and Techniques", 2nd Edition, CRC Press, 2014. |
| 4. | Michael J. Pont, "Embedded C", Pearson Education India, 1st Edition, 2007. |
| 5. | Dr.Yifeng Zhu, "Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C", E-Man Press LLC, 3rd Edition, 2017. |

# PYTHON PROGRAMMING AND APPLICATIONS

PE503EC
*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*
*Prerequisites: Network Theory (PC402C), Signals and Systems(PC405EC)*

Course Objectives:

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| 1. To acquire programming skills by learning Syntax, Semantics and Regular expressions in core Python. |
| 2. To analyse electronic circuits and examine the various signal transformation techniques using Python |
| 3. To build IoT solutions using MicroPython running on small, dedicated microcontroller boards |

**Course Outcomes:** On successful completion of the course, the students will be able to

| |
|---|
| 1. build basic programs using fundamental programming constructs like variables, conditional logic, looping, and functions |
| 2. examine Python syntax and semantics and be fluent in the use of Python flow control and functions. |
| 3. create, run and manipulate Python Programs using core data structures like Lists, dictionaries and use Regular Expressions |
| 4. develop programs in Python for implementation of non-linear circuits and analyze filters. |
| 5. program their own IoT solutions in Python using MicroPython on small microcontroller boards. |

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| **UNIT-I** |
| **Introduction to Python**: History of Python, Need of Python programming, Features of python, Python basics: Tokens, working with data types and variables, working with numeric data,working with string data, Python functions, Boolean expressions, selection structure, iteration structure<br>**Functions:** default values of arguments, named arguments, local and global variables,<br>**Modules**: creating, documenting and Importing modules, Use of standard modules. |
| **UNIT-II** |
| **Lists:**basic lists,creating and processing list of lists, Tuples, Dictionaries<br>**Data structures**: Implementation of stacks and sets, binary search trees, Graph searching, working on sequences- reversing, permuting, sorting, Data Visualization: Different types ofcharts and graphs, selection of correct data visualization elements, software and tools availablefor data visualization. |
| **Unit-III** |
| **Python Installation and Packages**: Introduction to PIP, installing and uninstalling packages via PIP, Using python Packages: Numpy, Matplotlib, Scipy.<br>**Circuit analysis**: Operations on vectors and matrices, Circuit representation, processing of components, Data structures of components, Introduction to Nodes, Branches and Loops, Loop and Nodal analysis.<br>**Case study**: Model circuits and perform nodal analysis and loop analysis using **Lcapy(**open-source) Python package for solving linear circuits using matrix operations. |
| **Unit- IV** |
| **Signal Analysis:** Representation Continuous time signals, Discrete time signals, Python Implementation of sampling, Fourier Transform, Laplace transform, Z-transform, Discrete |

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| Fourier Transform, Fast Fourier transform, Design of LTI filters, FIR filters and IIR filters using Python<br>**Case study:** Cleaning Up Data Noise with Fourier Transform using Python |
| **Unit-V** |
| **MicroPython :** Introduction, Installing and running MicroPython, **Pyboard**- Architectural overview and Networking, hardware features of BBCmicro:bit, Overview of MicroPython libraries<br>**Case study:** Traffic light simulation using MicroPython |

## Suggested Reading:


| | |
|---|---|
| 1. | Michael Urban and Joel Murach, "Python Programming", Mike Murach& Associates, Incorporated, 2016. |
| 2. | Kalilur Rahman, "Python Data Visualization Essentials Guide", BPB publications,2021. |
| 3. | Shivkumar V. Iyer , " Simulating Nonlinear Circuits with Python Power Electronics-An Open-Source Simulator, Based on Python, Springer International Publishing, 2018. |
| 4. | Thomas Haslwanter, "Hands-on Signal Analysis with Python: An Introduction",Springer International Publishing, 2021. |
| 5. | *Charles Bell, "MicroPython for the Internet of Things A Beginner's Guide to Programming with Python on Microcontrollers", Apress, 2017* |

# NEURAL NETWORKS

**PE501EC**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*
*Prerequisites:Probability Theory and Stochastic Processes (ES304ES)*

## Course Objectives:

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|---|
| 1. To understand the functioning of biological neuron and its electronic implementation using different neuron models |
| 2. To acquire knowledge on learning algorithms, architecture of deep learning, CNN and transfer learning. |
| 3. To implement simple neural network using python programming. |

**Course Outcomes:** On successful completion of the course, the students will be able to

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|---|
| 1. differentiate between biological neuron & artificial neuron and different neuron models |
| 2. apply learning algorithms and different feed forward neural networks |
| 3. understand deep learning concepts and its architectures. |
| 4. learn concepts of CNN and transfer learning techniques. |
| 5. develop programs in Python for implementation of neural networks models |

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| **UNIT – I** |
| **Introduction to Neural Networks**: Description of Biological Neuron, Mathematical model of Artificial Neural Network, Classification of Neural Networks, Different Neuron models: McCulloch-Pitts Neuron model, Perceptron Neuron model and ADALINE Neuron model, Basic learning laws. |
| **UNIT – II** |
| **Neural Networks Algorithms:** Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient decent, Curse of Dimensionality. |
| **UNIT – III** |
| **Introduction to Deep Learning & Architectures**: Machine Learning Vs. Deep Learning, Representation Learning, Width Vs. Depth of Neural Networks, Activation Functions: Sigmoid, RELU, LRELU, ERELU, Tanh. Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Autoencoders. |
| **UNIT – IV** |
| **Convolution Neural Networks**: Architectural Overview – Motivation - Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet . Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet. |
| **UNIT – V** |
| **Python programming**: Python basics, Arrays and array operations, Functions and Files, Simple implementation of Artificial Neural Network, Classification with Multilayer Perceptron using Scikit-learn (MNIST Dataset). |

**Suggested Reading:**


| | |
|---|---|
| 1. | B. Yeganaranarana, "Artificial Neural Networks", Eleventh EditionPrentice Hall, New Delhi, 2007. |
| 2. | Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2017. |
| 3. | Subir Varma and Sanjiv Das," Deep Learning" , 1st Edition, Published by Bookdown , 2018. |
| *4.* | *Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.* |
| 5. | Ahmed Gad and Fatima Jarmouni, "Introduction to Deep Learning and Neural Networks with Python," A Practical Guide by Elsevier 1st Edition, 2020. |

**PROFESSIONALELECTIVE-II**

# FPGA Architectures

PE505EC

*Instruction:3periodsperweek* *Duration of SEE:3 hours*
*CIE:30marks* *SEE:70 marks*
*Credits: 3*
*Prerequisites: Digital Electronics (ES303EC)*

## Objectives:

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|---|
| 1. To discuss about Application Specific IC(ASIC)fundamentals and FPGA |
| 2. To describe the power consumption in IC design |
| 3. To discuss about the interconnection, placement and routing, verification and testing schemes. |

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

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|---|
| 1. understandthedesignflowofASICsandidentifytheimplementationtoolsrequiredforsimulationandsynthesisof FPGA Design. |
| 2. demonstrate the architecture of FPGAs. |
| 3. Explain the physical design of FPGAs and CAD tools for low level design entry. |
| 4. Identify the placement & routing algorithms. |
| 5. Validate the digital design and analyse the general design issues. |

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| **UNIT– I** |
| **Introduction to ASICs:**TypesofASICs,ASICdesignflow,EconomiesofASIC's,Programmable ASICs: CPLD and FPGA. Commercially available CPLDs and FPGAs: XILINX,ALTERA,ACTEL.FPGADesigncycle,Implementationtools:Simulationandsynthesis,Programmingtechnologies.Applicationsof FPGAs. |
| **UNIT– II** |
| FPGA logic cell for XILINX, ALTERA and ACTEL ACT, Technology trends, Programmable I/Oblocks,FPGA interconnect: Routing resources, Elmore's constant, RC delay and parasitic capacitance, FPGA design flow, Dedicated specialized components of FPGAs. |
| **UNIT– III** |
| FPGA physical design, CAD tools, Power dissipation, FPGA Partitioning, Partitioning methods. Floor planning:I/O,Power and clock planning, Low-level design entry. |
| **UNIT– IV** |
| **Placement and Routing:** Placement algorithms: Min-cut based placement,Iterative Improvement and simulated annealing.<br>Routing: introduction,Global routing:Global routing methods, Back-annotation. Detailed Routing: Channel density, Segmented channel routing,Mazerouting,Clock and power routing,Circuit extraction and DRC. |

| UNIT– V |
|---|
| **Verification and Testing:** Verification: Logic simulation, Design validation, Timing verification.Testing concepts: Failures, mechanism and faults, and fault coverage. Design Applications: General Design issues, Counter Examples, Case study of adders and accumulator architectures with XilinxVivadotool. |

**Suggested Reading:**


| | |
|---|---|
| 1 | Michael John Sebastian Smith, “Application Specific Integrated Circuits”, PearsonEducationAsia,3rd edition, 2001. |
| 2 | Pak and Chan, Samiha Mourad, “Digital Design using Field Programmable Gate Arrays”,PearsonEducation,1st edition, 2009 |
| 3 | S.Trimberger,Edr, “FieldProgrammableGateArrayTechnology”,KluwerAcademicPublications,1994. |
| 4 | John V. Oldfield, Richard C Dore, “Field Programmable Gate Arrays”, WileyPublications. |
| 5 | CliveMaxfield, “TheDesignWarrior’sGuidetoFPGAs‟,Elsevier,2004. |

## ADVANCED DIGITAL SIGNAL PROCESSING

PE506EC

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*
*Prerequisites: Digital Signal Processing (PC408EC)*

### Course Objectives:

| | |
|---|---|
| 1. | To comprehend characteristics of discrete time signals and systems |
| 2. | To analyze signals using various transform techniques |
| 3. | To identify various factors involved in design of digital filters |

**Course Outcomes:** On successful completion of the course, the students will be able to

| | |
|---|---|
| *1.* | design FIR and IIR filters structure for different applications |
| *2.* | design FIR and IIR type digital filters with error analysis |
| *3.* | interpret various DSP algorithms for arithmetic operations |
| *4.* | identify filter structures and evaluate the coefficient quantization effects |
| *5.* | estimate power spectrum of signals using different methods |

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| **UNIT – I** |
| **Digital Filter Structures:**FIR filters - Direct form, Cascade form, Frequency sampling, Lattice IIR filter - Direct form I, Direct form II, Cascade form, Parallel form Lattice & Lattice loader, Quantization of filter coefficients - Sensitivity to Quantization of filter coefficients,Quantization of coefficients in FIR filters, Round off effects in digital filters - Limit cycle, scaling to prevent overflow. |
| **UNIT – II** |
| **Digital Filter Design:**Linear phase FIR filter, characteristic response, location of zeros, Design of FIR filter - Windowing, Frequency sampling, Design of IIR filters from Analog filters - Impulse invariance, Bilinear transformation, Matched z-transform. Spectral transformations of IIR filters – FIR filter design –based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least –square design of FIR digital filters. |
| **UNIT – III** |
| **DSP Algorithm Implementation:** Computation of the discrete Fourier transform, Number representation, arithmetic operations, handling of overflow, tunable digital filters, function approximation. |
| **UNIT – IV** |
| **Analysis of Finite Word Length Effects:** The Quantization process and errors, Quantization of fixed–point and floating–point Numbers, Analysis of coefficient Quantization effects, Analysis of Arithmetic Round-off errors, Dynamic range scaling, signal-to-noise in Low-order IIR filters, Low-Sensitivity Digital filter, Reduction of Product round-off errors feedback, Limit cycles in IIR digital filter, Round-off errors in FFT Algorithms. |
| **UNIT – V** |
| **Power Spectrum Estimation:** Estimation of spectra from finite duration observation signals, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey |

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| methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods. Parametric Method of Power Spectrum Estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models. |

**Suggested Reading:**

| | |
|---|---|
| 1 | John G.Proakisand DimitrisG. Manolakis, "Digital Signal Processing-Principles,Algorithms and Applications", PHI, 3rdedition, 2002. |
| 2 | AlanV.Oppenheim and Ronald W.Schafer , "DiscreteTimeSignalProcessing" 3rdEdition, PHIPublications. |
| 3 | Glenn Zelniker,Fred J. Taylor, "AdvancedDigitalSignalProcessing-TheoryandApplications", CRC Press. |
| 4 | Li Tan, "Digital Signal Processing-Fundamentals and Applications", Academic Press Publications. |
| 5 | nanuel C. Ifeacher, Barrie. W. Jervis, "DSP – A Practical Approach", 2ndedition, Pearson Education. |

# CMOS ANALOG IC DESIGN

## PE507EC

*Instruction: 3 periods per week* *Duration of SEE:- 3hours*
*CIE: 30 marks* *SEE:- 70 Marks*
*Credits: 3*
*Prerequisites: VLSI Design (PC414EC)*

## Course Objectives:

| | |
|---|---|
| 1. | To develop models of basic CMOS amplifiers and Learn the concepts of advanced current mirrors. |
| 2. | To design and analyse differential amplifier and two-stage operational amplifier. |
| 3. | To study the Bandgap Reference circuits. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| | |
|---|---|
| *1.* | describe the small signal model of MOSFET and analyse the Single Stage Amplifiers. |
| *2.* | analyse the differential amplifiers with MOS Loads and Current mirror loads. |
| *3.* | analyse the frequency response of amplifiers. |
| *4.* | design a fully compensated opamp and analyse the frequency response of the opamp. |
| *5.* | analyse the bandgap reference circuits. |

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| **UNIT I** |
| **Basic MOS device Physics:** MOS FET device I/V characteristics, second order effects, MOS device Capacitances, MOS small signal Model, NMOS verses PMOS devices.<br>**Single stage amplifiers:** Common source stage with resistive load, diode connected load, triode load, current source load, CS stage with source degeneration, source follower, Common Gate stage, Gain boosting techniques, Cascode, folded cascode, choice of device models. |
| **UNIT –II** |
| **Differential amplifiers:** Single ended and differential operation, Basic differential pair, Common mode response, Differential amplifier with MOS loads, Gilbert cell.<br>**Passive and Active Current mirrors:** Basic Current mirrors, Cascode Current mirrors, Active Current mirrors, Wilson and Widlar current mirrors |
| **UNIT- III** |
| **Frequency Response of Amplifiers:** General Considerations, Common-Source Stage, Source Followers, Common–Gate Stage, Cascode Stage, Differential Pair. |
| **UNIT – IV** |
| **Operational Amplifiers:** General Considerations, One stage Op-amp, 2- stage OP amp, Gain Boosting, Common mode feedback, Phase Margin, Frequency compensation. |
| **UNIT –V** |
| **Band Gap References:** General considerations, Supply independent biasing, temperature-independent references, negative-TC voltage, positive TC voltage, Bandgap reference, PTAT current generation. |

Suggested Reading:


| | |
|---|---|
| 1. | Behzad Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw Hill. 2002 |
| 2. | Jacob Baker.R.et.al., CMOS Circuit Design, IEEE Press, Prentice Hall, India, 2000 |
| 3. | David Johns, Ken Martin, Analog Integrated Circuit Design, John Wiley & sons. 2004 |
| 4. | Philip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, International Second Edition/Indian Edition, 2010. |
| 5. | Paul.R. Gray & Robert G. Major, Analysis and Design of Analog Integrated Circuits, John Wiley & sons. 2004 |

## IoT SYSTEM DESIGN AND APPLICATIONS

**PE508EC**

*Instruction: 3periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*
*Prerequisites:MicroProcessor and MicroController(PC409EC)*

### Course Objectives:

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|---|
| 1. To discuss fundamentals of IoT and its applications and requisite infrastructure. |
| 2. To describe Internet principles and architecture and applications relevant to IoT. |
| 3. To discuss private and security aspects of IoT system. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| |
|---|
| 1. understand IoT technology and research directions. |
| 2. comprehend various protocols and architecture of IoT |
| 3. design simple IoT systems with IoT reference model |
| 4. understand the various applications of IoT |
| 5. comprehend the different privacy and security approaches at IoT. |

| |
|---|
| **UNIT – I** |
| **IoT & Web Technology**The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics. |
| **UNIT – II** |
| **M2M to IoT** – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. |
| **UNIT – III** |
| **IoT Architecture** -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. |
| **UNIT – IV** |
| **IoT Applications:** Introduction, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi - Controlling LED and LDR using Pi, Opinions on IoT Application and Value for Industry, Home Management, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and eHealth. |
| **UNIT – V** |
| **Internet of Things Privacy:** Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security |

**Suggested Reading:**


| | |
|---|---|
| 1 | Vijay Madisetti and ArshdeepBahga, 'Internet of Things (A Hands-on-Approach)',1st edition, VPT, 2014. |
| 2 | Francis daCosta, 'Rethinking the Internet of Things: A Scalable Approach to Connecting Everything', 1st edition, Apress Publications, 2013. |
| 3 | Cuno Pfister, 'Getting Started with the Internet of Things', O"Reilly Media, 2011. |
| 4 | Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley India Publishers,2014. |
| 5 | Vermesan, Ovidiu and Peter Friess, eds. Internet of things: converging technologies for smart environments and integrated ecosystems. River publishers, 2013. |

# OPEN ELECTIVE-1

# PRINCIPLES OF ELECTRONIC COMMUNICATION

OE601EC

*Instruction:3periodsperweek* *Duration of SEE:3 hours*
*CIE:30marksSEE:70 marks*
*Credits: 3*

## Course Objectives:

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|---|
| 1. To provide an introduction to fundamental concepts in the understanding of communications systems. |
| 2.To describe the network model and some of the network layers including physical layer, data link layer ,network layer and transport layer. |
| 3.To discuss the evolution of wireless systems and current wireless technologies. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| |
|---|
| 1.understandthe working of analog and digital communication systems. |
| 2.explain the OSI network model and the working of data transmission. |
| 3.describe the evolution of communication technologies from traditional telephony systems to modern wireless communication systems. |
| 4.differentiate between analog and digital modulation techniques |
| 5.understand the optical fiber communication link, structure, propagation and transmission properties. |

| |
|---|
| **UNIT– I** |
| Introduction to Communication Systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.<br>Signal Transmission Concepts: Baseband transmission and Broadband transmission, Communication Parameters: Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation: Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation. |
| **UNIT– II** |
| Analog and Digital Communications: Amplitude modulation and demodulation, FMmodulation and demodulation, Digital converters, Digital modulation schemes– ASK,FSK,PSK,QPSK, Digital demodulation. |
| **UNIT– III** |
| Data Communication and Networking: Network Models, OSI Model, Data Link Layer–Media Access control, Ethernet, Network Layer–Internet Protocol(IPv4/IPv6),Transport Layer–TCP,UDP. |
| **UNIT-IV** |
| Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.<br>Optical Communications: Optical Principles, Optical Communication Systems, Fiber–Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing. |
| **UNIT-V** |
| Wireless Communications: Evolution of Wireless Systems: AMPS,GSM,CDMA,WCDMA,OFDM.Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks,Vehicular adhoc networks. |

## Suggested Reading:



| | |
|---|---|
| 1 | LouisE.Frenzel, "PrinciplesofElectronicCommunicationSystems",3rd edition,McGrawHill,2008. |
| 2 | BehrouzA. Forouzan, "DataCommunicationsandNetworking",5th edition,TMH,2012. |
| 3 | George Kennedy, Bernard Davis, "ElectronicCommunicationsystems",4th edition,McGrawHill,1999. |
| 4 | RappaportT.S.,"Wirelesscommunications",2nd edition,PearsonEducation,2010. |
| 5 | Wayne Tomasi, "Advanced Electronic Communications Systems", 6th edition, Pearson Education. |

# DIGITAL SYSTEM DESIGN USING VERILOG HDL

**OE602EC**

*Instruction:3periods perweek* *Duration of SEE: 3*
*hoursCIE:30 marks* *SEE:70marks*
*Credits:3*

## Course Objectives:

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|---|
| 1.To familiarize with various modeling styles: structural, dataflow and behavioral of Verilog HDL. |
| 2.To develop combinational and sequential circuits using various modeling styles of Verilog HDL. |
| 3.To review the implementation of Verilog HDL Modeling using real time examples. |

**Course Outcomes:**On successful completion of the course, the students will be able to

| |
|---|
| 1.implement and distinguish different Verilog HDL modeling styles |
| 2.construct and analyze Verilog HDL models of combinational and sequential circuits. |
| 3.design and develop Verilog HDL modeling and test bench for digital systems for the given specifications. |
| 4.outline FPGA design flow and timing analysis. |
| 5.understandtherealworlddesignexamples such as UART, timers, and CPUs. |

| |
|---|
| **UNIT-I** |
| Structural modeling:Overview of Digital Design with Verilog HDL,Basic concepts,modules and ports, gate-level modeling, hazards and design examples. |
| **UNIT-II** |
| Data flow and Switch level modeling: data flow modeling, operands and operators.Switch Level Modeling:CMOS switches and bidirectional switches and design examples. |
| **UNIT-III** |
| Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls,Conditional Statements,multi-way branching,Loops,Sequential and Parallel blocks, Generate blocks. Combinational, sequential logic modules and design examples. |
| **UNIT-IV** |
| Synthesis and Verification: Tasks and Functions: Differences between Tasks and Functions. Verilog HDL synthesis, Application Specific IC (ASIC) and Field Programmable Gate Array(FPGA)designflow.Verification:TiminganalysisandTestbenchdesign.Designexamples. |
| **UNIT-V** |
| Real time implementations: Fixed-Point Arithmetic modules:Addition, Multiplication, Division, Arithmetic and Logic Unit (ALU), Timer, Universal Asynchronous Receiver and Transmitter(UART),CPU design: Datapath and control units. |

Suggested Reading:


| | |
|---|---|
| 1. | SameerPalnitkar, "Verilog HDL AGuide to Digital Design and Synthesis", 2nd edition,Pearson Education,2006. |
| 2. | Ming-BoLin,"DigitalSystemDesignsandPractices:UsingVerilogHDLandFPGA",WileyIndiaedition,2008. |
| 3. | J. Bhasker, AVerilogHDLPrimer,2nd edition, BSPublications, 2001. |
| 4. | CharlesRoth,Lizy.K.John,ByeongKilLee,-Digital SystemsDesignUsingVerilog,1st edition,CengageLearning, 2015. |
| 5. | T.R.Padmanabhan,B.BalaTripuraSundari, "DesignthroughVerilogHDL" ,Studentedition,Wiley Publishers,2008. |

# COMMUNICATION SYSTEMS LAB

**PC458EC**

*Instruction:2periodsperweek* *Duration of SEE:3 hours*
*CIE:25marks* *SEE:50 marks*
*Credits:1*

## Course Objectives:

| |
|---|
| 1.To demonstrate AM, FM, Mixer, PAM, PWM, PPM and multiplexing techniques. |
| 2.To understand and simulate digital modulation (i.e., ASK, FSK, BPSK, QPSK) generation. |
| 3.To model analog, pulse modulation, PCM, Delta and Digital modulation techniques using CAD tools. |

**Course Outcomes:**On successful completion of the course, the students will be able to

| |
|---|
| 1.understand and simulate modulation and demodulation of AM and FM. |
| 2.construct and understand the need for pre-emphasis and de-emphasis at the transmitter and receiver respectively. |
| 3.simulate the PAM, PWM & PPM circuits. |
| 4.understand generation and detection of baseband transmission (i.e., PCM, DM, and ADM) and bandpass transmission (i.e., ASK,FSK,PSK, MSK and QPSK) |
| 5.understand the error control coding. |

## List of Experiments

### PART-A

**Analog Communication**

1. Amplitude Modulation and Demodulation.
2. Frequency Modulation and Demodulation.
3. Pre-emphasis and De-emphasis and plot the frequency response.
4. Multiplexing Techniques (FDM and TDM).
5. Mixer Characteristics and plot the frequency response.
6. Verification of Sampling Theorem.
7. PWM, PPM generation and detection.
8. Generation and Detection of AM, FM, PAM, PWM, PPM modulation techniques using MATLAB/Simulink/Lab-view.

### PART-B

**Digital Communication**

1. PCM modulation and demodulation.
2. Channel encoding and decoding.
3. Linear and Adaptive Delta Modulation and Demodulation.
4. ASK generation and Detection.
5. FSK and Minimum Shift Keying generation and Detection.
6. ASK generation and Detection.
7. Generation and Detection of PCM, Delta modulation and Digital modulation schemes (ASK, FSK, BPSK, QPSK) by using MATLAB/Simulink/Lab-view.

NOTE:

1. At least ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and 5 from Part B is compulsory.

## DIGITAL INTEGRATED CIRCUITS DESIGN LAB

**PC459EC**

*Instruction: 2 periods per week* *Duration of SEE:- 3hours*
*CIE: 25 marks* *SEE:- 50 Marks*
*Credits: 1*

### Course Objectives:

| | |
|---|---|
| 1. | To develop verilog HDL code for digital circuits using gate level, data flow and behavioral, modeling and Verify the design block using stimulus. |
| 2. | To study the VLSI CAD tools. |
| 3. | To implement transistor level circuits. |

**Course Outcomes:** On successful completion of the course, the students will be able to

| |
|---|
| *1.write the Verilog HDL programs in gate level and data flow modeling.* |
| *2.implement combinational and sequential circuits using Verilog.* |
| *3.analyse digital circuits using VLSI CAD tools like Mentor Graphics / Cadence* |
| *4.design CMOS circuits like basic gates, adders at the transistor level* |
| *5. implement the layout of simple CMOS circuits like inverter and basic gates.* |

### List of Experiments:

### Part-A

Write the Code using Verilog and simulate the following:

1. Write structural and dataflow Verilog HDL models for
a) 4-bit ripple carry adder.
b) 4-bit carry Adder – cum Subtractor.
c) 2-digit BCD adder / subtractor.
d) 4-bit carry look ahead adder
e) 4-bit comparator

2. Write a Verilog HDL program in behavioral model for
a) 8:1 multiplexer
b) 3:8 decoder
c) 8:3 encoder
d) 8 bit parity generator and checker

3. Write a Verilog HDL program in Hierarchical structural model for
a) 16:1 multiplexer realization using 4:1 multiplexer
b) 3:8 decoder realization through 2:4 decoder
c) 8-bit comparator using 4-bit comparators and additional logic

4. Write a Verilog HDL program in behavioral model for D,T and JK flip flops, shift registers and counters.

5. Write a Verilog HDL program in structural and behavioral models for
a) 8 bit asynchronous up-down counter b) 8 bit synchronous up-down counter

6.Write a Verilog HDL program for 4 bit sequence detector through Moore state machines
7.Write a Verilog HDL program for 4 bit sequence detector through Mealy state machines

**PART-B**

Transistor Level implementation of CMOS circuits using VLSI CAD tool

1. Basic Logic Gates: Inverter, NAND and NOR
2. Half Adder and Full Adder
3. 2:1 Multiplexer and 4:1 Multiplexer using 2:1 Multiplexer
4. one bit comparator and four-bit magnitude comparator using one bit comparator
5. Implement the Layout of CMOS Inverter.
6. Implement the Layout of CMOS NAND.

Note:

2. A total of 10 experiments must be completed in the semester.
3. Minimum of 5 experiments from Part-A and 5 from Part-B is compulsory.

## DATA COMMUNICATION AND COMPUTER NETWORKSLAB

PC460EC

*Instruction:2periodsperweek* *Duration ofSEE: 3hours*
*CIE:25marks* *SEE:50marks*
*Credits: 1*

Objectives:

| |
|---|
| 1. To understand a conceptual foundation for the study of data communications using the open Systems interconnect (OSI) model for layered architecture. |
| 2. To understand the performance of data link layer protocol HDLC. |
| 3. To understand network layer routing protocols and algorithms. |

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

| |
|---|
| 1.understand the working of various network topologies in circuit and packet switching. |
| 2. implement HDLC protocol and significance of MAC protocols. |
| 3. understand the network routing protocols and the associated algorithms. |
| 4. understand the transport layer working with TCP, and UDP. |
| 5. implement network scenario and obtain its performance evaluation. |

List of Experiments:

**PART-A**

Design and implement the following experiments using C Compiler and packet tracer software

1. Study of network devices in detail.
2. A HDLC frame to perform the following.
   i.Bit stuffing
   ii.Character stuffing.
3. Distance vector algorithm and find path for transmission.
4. Dijkstra's algorithm to compute the shortest routing path.
5. Simulation of network topologies.
6. Configuration of a network using different routing protocols.

PARTB

**Simulation using NS2/ NS3/ NCTUNS/ NetSim or any other equivalent tool in Linux OS.**

1. Point to point network with four nodes and duplex links between them. Analyse the network performance by setting the queue size and varying the bandwidth.
2. Four node point to point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent byTCP/UDP.
3. Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.
4. Implement Ethernet LAN using n nodes and assignment of multiple traffic to obtain congestion window for different sources/destinations.
5. ESS with transmission nodes in Wireless LAN and study of performance parameters.
6. Implementation of Link state routing algorithm.

NOTE:

1. At least ten experiments to be conducted in the semester.

2. Minimum of 5 from Part A and 5 from Part B is compulsory.

## SUMMER INTERNSHIP

**PW702EC**

*Instruction: NA* *Duration of SEE: NA*
*CIE: 50 marks* *SEE: NA*
*Credits : 2*

### Course Objectives:

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|---|---|
| 1. | To enhance practical and professional skills. |
| 2. | To provide training in soft skills and also train them in presenting seminars and technical report writing. |
| 3. | To expose the students to industry practices and team work |

**Course Outcomes:** On successful completion of the course, the students will be able to

| | |
|---|---|
| 1. | acquirepractical experience of software design and development, and coding practices within Industrial/R&D Environments. |
| 2. | understand working practices within Industrial/R&D Environments |
| 3. | prepare reports and deliver effective presentation. |
| 4. | demonstrate effective written and oral communication skills |
| 5. | innovate in various engineering disciplines and nurture their entrepreneurial ideas. |

Summer Internship is introduced as part of the curriculum for encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organisations/Computer Industry/Software Companies/R&D Organization for a period of 4 to 6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).
The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship
- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:
1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Award of internal marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co-ordinate theoverall activity of Industry Attachment Program.

**Note:** Students have to undergo summer internship of 4 to 6 weeks at the end of semester VI andcredits will be awarded after evaluation in VII semester.