

## COURSE OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge in solving circuits using network theorems.
- To introduce the phenomenon of resonance in coupled circuits.
- To analyze the transient response of circuits.
- To know the concepts of duality.

|               |                                |          |
|---------------|--------------------------------|----------|
| <b>UNIT I</b> | <b>BASIC CIRCUITS ANALYSIS</b> | <b>9</b> |
|---------------|--------------------------------|----------|

Ohm's Law – Kirchhoff's laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits – Phasor Diagram – Power, Power Factor and Energy.

---

**UNIT II      NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS** **9**

Network reduction: voltage and current division, source transformation – star delta conversion - Thevenin and Norton Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

## UNIT III      RESONANCE AND COUPLED CIRCUITS      9

**Series and parallel resonance** – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits – Double tuned circuits.

## UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS 9

Transient response of RL, RC, RLC circuits using Laplace transform for DC input and A.C. with sinusoidal input – Characterization of two port networks in terms of Z, Y, h and ABCD parameters.

## UNIT V CONCEPTS OF DUALITY 9

Concept of duality, Dual network, Graphs of a network, Trees, twig, link and branches, Incidence matrix, Tieset matrix and cutset matrix of a graph, Inverse networks and equalizers - Applications.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES

At the end of this course, the students will be able to

- analyze electrical circuits
- apply circuit theorems
- analyze AC and DC Circuits
- design resonance circuits
- understand the concepts of Duality

## TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6<sup>th</sup> edition, New Delhi, 2003.
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi, 2001.
3. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2007.

## REFERENCES

1. M Russell, Mersereau and Joel R. Jackson, "Circuit Analysis- A System Approach", Pearson Education, 2007.
2. Chakrabati A, "Circuits Theory (Analysis and synthesis)", Dhanpath Rai & Sons, New Delhi, 1999.
3. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2003.
4. Robert L. Boylestad, "Experiments in Circuit Analysis to Accompany Introductory Circuit Analysis", Prentice Hall, 2000.

## WEB LINKS

1. <http://www.electronics-tutorials.ws/>
2. [www.electrical4u.com](http://www.electrical4u.com)
3. <http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/esc102/index.html>
4. [http://www.tina.com/1200\\_problems\\_and\\_examples](http://www.tina.com/1200_problems_and_examples)
5. [www.circuits-magic.com](http://www.circuits-magic.com)
6. [www.zen22142.zen.co.uk](http://www.zen22142.zen.co.uk)

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Programme Outcomes(POs)                                                                                                     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO                                                                                                                          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO2                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO3                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO4                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO5                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |



**COURSE OBJECTIVES**

- To learn the basics of diode and rectifiers
- To study the basics and characteristics of BJT
- To understand the basics and characteristics of FET
- To know the basics of special semiconductor devices, power devices and display devices
- To be familiar with the theory, construction, and operation of Basic electronic devices.

**UNIT I SEMICONDUCTOR DIODE 9**

PN junction diode, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Switching Characteristics. Clipping & Clamping Circuits – Voltage multipliers using diodes- Half wave and full wave rectifier.

**UNIT II BIPOLAR JUNCTION 9**

NPN -PNP -Junctions-Early effect-Current equations – Input and Output characteristics of CE, CB CC-Hybrid - $\pi$  model - h-parameter model, Ebers Moll Model- Multi Emitter Transistor.

**UNIT III FIELD EFFECT TRANSISTORS 9**

JFETs – Drain and Transfer characteristics, -Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Current equation - Equivalent circuit model and its parameters, FINFET, DUAL GATE MOSFET.

**UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9**

Metal-Semiconductor Junction- MESFET, Schottky barrier diode-Zener diode- PIN Diode- Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

**UNIT V POWER DEVICES AND DISPLAY DEVICES 9**

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS - LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

At the end of this course, the students will be able to

- gain knowledge in the theory, construction, and operation of semiconductor diode
- understand the basics and characteristics of BJT
- know the basics and characteristics of FET
- be familiar with the concepts of special semiconductor devices, power devices and display devices.
- use the basic electronic devices

## TEXT BOOKS

1. J Millman, C. Halkias & Satyabrata JIT "Electronic Devices and Circuits", Tata McGraw-Hill, 2007.
2. Donald A Neaman, "Semiconductor Physics and Devices", Third Edition, Tata McGrawHill Inc. 2007.
3. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Education 2006.

## REFERENCES

1. Christo Papadopoulos, "Solid State Electronic Devices", Springer-Verlag, New York, 2014
2. Thomas L. Floyd, "Electronic Devices", Merrill, 1992
3. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.
4. David A. Bell, "Electronic Devices and Circuits", Prentice Hall, 1986

## WEB LINKS

1. [www.electronics-tutorials.ws/](http://www.electronics-tutorials.ws/)
2. <http://www.radio-electronics.com>
3. [www.allaboutcircuits.com](http://www.allaboutcircuits.com)
4. <http://textofvideo.nptel.iitm.ac.in/122106025/>
5. [www.electronicsforu.com](http://www.electronicsforu.com)
6. [www.chegg.com](http://www.chegg.com)

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Programme Outcomes(POs)                                                                                                     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO                                                                                                                          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO2                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO3                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO4                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO5                                                                                                                         | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |





**COURSE OBJECTIVES**

To enable the students to

- gain the knowledge about circuit theorem
- learn about characteristics of electronic devices
- understand the characteristics of photo devices

**LIST OF EXPERIMENTS**

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems
3. Verification of superposition Theorem
4. Verification of Maximum power transfer and reciprocity theorems
5. Frequency response of series and parallel resonance circuits
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET
11. Characteristics of Diac and Triac
12. Characteristics of Photodiode and Phototransistor

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES**

At the end of this course, the students will be able to

- impart knowledge by analyzing and verifying the circuit theorems.
- analyze the characteristics of electronic devices
- acquire the knowledge of Photo devices

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Cos                                                                                                                         | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                             | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                         | 3                       | 3   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2                                                                                                                         | 3                       | 3   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3                                                                                                                         | 3                       | 3   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

To enable the students to

- introduce the basic concepts of biasing.
- inculcate a comprehensive understanding of small signal Amplifiers.
- study the Multistage Amplifiers.
- understand various types of Large Signal Amplifiers
- know about rectifiers, filters and power supplies

**UNIT I      LOAD LINE AND BIAS STABILITY****9**

Transistor Biasing, Methods of Transistor Biasing - DC load line, AC load line, Quiescent point variation due to uncertainty in  $\beta$ , Effect of temperature on the Q-point, Stability factor analysis, Bias compensation techniques, Biasing the FET.

**UNIT II      MID-BAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS****9**

Two-Port Networks, Analysis of a Transistor Circuit using h-parameters, Simplified CE Hybrid Model, Analysis of CE, CC, and CB Configuration using Approximate Model, BJT Amplifiers, Single Stage Amplifiers, Small Signal Analysis of Single Stage BJT Amplifiers, Miller's Theorem and its Dual, Design of Single Stage RC Coupled Amplifier using BJT, FET Amplifiers, The FET SmallSignal Model, Differential Amplifiers.

**UNIT III      MULTISTAGE AMPLIFIERS****9**

Different Coupling Schemes used in Amplifiers, General Analysis of Cascade Amplifiers, Choice of Transistor Configuration in Cascade Amplifier, Two Stage RC Coupled Amplifier, Transformer Coupled Amplifier, Direct Coupled Amplifiers, Darlington Amplifiers, Cascode Amplifiers

**UNIT IV      HIGH FREQUENCY AND LARGE SIGNAL AMPLIFIERS****9**

General Shape of Frequency Response of Amplifiers, High Frequency  $\pi$  Model for Transistor, Emitter Follower at Higher Frequencies, Large Signal Amplifiers - Introduction, Classification Based on Biasing Condition - Class A, Class B, Class AB, Class C, Class D, Class S Power Amplifiers, MOSFET Power Amplifiers, Thermal Stability and Heat Sink.

**UNIT V      RECTIFIERS, FILTERS AND POWER SUPPLIES****9**

Linear Mode Power Supply - Filters and its types - Voltage Regulators – Rectifiers - Half wave rectifier - Full wave rectifier - Bridge rectifier - Switched Mode Power Supply .

**TOTAL PERIODS****45****COURSE OUTCOMES**

At the end of the course, the students will be able to

- understand the concept of biasing .
- obtain the knowledge about the small signal amplifiers

- know about the various multistage amplifiers
- know about the concepts of large signal Amplifier
- acquire the concepts of power supplies

### TEXT BOOKS

1. Donald L.Schilling, Charles belowe, “Electronic Circuits”, 3<sup>rd</sup> edition, McGraw Hill, 1989
2. Salivahanan.S, Sureshkumar.N, “Electronic Devices and Circuits”, 3<sup>rd</sup> edition, McGraw Hill, 2014.

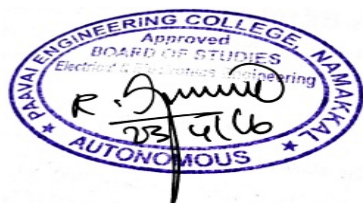
### REFERENCES

1. Jacob Millman, Christos C.Halkias, “ Electronic Devices and Circuits”, Tata McGraw Hill,1991.
2. Donald.A.Neamen, “Electronic Circuit Analysis and Design”, 2<sup>nd</sup> edition, Tata McGraw Hill, 2007.
3. Adel.S.Sedra, Kenneth C.Smith, “Micro Electronic Circuits”, 5<sup>th</sup> edition, Oxford University Press, 2004.

### Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

| Cos | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |       |       |       |       |       |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|-------|-------|
|     | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| C01 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | -     | -     | 3     | 3     | 3     |
| C02 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | -     | -     | 3     | 3     | 3     |
| C03 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | -     | -     | 3     | 3     | 3     |
| C04 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | -     | -     | 3     | 3     | 3     |
| C05 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | -     | -     | 3     | 3     | 3     |



**COURSE OBJECTIVES**

To enable the students to

- understand the fundamentals and simplification of digital logic
- design the various combinational circuits
- study and design synchronous sequential circuits
- design and implement asynchronous sequential circuits
- acquire basic knowledge in memory and HDL programming

**UNIT I      BOOLEAN ALGEBRA AND LOGIC GATES      9**

Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean functions – Minimization of Boolean functions– Karnaugh map Minimization – Tabulation Method - Don't care conditions. Logic Gates- Implementations of Logic Functions using gates - NAND – NOR implementations - TTL - CMOS - NAND, NOR, NOT –Tristate gates.

**UNIT II      COMBINATIONAL CIRCUITS      9**

Design procedure of Combinational circuits: Adders-Subtractors – Parallel and serial adder/ Subtractor- Carry look ahead adder- BCD adder - 2 bit Magnitude Comparator- Multiplexer/ Demultiplexer- encoder / decoder – parity generator and checker – code converters.

**UNIT III      SEQUENTIAL CIRCUITS      9**

Flip flops – Triggering –Realization of flip flop using other flip flops –Asynchronous and Synchronous counters –Modulo-n counter –Classification of sequential circuits – Moore and Mealy Design of Synchronous counters – ASM Chart - Shift registers - Ring counters.

**UNIT IV      ASYNCHRONOUS SEQUENTIAL CIRCUITS      9**

Design of fundamental mode and pulse mode circuits – primitive state / flow table – Minimization of primitive state table – state assignment – Excitation table – cycles – Race Free State assignment - Hazards: Static –Dynamic – Essential – Hazards elimination.

**UNIT V      MEMORY DEVICES AND INTRODUCTION TO HDL      9**

Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation– Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – Dynamic RAM cell. Programmable Logic Devices – PLA – PAL - FPGA - Introduction to HDL –Simple programs Using Verilog HDL.

**TOTAL PERIODS      45**

**COURSE OUTCOMES**

At the end of the course, the students will be able to

- understand the realization of boolean functions using many techniques
- design and implement combinational circuits .

- design and implement synchronous sequential circuits.
- design and study the effect of hazards in asynchronous sequential circuits.
- know the concept of Memories and HDL.

### TEXT BOOKS

1. M. Morris Mano, “Digital Design”, 3.ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2003/Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003 .
2. H. Charles Roth Jr, “Digital System Design using VHDL”, Thomson/ Brookscole, 2005.

### REFERENCES

1. S. Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, 3rd Edition, Vikas Publishing House Pvt.Ltd, New Delhi, 2007.
2. John .M Yarbrough, “Digital Logic Applications and Design”, Thomson Publications, New Delhi,2007.
3. Charles H.Roth, “Fundamentals of Logic Design”, Thomson Publication Company, 2003.
4. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, 5<sup>th</sup> edition, Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2003.
5. Donald D.Givone, “Digital Principles and Design”, Tata Mc-Graw Hill Publishing company limited, New Delhi, 2003.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak |                         |      |      |      |      |      |      |      |      |       |       |       |       |       |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| COs                                                                                                                          | Programme Outcomes(POs) |      |      |      |      |      |      |      |      |       |       |       |       |       |
|                                                                                                                              | PO 1                    | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 |
| CO1                                                                                                                          | 3                       | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 3     | 3     | 3     | 3     |
| CO2                                                                                                                          | 3                       | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 3     | 3     | 3     | 3     |
| CO3                                                                                                                          | 3                       | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 3     | 3     | 3     | 3     |
| CO4                                                                                                                          | 3                       | 3    | 3    | 1    | -    | -    | -    | -    | -    | -     | 3     | 3     | 3     | 3     |
| CO5                                                                                                                          | 3                       | 3    | 3    | 1    | -    | -    | -    | -    | -    | -     | 3     | 3     | 3     | 3     |



**COURSE OBJECTIVES**

To enable the students to

- introduce the basic concepts of continuous time and discrete time signals and systems
- analyze signals and systems using different transforms
- know about the analysis and realization of LTI – Continuous Time systems
- acquire the basic knowledge in Sampling and Z transform
- know about the analysis and realization of LTI – Discrete Time systems

**UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9**

Continuous time signals (CT signals) - Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential, basic operation on signals, classification of CT and DT signals –periodic and aperiodic signals, Energy & Power signals - CT systems and DT systems, Basic system properties - LTI system – Discrete time – Convolution Sum – continuous time – Convolution Integral - properties

**UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9**

Fourier series definition, properties and analysis - Fourier transform definition, properties - analysis - Laplace Transform definition – ROC -- properties -- Signal Analysis – unilateral - bilateral Laplace Transform.

**UNIT III LINEAR TIME INVARIANT – CONTINUOUS TIME SYSTEMS 9**

Differential Equation - impulse response, Step response and output response - Fourier and Laplace transforms in Analysis of continuous time systems - Block diagram representation - Direct Form I Direct Form II - Cascade and Parallel Realization.

**UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9**

Sampling Theorem – Reconstruction – Aliasing - DTFT and properties - z-transform - Region of Convergence - properties of ROC - Properties of z-transform - Inverse z-transform using Partial fraction expansion.

**UNIT V LINEAR TIME INVARIANT –DISCRETE TIME SYSTEMS 9**

Difference equations using Z transform - Impulse response - Analysis of Discrete time system using DTFT and Z transforms – Block diagram representation - Direct form I – Direct form II Cascade and Parallel Realization

**TOTAL PERIODS 45**

**COURSE OUTCOMES**

At the end of the course, the students will be able to

- analyze the basic concepts of solving electronics and communication engineering problems.
- demonstrate critical thinking and problem solving capabilities .
- solve problems and solutions relating to LTI – continuous time systems.

- demonstrate the basic knowledge and competence in the analysis of discrete time systems.
- have an in-depth knowledge about LTI – discrete time systems.

### TEXT BOOKS

1. Allan V. Oppenheim, S. Willsky and S. H. Nawab, “Signals and Systems”, Pearson, Indian Reprint, 2007.
2. B P Lathi, “Linear Systems and Signals”, Oxford University Press Inc, Chennai, 2004.
3. Simon Haykins and Barry Van Veen, “Signals and Systems”, John Wiley & sons, Inc. 2004.

### REFERENCES

1. S.K. Poornachandra, “Signals and Systems, Third edition, Tata McGraw-Hill.
2. K. Krishnaveni, A. Rajeswari, “Signals and Systems”, Wiley India Private Limited (2012).
3. H P Hsu, Rakesh Ranjan, “Signals and Systems”, Schaum’s Outlines, Tata McGraw Hill, Indian Reprint 2007.
4. Edward W. Kamen, Bonnie S. Heck, “Fundamentals of Signals and Systems Using the Web and MATLAB”, Pearson, Indian Reprint, 2007.
5. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.
6. M.J. Roberts, “Signals & Systems, Analysis using Transform methods & MATLAB”, Tata McGraw Hill (India), 2007.
7. Roberts Michael J. “Fundamentals of Signals and Systems”, Tata McGraw-Hill, New Delhi, 2008.

### Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

| COs | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|     | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -    | -    | 3    | 3    | 3    |
| CO2 | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -    | -    | 3    | 3    | 3    |
| CO3 | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -    | -    | 3    | 3    | 3    |
| CO4 | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -    | -    | 3    | 3    | 3    |
| CO5 | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -    | -    | 3    | 3    | 3    |



## COURSE OBJECTIVES

To enable the students to

- learn the systematic way of solving problems
- understand the different methods of organizing large amounts of data.
- introduce linear, non-linear data structures and their applications.
- efficiently implement the different data structures
- efficiently implement solutions for specific problems

### UNIT I DATA ABSTRACTION AND OVER LOADING 9

Overview of C++ – control Structures –Functions in C++, classes and objects – Constructors – Destructors – Friend Function –Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator Overloading.

### UNIT II INHERITANCE AND POLYMORPHISM 9

Inheritance – Overriding – Constructors and Destructors in derived Classes – Implicit Derived – Type Conversion – polymorphism – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes –Virtual Destructors – Dynamic Binding.

### UNIT III LINEAR DATA STRUCTURES 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation – singly linked lists – Polynomial Manipulation - Stack ADT – Queue ADT -Evaluating arithmetic expressions .

### UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components.

### UNIT V SORTING AND SEARCHING 9

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search – Introduction to Algorithm Design Techniques –Greedy algorithm (Minimum Spanning Tree)

**TOTAL PERIODS 45**

## COURSE OUTCOMES

After Completion of the course, the students will be able to

- design problem solutions using object oriented techniques.
- apply the concepts of data abstraction, encapsulation and inheritance for problem solutions.
- use the control structures of c++ appropriately.



- critically analyze the various algorithms.
- apply the different data structures to problem solutions

### TEXT BOOKS

1. Deitel and Deitel, “C++, How To Program”, Fifth Edition, Pearson Education, 2005.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, AddisonWesley, 2007.

### REFERENCES

1. Bhushan Trivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Mc Graw Hill, 2002.
4. Bjarne Stroustrup, “The C++ Programming Language”, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, 2007.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                          | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                              | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO2                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO3                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO4                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO5                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

To enable the students to

- introduce DC machines
- understand concepts in electrical generators, motors and transformers
- learn the concepts of Electronic measurements
- gain knowledge of the importance of digital instruments in measurements
- understand the importance of signal generators and signal analyzers in measurements

**UNIT I DC MACHINES****9**

Construction of DC machines – Theory of operation of DC generators – Characteristics of DC generators - Operating principle of DC motors – Types of DC motors and their characteristics – Speed control of DC motors - Applications.

**UNIT II TRANSFORMER AND AC MACHINES****9**

Single phase transformer construction and principle of operation – EMF equation of transformerTransformer no-load– Transformer on-load –Equivalent circuit of transformer- Transformer losses and efficiency-All day efficiency –auto transformers - Construction of single-phase induction motors – Types of single phase induction motors- Equivalent circuit – Principles of alternator – Construction- Equation of induced EMF- synchronous motors – Torque equation – V curves.

**UNIT III BASICS OF MEASUREMENT SYSTEM****9**

Measurement systems – Static and dynamic characteristics –units and standards of measurements – error :- accuracy and precision, types, statistical analysis –moving coil, moving iron meters – multimeters – Bridge measurements : –Maxwell, Hay, Schering, Anderson and Wien bridge.

**UNIT IV DIGITAL INSTRUMENTS AND DATA ACQUISITION SYSTEM****9**

Digital Voltmeter – Digital Multimeter – Digital Storage Oscilloscope - Digital frequency meter - Universal counter timer - Digital Data Acquisition System - Overview of PC Based instrumentation.

**UNIT V SIGNAL GENERATORS AND ANALYZERS****9**

Function generators, Pulse and square wave generators, RF signal generators - Sweep generators - Frequency synthesizer –Wave analyzer – Harmonic distortion analyzer – Spectrum analyzer :- Digital spectrum analyzer, Vector Network Analyzer – Digital L,C,R measurements, Digital RLC meters.

**TOTAL PERIODS****45****COURSE OUTCOMES**

After the completion of the course, the students will be able to

- understand the concepts in DC machines
- understand the concepts in transformers and AC machines
- gain knowledge in the basic measurement and instrumentation based devices

- know the relevance of digital instruments in measurements
- know about signal generators and signal analyzers

### TEXT BOOKS

1. J Nagarath and Kothari DP, “Electrical Machines”, McGraw-Hill Education (India) Pvt Ltd 4th Edition, 2010 .
2. Thereja .B.L, “Fundamentals of Electrical Engineering and Electronics”, S Chand & Co Ltd, 2008 .
3. A.K.Sawhney, “A Course in Electrical & Electronic Measurements and Instrumentation”, Dhanpat Rai and Co, 2004.

### REFERENCES

1. Del Toro, “Electrical Engineering Fundamentals” Pearson Education, New Delhi, 2007.
2. W.D.Cooper & A.D.Helfrick, “Modern Electronic Instrumentation and Measurement Techniques”, 5th Edition, PHI, 2002.
3. Ernest O. Doebelin, “Measurement Systems-application and Design”, TMH, 2007
4. B.C. Nakra and K.K. Choudhry, “Instrumentation, Measurement and Analysis”, 2<sup>nd</sup> Edition, TMH, 2004.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                          | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                              | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | 1   | -    | -    | 3    | 3    | 3    |
| CO2                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | 3   | -    | -    | 3    | 3    | 3    |
| CO3                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | 3   | -    | -    | 3    | 3    | 3    |
| CO4                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | 3   | -    | -    | 3    | 3    | 3    |
| CO5                                                                                                                          | 3                       | 3   | 3   | 3   | 3   | 2   | -   | -   | 3   | -    | -    | 3    | 3    | 3    |



**COURES OBJECTIVES**

- gain knowledge about frequency response of different types of amplifiers
- learn about transfer characteristics of Differential and power amplifiers
- know about the response of amplifiers
- understand about different types of rectifiers

**LIST OF EXPERIMENTS**

1. Design the biasing methods using BJT
2. Determination of the Frequency response of CE amplifier
3. Determination of the Frequency response of CB amplifier
4. Determination of the Frequency response of CS Amplifiers
5. Design Class A power amplifiers and determination its efficiency
6. Design Class B power amplifiers and determination its efficiency
7. Measurement of CMRR of differential amplifier
8. Determination of the bandwidth of Cascade amplifier
9. Determination of the bandwidth of Cascode amplifier
10. Determination of the efficiency and ripple factor of half wave rectifier
11. Determination of the efficiency and ripple factor of full wave rectifier

**TOTAL PERIODS : 60****COURSE OUTCOMES**

After the completion of the course, the students will be able to

- explain the working condition and frequency response of different types of Amplifiers
- comprehend the Differential and power amplifiers
- analyse the bandwidth of multi-stage, Cascade and Cascode amplifiers elaborate about measurement of CMRR
- determine the efficiency and ripple factor of half and full wave rectifier

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

| COs | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|     | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO2 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO3 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO3 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

- design and implement Adders and Subtractors
- design and implement code converters
- get the knowledge about design and implementation of combinational and sequential logic circuits
- acquire the knowledge about simulation of digital circuits with Verilog HDL

**LIST OF EXPERIMENTS**

1. Design and implementation of Adders and Subtractors using logic gates. 2. Design and implementation of code converters using logic gates
  - i. BCD to excess-3 code and vice versa.
  - ii. Binary to gray and vice-versa.
3. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
4. Design and implementation of 2 Bit Magnitude Comparator using logic gates
5. Design and implementation of 4 bit odd/even parity checker generator using IC74180.
6. Design and implementation of Multiplexer and De-multiplexer using basic logic gates and study of IC 74150 and IC 74154.
7. Design and implementation of encoder and decoder using logic gates and study of IC7445 and IC74147.
8. Construction and verification of 4 bit ripple counter and Mod-n Ripple counters.
9. Design and implementation of 3-bit synchronous up (or) down counter.
10. Implementation of 3-bit shift registers using Flip flops.
11. Design and Simulation of Adders, Subtractors, Multiplexer and De-multiplexer, encoder and decoder, 4 bit ripple counter using Verilog HDL.

**TOTAL PERIODS: 60****COURSE OUTCOMES**

After the completion of the course, the students will be able to:

- gain knowledge of basic logic gates, boolean theorems and karnaugh map.
- analyze the different categories of combinational & sequential and its applications.
- design the various counters and shift registers in digital circuits.
- gain knowledge of verilog operations and their coding styles.

Mapping of Course Outcomes with Programme Outcomes:  
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

| COs | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|     | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO2 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO3 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO4 | 3                       | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

- be familiarized with good programming design methods, particularly Top- Down design.
- getting exposure in implementing the different data structures using C++
- efficiently implement the different data structures
- analyze solutions for specific problems

**LIST OF EXPERIMENTS**

1. Basic Programs for C++ Concepts
2. Array implementation of List Abstract Data Type (ADT)
3. Linked list implementation of List ADT
4. Cursor implementation of List ADT
5. Stack ADT - Array and linked list implementations by implementing the following source files
  - (a) Program source files for Stack Application
  - (b) Array implementation of Stack ADT
  - (c) Linked list implementation of Stack ADT
6. Queue ADT – Array and linked list implementations
7. Search Tree ADT - Binary Search Tree
8. Heap Sort
9. Quick Sort
10. Minimum Spanning Trees

**TOTAL: 60 PERIODS****COURSE OUTCOMES**

After the completion of the course, the students will be able to:

- design and implement C++ programs for manipulating stacks, queues, linked lists, trees, and graphs.
- apply good programming design methods for program development.
- apply the different data structures for implementing solutions to practical problems.
- develop recursive programs using trees and graphs.

Mapping of Course Outcomes with Programme Outcomes:  
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

| COs | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|     | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO2 | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO3 | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |
| CO4 | 3                       | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 3    |





**COURSE OBJECTIVES**

To enable the students to

- acquire knowledge of the random variable and manipulate.
- understand the concepts of some standard distributions.
- analysis the relationship between the two random variables.
- provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems etc in communication engineering.
- enable students to understand the topics such as signals & systems, pattern recognition, voice and image processing and filtering theory.

**UNIT I      RANDOM VARIABLES      15**

Axioms of probability – Conditional probability – Total probability – Baye's theorem Random variable- Probability mass function – Probability density function – Properties - Moments Moment generating functions and their properties.

**UNIT II      STANDARD DISTRIBUTION      15**

Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions and their properties – Functions of a random variable.

**UNIT III      TWO DIMENSIONAL RANDOM VARIABLES      15**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables.

**UNIT IV      RANDOM PROCESS ANFD MARKOV CHAIN      15**

Classification - Stationary process - Poisson process-Markov Chain- Transition probabilities Limiting Distributions.

**UNIT V      COPRRELATION AMND SPECTRAL DENSITIES      15**

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties. Linear time invariant system – System transfer function – Linear systems with random inputs – Autocorrelation and Cross correlation functions of input and output.

**TOTAL PERIODS      75**

**COURSE OUTCOMES**

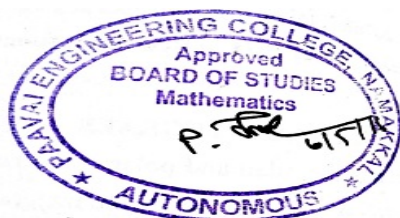
After the completion of the course, the students will be able to

- have a fundamental knowledge of the basic probability concepts.
- have a well – founded knowledge of standard distributions which can describe real life phenomena.
- acquire skills in handling situations involving more than one random variable and functions of random variables.

- ## TEXT BOOKS

- ## REFERENCES

- | Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                          | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                              | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                          | 3                       | 3   | 3   | 3   | -   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2                                                                                                                          | 3                       | 3   | 3   | 3   | -   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3                                                                                                                          | 3                       | 3   | 3   | 3   | -   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO4                                                                                                                          | 3                       | 3   | 3   | 3   | -   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO5                                                                                                                          | 3                       | 3   | 3   | 3   | -   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

To enable the students to

- analyze about the feedback amplifiers
- learn about tuned amplifiers
- study the concepts of oscillator
- study the wave shaping and multivibrator circuits
- acquire the basics of blocking oscillators

**UNIT I      FEEDBACK AMPLIFIERS****9**

Classification of Basic Amplifiers, Basic Concept of Feedback, Transfer Gain with Feedback, General Characteristics of Negative feedback Amplifiers, Effect of Negative Feedback on Input Resistance and Output Resistance, Method of Identifying Feedback Topology, Voltage-Series Feedback, Current Series Feedback, Current-Shunt Feedback, Voltage-Shunt Feedback, Stability of Feedback Amplifiers.

**UNIT II      TUNED AMPLIFIERS****9**

Small Signal Tuned Amplifiers, Effect of Cascading Single Tuned Amplifiers on Bandwidth, Effect of Cascading Double Tuned Amplifier on Bandwidth, Stagger Tuned Amplifiers, Comparison of Tuned Amplifiers, Large Signal Class - C Tuned Amplifiers – Stability of Tuned Amplifiers, Neutralization.

**UNIT III      OSCILLATORS****9**

Classification of Oscillators, Conditions for Oscillation, General form of an LC Oscillator - Hartley Oscillator, Colpitts Oscillator, Clapp Oscillator, RC Phase Shift Oscillators, Wien-Bridge Oscillator, Twin-T Oscillator, Crystal Oscillators.

**UNIT IV      WAVE SHAPING AND MULTIVIBRATOR CIRCUITS****9**

Waveform Shaping Circuits - Diode clippers – Clampers – Multivibrators - Triggering Methods for Bistable Multivibrators- Schmitt Trigger.

**UNIT V      BLOCKING OSCILLATORS AND TIME BASE GENERATORS****9**

UJT Relaxation Oscillator - Pulse Transformers - Blocking Oscillator - Triggered Blocking Oscillator – Voltage and Current Time Base Circuits.

**TOTAL PERIODS      45****COURSE OUTCOMES**

After the completion of the course, the students will be able to

- understand the concept of feedback amplifiers.

- understand the concept of tuned amplifiers.
- obtain the knowledge about oscillators.
- know about multivibrators .
- understand the blocking oscillators .

### TEXT BOOKS

1. Donald L.Schilling, Charles Belove, “Electronic Circuits”, 3<sup>rd</sup> edition, McGraw Hill, 1989.
2. Salivahanan.S, Sureshkumar.N, “Electronic Devices and Circuits”, 3<sup>rd</sup> edition, McGraw Hill, 2014.
3. Adel.S.Sedra, Kenneth C.Smith, “Micro Electronic Circuits”, 5<sup>th</sup> edition, Oxford University Press, 2004.

### REFERENCES

1. Jacob Millman, Christos C.Halkias, “Electronic Devices and Circuits”, Tata McGraw Hill, 1991.
2. F.Bogart Jr., “Electronic Devices and Circuits”, 6<sup>th</sup> edition, Pearson Education, 2007.
3. Donald.A.Neamen, “Electronic Circuit Analysis and Design”, 2<sup>nd</sup> edition, Tata McGraw Hill, 2007.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                          | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                              | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO4                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO5                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

To enable the students to

- know the basics of communication
- offer various Amplitude modulation and demodulation systems
- provide various Angle modulation and demodulation systems
- make the students familiar with the working of transmitters and receivers.
- understand the effect of noise on communication systems.

**UNIT I    AMPLITUDE MODULATION** **9**

Elements of an Electrical communication system-Communication channel and their characteristics-Need for modulation- Amplitude Modulation – Definition- single tone modulation- Phasor representations- power relations in AM waves- Generation of AM waves- **Detection of AM Waves- DSB MODULATION : Double side band suppressed carrier modulators- time domain and frequency domain description-Generation of SSB AM Modulated Wave** - Demodulation of SSB Waves-principles of Vestigial Side Band modulation, comparison of AM system.

**UNIT II    ANGLE MODULATION** **9**

Basic concepts-Frequency Modulation & Phase Modulation: Single tone frequency modulation- **Spectrum Analysis of Sinusoidal FM Wave- Narrow band FM-Phasor representation** -Wide band FM-Constant Average Power- Transmission bandwidth of FM Wave - Generation of FM Waves: Direct and Indirect FM-Detection of FM Waves: Balanced Slope detector- Foster Seeley discriminator- Ratio detector- Phase locked loop method of FM detection- Comparison of FM and AM.

**UNIT III    RADIO TRANSMITTERS AND RECEIVERS** **9**

Radio Transmitter - Classification of Transmitter: AM Transmitter- FM Transmitter – Variable reactance type and phase modulated FM Transmitter- **frequency stability in FM Transmitter**-Radio Receiver - Receiver Types - Tuned radio frequency receiver- Super heterodyne receiver- RF section and Characteristics - Frequency changing and tracking- Intermediate frequency- AGC- FM Receiver- Amplitude limiting- Comparison with AM Receiver.

**UNIT IV    NOISE** **9**

Noise sources and types -Noise figure- Calculation of noise figure- noise bandwidth- Equivalent noise resistance - Noise figure of cascaded stages-**noise figure measurement**- Noise temperature- Available Noise Power Noise in Analog communication System- Noise in DSB, SSB, AM and FM Systems - Threshold effect in FM System- Pre-emphasis & De-Emphasis in FM.

**UNIT V    INFORMATION THEORY** **9**

Entropy - Discrete Memory less channels - Channel Capacity -Hartley - Shannon law - Source coding theorem - **Huffman & Shannon - Fano codes.**

**COURSE OUTCOMES**

After the completion of the course, the students will be able to

- learn the basics of am communication systems
- design angle modulated communication systems
- understand the transmission and receiving concept of communication system
- analyze the noise performance of am and fm systems
- acquire the knowledge on discrete memory less channels

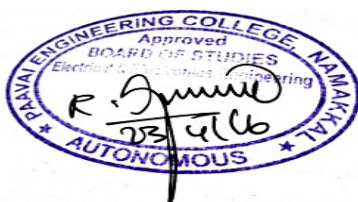
**TEXT BOOKS**

1. Proakis and Salehi, “Fundamentals of Communication Systems”, Pearson Education, 2006.
2. Wayne Tomasi, “Electronic Communication Systems Fundamentals through Advanced”, 5th Edition, Pearson Education Inc, 2004.
3. Michael P. Fitz, “Fundamentals of Communication Systems” Tata McGraw-Hill, Edition-2008.

**REFERENCES**

1. H Taub & D.Schilling, GautamSahe, “Principles of Communication Systems”, Tata McGraw Hill, 3rd Edition, 2007.
2. Simon Haykin, “Communication Systems”, John Wiley, 5th Edition, 2009.
3. B.P.Lathi, “Communication Systems”, BS Publication, 2006.
4. George Kennedy and Bernard Davis, “Electronics & Communication System”, Tata McGraw Hill, 2004.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                         | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                             | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                         | 3                       | 3   | -   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO2                                                                                                                         | 3                       | 3   | -   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO3                                                                                                                         | 3                       | 3   | -   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO4                                                                                                                         | 3                       | 3   | -   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |
| CO5                                                                                                                         | 3                       | 3   | -   | -   | -   | -   | -   | -   | -   | -    | 3    | -    | 3    | 3    |



**COURSE OBJECTIVES**

- To introduce the basic of operational amplifier
- To learn linear and nonlinear applications of operational amplifier
- To study the applications of analog multiplier and PLL
- To introduce theory of analog and digital conversion
- To acquire the basic knowledge of special function IC's

**UNIT I INTEGRATED CIRCUIT FABRICATION AND BASICS OF OPERATIONAL AMPLIFIER 9**

Integrated Circuit classification, Fundamentals of Monolithic IC Technology, Basic Fabrication process Fabrication of a typical circuit – Active and passive components of ICs - Operational amplifier – Basic information of Op-Amps – Ideal Op-Amp –operational amplifier Internal circuit– Examples of IC OpAmps - DC, AC Characteristics of Op-Amp -virtual ground, frequency compensation techniques - slew rate.

**UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9**

Basic Op-Amp applications (sign changer, scale changer, voltage follower, adder and subtractor) – Instrumentation amplifier – Voltage-to-Current and Current-to-Voltage converter – Logarithmic amplifier - Anti-logarithmic amplifiers – Differentiator - Integrator - Comparator – Schmitt trigger – Active filters – Design of Low pass, high pass and band pass filters – Op-Amp circuits using Diodes.

**UNIT III ANALOG MULTIPLIER AND PLL 9**

Analog multiplier IC – applications - Analysis of four quadrant and variable Trans-conductance multipliers –PLL: Basic principles-Phase Detector/Comparator- Voltage controlled Oscillator – Monolithic PLL - PLL applications – Frequency multiplier - AM, FM and FSK demodulators - Frequency synthesizers – Frequency translation.

**UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTORS 9**

Introduction - basic DAC techniques: Binary weighted resistor type – R-2R ladder type – sample and hold circuits – Analog-to-Digital converters: Flash type ADC – Counter type ADC – Successive approximation register type ADC- Dual slope ADC – DAC / ADC Specifications.

**UNIT V SPECIAL FUNCTION ICS 9**

Waveform generators – Basic principles of sine wave oscillators – Astable and monostable multivibrators using Op-Amp - ICL8038 Function Generator – 555 timer: description of functional diagram – Astable, monostable operation – 723 general purpose voltage regulator – switching regulator – Switched capacitor filter – LM380 audio amplifier – Opto-couplers and fiber optic ICs.

**TOTAL PERIODS 45****COURSE OUTCOMES**

After the completion of the course, the students will be able to

- learn the basic concepts of operational amplifier
- understand the working and applications of operational amplifier
- learn about PLL applications in modulator circuits
- study about working of analog and digital communication circuits
- know the basic function of special function IC

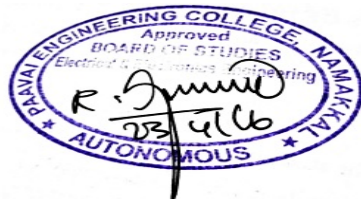
### TEXT BOOKS

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., Fourth edition 2010.
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw Hill, 3<sup>rd</sup> edition 2007

### REFERENCES

1. William D.Stanely, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education, 2004.
2. David L.Terrell, "Op Amps-Design, Application, and Troubleshooting", Elsevier publications 2005.
3. Ramakant A. Gayakwad, "OP - AMP and Linear IC's", Prentice Hall, 1994.
4. Botkar K.R., "Integrated Circuits", Khanna Publishers, 1996.
5. Taub and Schilling, "Digital Integrated Electronics", McGraw Hill, 1977.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                          | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                              | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO4                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO5                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |





**COURSE OBJECTIVES**

- To gain knowledge on system modeling and time response of a system.
- To understand the concept of time and frequency domain design of control systems.
- To study methods to analyze the stability of control systems
- To carryout analysis using MATLAB.
- To know the concept of state variable analysis in control systems.

**UNIT I CONTROL SYSTEM MODELING 9**

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function concept- Modeling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques – Signal flow graph – Mason's gain formula.

**UNIT II TIME RESPONSE ANALYSIS 9**

Standard Test Signals - Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation, Analysis using MATLAB.

**UNIT III FREQUENCY RESPONSE ANALYSIS 9**

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol's Chart - Nichol's Chart in Control System Analysis - Series, Parallel, series-parallel Compensators - Analysis using MATLAB.

**UNIT IV STABILITY ANALYSIS 9**

Stability-Location of roots in S plane for stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Nyquist Stability Criterion, Analysis using MATLAB.

**UNIT V STATE VARIABLE ANALYSIS 9**

State space representation of Continuous Time systems – State equations- Transfer function from state Variable representation – Solutions of the state equations- Concepts of Controllability and Observability

**TOTAL PERIODS 45**

**COURSE OUTCOMES**

After the completion of the course, the students will be able to

- determine the models of control systems and their representation
- learn time and frequency domain techniques to design a control system
- identify the major causes that affect the stability of a control system
- understand the basic matlab commands related to control systems

able to know the concept of state variable analysis of control systems

### TEXT BOOKS

1. J.Nagrath and M.Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition, 2007.
2. Katsuhiko Ogata, “Modern Control Engineering”, second edition, Prentice Hall of India Private Limited, New Delhi, 1995.

### REFERENCES

1. Benjamin.C.Kuo, “Automatic control systems”, Prentice Hall of India, 7<sup>th</sup> Edition, 1995.
2. M.Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 2<sup>nd</sup> Edition, 2002.
3. Schaum’s Outline Series, “Feedback and Control Systems”, Tata McGraw-Hill, 2007.
4. John J.D’azzo & Constantine H.Houpis, “Linear control system analysis and design”, Tata McGraw-Hill Inc., 1995.
5. Richard C. Dorf & Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 1999.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                         | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                             | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                         | 3                       | 3   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2                                                                                                                         | 3                       | 3   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3                                                                                                                         | 3                       | 3   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO4                                                                                                                         | 3                       | 3   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO5                                                                                                                         | 3                       | 3   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

- To analyze fields and potentials due to static charges.
- To evaluate static magnetic fields.
- To realize how materials affect electric and magnetic fields.
- To identify the relation between the fields under time varying situations.
- To understand principles of propagation of uniform plane waves.

**UNIT I ELECTRIC STATIC FIELDS 9**

Co-ordinate systems, Vector differential operators, Coulombs law, Divergence theorem, Stokes theorem, Electric field intensity – charge distribution, electric flux density –Applications of Gauss's law, Electric potential, Electric dipole, Energy and Energy density.

**UNIT II ELECTRIC FIELDS IN MATERIAL SPACE 9**

Conductors – Polarization in dielectrics, Dielectric constant and strength, Uniqueness theorem – continuity equation, Boundary conditions, Poisson's and Laplace's equation – General procedure for solving Poisson's and Laplace's equation– Resistance and Capacitance, Method of images.

**UNIT III MAGNETOSTATIC FIELDS 9**

Biot – Savart's law, Ampere's circuit law - Magnetic flux Density and Field intensity – applications of Ampere's Law –Magnetic scalar and vector potentials -Force due to magnetic fields -Magnetic Torque and moment, Magnetization in materials, magnetic boundary conditions, Inductors and Inductances – magnetic Energy – magnetic circuits.

**UNIT IV TIME VARYING FIELDS AND MAXWELL'S EQUATIONS 9**

Faradays law, Transformer and motional electromotive forces, The equation of continuity for time varying fields – Inconsistency of Ampere's Law - Maxwell's equation, Displacement current, time varying potentials – time harmonic fields – Electromagnetic spectrum.

**UNIT V ELECTROMAGNETIC WAVE PROPAGATION 9**

Wave propagation in lossy dielectric – plane waves in lossless dielectrics-plane waves in free spaceplane waves in good conductors-power and the Poynting vector-Reflection of plane waves at normal incidence-Reflection of plane wave at oblique incidence- Transmission line analogyApplication Note- microwaves.

**TOTAL PERIODS 45****COURSE OUTCOMES**

After the completion of the course, the students will be able to

- examine the field potentials due to static changes
- study the effect of field on materials
- evaluate the field intensity due to static magnetic fields

- analyze the relation between the fields under time varying situations
- discuss the principles of propagation of uniform plane waves

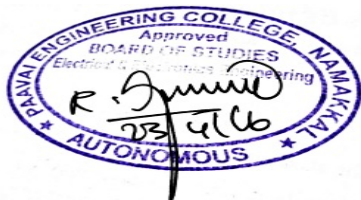
### TEXT BOOKS

1. Mathew. N.O.Sadiku, “Principles of Electromagnetics”, Oxford University Press, 2011.
2. E.C. Jordan and K.G. Balmain, “Electromagnetic Waves and Radiating Systems”, Printicehall of India/PHI, 2nd edition, 2007.
3. Kraus, Fleisch, “Electromagnetics with Applications”, McGraw-Hill, 2005.
4. David .K.Cheng, “Field and wave Electromagnetics”, 2nd edition, Pearson education, 2004.

### REFERENCES

1. Karl E.Longman and Sava V.Savov, “Fundamentals of Electro-Magnetics”, Prentice Hall of India, 2006.
2. W.H.Hayt and A.Buck, “Engineering ElectroMagnetics”, 7th Edition, McGraw Hill, 2006.
3. AshutoshPramanik, “Electro Magnetism”, Prentice Hall of India, 2006.
4. Ramo, Whinnery and Van Duzer, “Fields and Waves in Communications Electronics”, John Wiley & Sons, 3rd edition 2003.

| Mapping of Course Outcomes with Programme Outcomes:<br>(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak |                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs                                                                                                                          | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|                                                                                                                              | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO4                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO5                                                                                                                          | 3                       | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

- To gain hands on experience in designing feedback amplifiers
- To acquire knowledge about the design of oscillators
- To learn the simulation software used for circuit design
- To understand the concepts of Multivibrators

**LIST OF EXPERIMENTS**

1. Design of Feedback amplifier circuits
2. Frequency response of class C tuned amplifier
3. Design of integrator and differentiator
4. Design of RC oscillators (RC Phase shift / Wien bridge)
5. Design of LC oscillators (Hartley /Colpitts /Clapp)
6. Design of multivibrators (Astable / monostable / bistable)
7. Design of clippers and clampers
8. Spice simulation of differential amplifiers
9. Spice simulation of Multivibrators
10. Spice simulation of integrator and differentiator

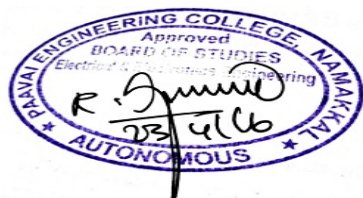
**TOTAL: 60 PERIODS****COURSE OUTCOMES**

After the completion of this lab course, the students will be able to

- analyze feedback amplifiers
- analyze differential and power amplifiers
- design of oscillators and multivibrators for the given specifications
- analyze electronic circuits through simulation

Mapping of Course Outcomes with Programme Outcomes:  
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

| COs | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|     | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO4 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |



**COURSE OBJECTIVES**

- To study the application of operational amplifier
- To know the design of multivibrators using operational amplifier and 555 timer
- To design oscillators and active filters in various applications.
- To simulate the Op-Amp application circuits using PSPICE software

**LIST OF EXPERIMENTS****Design and testing of**

1. Inverting, Non inverting amplifier and differential amplifier
2. Instrumentation amplifier
3. Integrator and Differentiator
4. Active low pass, High pass and band pass filters.
5. Astable, Monostable Multivibrators and Schmitt trigger (using IC 741)
6. Phase shift Oscillator and Wien bridge oscillators (using IC 741)
7. Astable and monostable Multivibrators using NE555 Timer
8. Frequency multiplier using PLL IC
9. Voltage regulation using LM317 and LM723 **Simulation Experiments**
10. Simulation of (i) Instrumentation amplifier, (ii) Integrator and Differentiator, (iii) Active low pass, High pass and band pass filters, (iv) Astable, Monostable Multivibrators and Schmitt trigger (using IC 741), (v) Phase shift Oscillator and Wien bridge oscillators (using IC 741), (vi) Astable and monostable Multivibrators using NE555 Timer, (vii) Frequency multiplier using PLL IC using PSPICE

**TOTAL PERIODS : 60****COURSE OUTCOMES**

After the completion of the course, the students will be able to

- design and test the op-amp applications
- understand the working and applications of filters
- design oscillators and multivibrators for various applications
- analyze the working of power supply

Mapping of Course Outcomes with Programme Outcomes:  
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

| COs | Programme Outcomes(POs) |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|     | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO2 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO3 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |
| CO4 | -                       | 3   | 3   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 3    | 3    |



|                                                                                                      |                        |
|------------------------------------------------------------------------------------------------------|------------------------|
| 13. (DC Shunt Motor: kW: 7.4/ volts: 220/ Amps: 38.5/ Speed: 960 RPM<br>Field current 1.2A)          |                        |
| 14. (DC Compound Generator: kW: 7.5/ volts: 220/ Amps: 38.5/<br>Speed: 960 RPM / Field current 1.2A) |                        |
| 15. Tachometer –Digital/Analog                                                                       | 8                      |
| 16. Single Phase Auto Transformer;(0-270)V                                                           | 2                      |
| 17. Three Phase Auto Transformer;(0-270)V                                                            | 1                      |
| 18. MC Voltmeter-(0-300/600)V                                                                        | 5                      |
| 19. MC Ammeter (0-10/20)A                                                                            | 5                      |
| 20. MC Ammeter (0-2/1)A                                                                              | 4                      |
| 21. MI Voltmeter (0-300/600)V                                                                        | 5                      |
| 22. MI Ammeter (0-10/20)A                                                                            | 6                      |
| 23. MI Ammeter (0-1/2)A                                                                              | 4                      |
| 24. UPF Wattmeter (300/600V,10/20A)                                                                  | 4                      |
| 25. LPF Wattmeter (300/600V,10/20A)                                                                  | 4                      |
| 26. Single Phase Resistive Loading Bank(10KW)                                                        | 2                      |
| 27. Three Phase Resistive Loading Bank(10KW)                                                         | 2                      |
| 28. SPST switch                                                                                      | 2                      |
| 29. Fuse various ranges                                                                              | As per the requirement |
| 30. Wires                                                                                            | As per the requirement |
| 31. Rheostats(100Ω,1A;250Ω,1.5A;75Ω,16A,1000Ω,1A)                                                    | Each 2                 |
| 32. Computers with MATLAB or equivalent Software.                                                    |                        |

**EC6501**

**DIGITAL COMMUNICATION**

**L T P C**

**3 0 0 3**

### OBJECTIVES:

- To know the principles of sampling & quantization
- To study the various waveform coding schemes
- To learn the various baseband transmission schemes
- To understand the various Band pass signaling schemes
- To know the fundamentals of channel coding

### UNIT I SAMPLING & QUANTIZATION

**9**

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - **Logarithmic Companding of speech signal**- PCM - TDM

### UNIT II WAVEFORM CODING

**9**

**Prediction filtering and DPCM** - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding

### UNIT III BASEBAND TRANSMISSION

**9**

**Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ** – Bipolar NRZ - Manchester- ISI – **Nyquist criterion for distortionless transmission** – Pulse shaping – Correlative coding - Mary schemes – **Eye pattern - Equalization**



**UNIT IV      DIGITAL MODULATION SCHEME** **9**  
 Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - **structure of Non-coherent Receivers** - Principle of DPSK.

**UNIT V      ERROR CONTROL CODING** **9**  
**Channel coding theorem** - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - **Viterbi Decoder**

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, students will be able to**

- Design PCM systems
- Design and implement base band transmission schemes
- Design and implement band pass signaling schemes
- Analyze the spectral characteristics of band pass signaling schemes and their noise performance
- Design error control coding schemes

**TEXT BOOK:**

1. S. Haykin, "Digital Communications", John Wiley, 2005

**REFERENCES:**

1. B. Sklar, "Digital Communication Fundamentals and Applications", 2<sup>nd</sup> Edition, Pearson Education, 2009
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3<sup>rd</sup> Edition, Oxford University Press 2007.
3. H P Hsu, Schaum Outline Series - "Analog and Digital Communications", TMH 2006
4. J.G Proakis, "Digital Communication", 4<sup>th</sup> Edition, Tata Mc Graw Hill Company, 2001.

|               |                                                |                |
|---------------|------------------------------------------------|----------------|
| <b>EC6502</b> | <b>PRINCIPLES OF DIGITAL SIGNAL PROCESSING</b> | <b>L T P C</b> |
|               |                                                | <b>3 1 0 4</b> |

**OBJECTIVES:**

- To learn discrete Fourier transform and its properties
- To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals
- To understand Finite word length effects
- To study the concept of Multirate and adaptive filters

**UNIT I      DISCRETE FOURIER TRANSFORM** **9**  
 Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution - **Filtering methods based on DFT – FFT Algorithms** – **Decimation in time Algorithms, Decimation in frequency Algorithms** – Use of FFT in Linear Filtering.

**UNIT II      IIR FILTER DESIGN** **9**  
 Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, **Approximation of derivatives – (LPF, HPF, BPF, BRF)** filter design using frequency translation.

**UNIT III      FIR FILTER DESIGN****9**

**Structures of FIR – Linear phase FIR filter – Fourier Series** - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques – Finite word length effects in digital Filters: Errors, Limit Cycle, Noise Power Spectrum.

**UNIT IV      FINITE WORDLENGTH EFFECTS****9**

**Fixed point and floating point number representations** – ADC –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Roundoff noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling

**UNIT V      DSP APPLICATIONS****9**

Multirate signal processing: Decimation, Interpolation, **Sampling rate conversion by a rational factor** – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization.

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

**Upon completion of the course, students will be able to**

- apply DFT for the analysis of digital signals & systems
- design IIR and FIR filters
- characterize finite Word length effect on filters
- design the Multirate Filters
- apply Adaptive Filters to equalization

**TEXT BOOK:**

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.

**REFERENCES:**

1. Emmanuel C..Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8<sup>th</sup> Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

**EC6503****TRANSMISSION LINES AND WAVE GUIDES****L T P C  
3 1 0 4****OBJECTIVES:**

- To introduce the various types of transmission lines and to discuss the losses associated.
- To give thorough understanding about impedance transformation and matching.
- To use the Smith chart in problem solving.
- To impart knowledge on filter theories and waveguide theories

## **UNIT I TRANSMISSION LINE THEORY**

**9**

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in  $Z_0$  - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

## **UNIT II HIGH FREQUENCY TRANSMISSION LINES**

**9**

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

## **UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES**

**9**

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

## **UNIT IV PASSIVE FILTERS**

**9**

Characteristic impedance of symmetrical networks - filter fundamentals, Design of filters: Constant K - Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections - low pass, high pass composite filters.

## **UNIT V WAVE GUIDES AND CAVITY RESONATORS**

**9**

General Wave behaviours along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TM and TE waves in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators.

### **OUTCOMES:**

Upon completion of the course, students will be able to:

- Discuss the propagation of signals through transmission lines.
- Analyze signal propagation at Radio frequencies.
- Explain radio propagation in guided systems.
- Utilize cavity resonators.

### **TEXT BOOKS**

1. John D Ryder, "Networks, lines and fields", 2<sup>nd</sup> Edition, Prentice Hall India, 2010.

### **REFERENCES**

1. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.
2. G.S.N Raju "Electromagnetic Field Theory and Transmission Lines" , Pearson Education, First edition 2005.

**OBJECTIVES:**

The student should be made to:

- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

**UNIT I THE 8086 MICROPROCESSOR****9**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

**UNIT II 8086 SYSTEM BUS STRUCTURE****9**

8086 signals – Basic configurations – System bus timing – System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure - Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

**UNIT III I/O INTERFACING****9**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

**UNIT IV MICROCONTROLLER****9**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

**UNIT V INTERFACING MICROCONTROLLER****9**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of the course, the student should be able to:

- Design and implement programs on 8086 microprocessor.
- Design I/O circuits.
- Design Memory Interfacing circuits.
- Design and implement 8051 microcontroller based systems.

**TEXT BOOKS:**

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.

**REFERENCE:**

1. Douglas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012

**EC6511****DIGITAL SIGNAL PROCESSING LABORATORY****L T P C****0 0 3 2****OBJECTIVES:****The student should be made to:**

- To implement Linear and Circular Convolution
- To implement FIR and IIR filters
- To study the architecture of DSP processor
- To demonstrate Finite word length effect

**LIST OF EXPERIMENTS:****MATLAB / EQUIVALENT SOFTWARE PACKAGE**

1. Generation of sequences (functional & random) & correlation
2. Linear and Circular Convolutions
3. Spectrum Analysis using DFT
4. FIR filter design
5. IIR filter design
6. Multirate Filters
7. Equalization

**DSP PROCESSOR BASED IMPLEMENTATION**

8. Study of architecture of Digital Signal Processor
9. MAC operation using various addressing modes
10. Linear Convolution
11. Circular Convolution
12. FFT Implementation
13. Waveform generation
14. IIR and FIR Implementation
15. Finite Word Length Effect

**TOTAL: 45 PERIODS****OUTCOMES:****Students will be able to**

- Carry out simulation of DSP systems
- Demonstrate their abilities towards DSP processor based implementation of DSP systems
- Analyze Finite word length effect on DSP systems
- Demonstrate the applications of FFT to DSP
- Implement adaptive filters for various applications of DSP

**LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS (2 STUDENTS PER SYSTEM)**

PCs with Fixed / Floating point DSP Processors (Kit / Add-on Cards) 15 Units

**LIST OF SOFTWARE REQUIRED:**MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems  
-15 Nos

Signal Generators (1MHz) – 15 Nos

CRO (20MHz) -15 Nos

**OBJECTIVES:**

The student should be made to:

- To visualize the effects of sampling and TDM
- To Implement AM & FM modulation and demodulation
- To implement PCM & DM
- To implement FSK, PSK and DPSK schemes
- To implement Equalization algorithms
- To implement Error control coding schemes

**LIST OF EXPERIMENTS:**

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Observation (simulation) of signal constellations of BPSK, QPSK and QAM
8. Line coding schemes
9. FSK, PSK and DPSK schemes (Simulation)
10. Error control coding schemes - Linear Block Codes (Simulation)
11. Communication link simulation
12. Equalization – Zero Forcing & LMS algorithms(simulation)

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of the course, the student should be able to:

- Simulate end-to-end Communication Link
- Demonstrate their knowledge in base band signaling schemes through implementation of FSK, PSK and DPSK
- Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system
- Simulate & validate the various functional modules of a communication system

**LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS PER EXPERIMENT):**

- i) Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes
- ii) CROs – 15 Nos
- iii) MATLAB / SCILAB or equivalent software package for simulation experiments
- iv) PCs - 10 Nos

**OBJECTIVES:****The student should be made to:**

- Introduce ALP concepts and features
- Write ALP for arithmetic and logical operations in 8086 and 8051
- Differentiate Serial and Parallel Interface
- Interface different I/Os with Microprocessors
- Be familiar with MASM

**LIST OF EXPERIMENTS:****8086 Programs using kits and MASM**

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching
5. Password checking, Print RAM size and system date
6. Counters and Time Delay

**Peripherals and Interfacing Experiments**

7. Traffic light control
8. Stepper motor control
9. Digital clock
10. Key board and Display
11. Printer status
12. Serial interface and Parallel interface
13. A/D and D/A interface and Waveform Generation

**8051 Experiments using kits and MASM**

14. Basic arithmetic and Logical operations
15. Square and Cube program, Find 2's complement of a number
16. Unpacked BCD to ASCII

**TOTAL: 45 PERIODS****OUTCOMES:****At the end of the course, the student should be able to:**

- Write ALP Programmes for fixed and Floating Point and Arithmetic
- Interface different I/Os with processor
- Generate waveforms using Microprocessors
- Execute Programs in 8051
- Explain the difference between simulator and Emulator

**LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS:****HARDWARE:**

|                       |               |
|-----------------------|---------------|
| 8086 development kits | - 30 nos      |
| Interfacing Units     | - Each 10 nos |
| Microcontroller       | - 30 nos      |

**SOFTWARE:**

|                                 |          |
|---------------------------------|----------|
| Intel Desktop Systems with MASM | - 30 nos |
| 8086 Assembler                  |          |
| 8051 Cross Assembler            |          |

**OBJECTIVES:**

- To make students understand the basic structure and operation of digital computer.
- To understand the hardware-software interface.
- To familiarize the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations.
- To expose the students to the concept of pipelining.
- To familiarize the students with hierarchical memory system including cache memories and virtual memory.
- To expose the students with different ways of communicating with I/O devices and standard I/O interfaces.

**UNIT I OVERVIEW & INSTRUCTIONS****9**

Eight ideas – Components of a computer system – Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Logical operations – control operations – Addressing and addressing modes.

**UNIT II ARITHMETIC OPERATIONS****7**

ALU - Addition and subtraction – Multiplication – Division – Floating Point operations – Subword parallelism.

**UNIT III PROCESSOR AND CONTROL UNIT****11**

Basic MIPS implementation – Building datapath – Control Implementation scheme – Pipelining – Pipelined datapath and control – Handling Data hazards & Control hazards – Exceptions.

**UNIT IV PARALLELISM****9**

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors

**UNIT V MEMORY AND I/O SYSTEMS****9**

Memory hierarchy - Memory technologies – Cache basics – Measuring and improving cache performance - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.

**TOTAL: 45 PERIODS****OUTCOMES:**

**At the end of the course, the student should be able to:**

- Design arithmetic and logic unit.
- Design and analyse pipelined control units
- Evaluate performance of memory systems.
- Understand parallel processing architectures.

**TEXT BOOK:**

1. David A. Patterson and John L. Hennessey, "Computer Organization and Design", Fifth edition, Morgan Kaufman / Elsevier, 2014.

**REFERENCES:**

1. V.Carl Hamacher, Zvonko G. Varanescic and Safat G. Zaky, "Computer Organisation", VI edition, Mc Graw-Hill Inc, 2012.
2. William Stallings "Computer Organization and Architecture", Seventh Edition , Pearson Education, 2006.
3. Vincent P. Heuring, Harry F. Jordan, "Computer System Architecture", Second Edition, Pearson Education, 2005.



## OUTCOMES:

### Upon completion of the course, students should

- Explain the basic CMOS circuits and the CMOS process technology.
- Discuss the techniques of chip design using programmable devices.
- Model the digital system using Hardware Description Language.

## TEXTBOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997

## REFERENCES:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addison Wesley 1993
2. R.Jacob Baker, Harry W.Li., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005
3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

EC6602

## ANTENNA AND WAVE PROPAGATION

L T P C  
3 0 0 3

### OBJECTIVES:

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

### UNIT I FUNDAMENTALS OF RADIATION

9

Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole, Yagi array.

### UNIT II APERTURE AND SLOT ANTENNAS

9

Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna , Reflector antenna , Aperture blockage , Feeding structures , Slot antennas ,Microstrip antennas – Radiation mechanism – Application ,Numerical tool for antenna analysis

### UNIT III ANTENNA ARRAYS

9

N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array

### UNIT IV SPECIAL ANTENNAS

9

Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR

## UNIT V PROPAGATION OF RADIO WAVES

9

Modes of propagation , Structure of atmosphere , Ground wave propagation , Tropospheric propagation , Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation

**TOTAL: 45 PERIODS**

### OUTCOMES:

**Upon completion of the course, students will be able to:**

- Explain the various types of antennas and wave propagation.
- Write about the radiation from a current element.
- Analyze the antenna arrays, aperture antennas and special antennas such as frequency independent and broad band

### TEXT BOOK:

1. John D Kraus, "Antennas for all Applications", 3<sup>rd</sup> Edition, Mc Graw Hill, 2005.

### REFERENCES:

1. Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006
2. R.E.Collin,"Antennas and Radiowave Propagation", Mc Graw Hill 1985.
3. Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.
4. Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.
5. S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
6. Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.
7. H.Sizun "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.

EC6611

**COMPUTER NETWORKS LABORATORY**

L T P C  
0 0 3 2

### OBJECTIVES:

**The student should be made to:**

- Learn to communicate between two desktop computers.
- Learn to implement the different protocols
- Be familiar with socket programming.
- Be familiar with the various routing algorithms
- Be familiar with simulation tools.

### LIST OF EXPERIMENTS:

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of Stop and Wait Protocol and sliding window
3. Implementation and study of Goback-N and selective repeat protocols
4. Implementation of High Level Data Link Control
5. Study of Socket Programming and Client – Server model
6. Write a socket Program for Echo/Ping/Talk commands.
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Network Topology - Star, Bus, Ring
9. Implementation of distance vector routing algorithm

- Implement different type of applications for smart phones and mobile devices with latest network strategies.

#### TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.(Unit IV,V)

#### REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

**EC6811**

**PROJECT WORK**

**L T P C**  
**0 0 12 6**

#### OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 180 PERIODS**

#### OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

**EC6001**

**MEDICAL ELECTRONICS**

**L T P C**  
**3 0 0 3**

#### OBJECTIVES:

- To gain knowledge about the various physiological parameters both electrical and non electrical and the methods of recording and also the method of transmitting these parameters.
- To study about the various assist devices used in the hospitals.
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

|                                                                                                                                                                                          |                                                              |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|----------|
| <b>UNIT I</b>                                                                                                                                                                            | <b>ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING</b>        | <b>9</b> |
| The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.      |                                                              |          |
| <b>UNIT II</b>                                                                                                                                                                           | <b>BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT</b> | <b>9</b> |
| pH, PO <sub>2</sub> , PCO <sub>2</sub> , colorimeter, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters. |                                                              |          |
| <b>UNIT III</b>                                                                                                                                                                          | <b>ASSIST DEVICES</b>                                        | <b>9</b> |
| Cardiac pacemakers, DC Defibrillator, Dialyser, Heart lung machine                                                                                                                       |                                                              |          |
| <b>UNIT IV</b>                                                                                                                                                                           | <b>PHYSICAL MEDICINE AND BIOTELEMETRY</b>                    | <b>9</b> |
| Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy Telemetry principles, frequency selection, biotelemetry, radiopill, electrical safety   |                                                              |          |
| <b>UNIT V</b>                                                                                                                                                                            | <b>RECENT TRENDS IN MEDICAL INSTRUMENTATION</b>              | <b>9</b> |
| Thermograph, endoscopy unit, Laser in medicine, cryogenic application, Introduction to telemedicine                                                                                      |                                                              |          |

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Discuss the application of electronics in diagnostic and therapeutic area.
- Measure biochemical and various physiological information.
- Describe the working of units which will help to restore normal functioning.

#### **TEXTBOOKS:**

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. John G.Webster, "Medical Instrumentation Application and Design", 3<sup>rd</sup> Edition, Wiley India Edition, 2007

#### **REFERENCES:**

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA Mc Graw-Hill, New Delhi, 2003.
2. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2004.

**EC6002**

**ADVANCED DIGITAL SIGNAL PROCESSING**

**L T P C**  
**3 0 0 3**

#### **OBJECTIVES:**

- To bring out the concepts related to stationary and non-stationary random signals
- To emphasize the importance of true estimation of power spectral density
- To introduce the design of linear and adaptive systems for filtering and linear prediction
- To introduce the concept of wavelet transforms in the context of image processing

|                                                                                                                                                                                                                                                                                                               |                                         |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------|
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                 | <b>DISCRETE-TIME RANDOM SIGNALS</b>     | <b>9</b> |
| <b>Discrete random process</b> – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes. |                                         |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                | <b>SPECTRUM ESTIMATION</b>              | <b>9</b> |
| <b>Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation, Levinson-Durbin recursion</b>                                                                                                                                     |                                         |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                               | <b>LINEAR ESTIMATION AND PREDICTION</b> | <b>9</b> |
| <b>Forward and Backward linear prediction, Filtering</b> - FIR Wiener filter- Filtering and linear prediction, non-causal and causal IIR Wiener filters, Discrete Kalman filter.                                                                                                                              |                                         |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                | <b>ADAPTIVE FILTERS</b>                 | <b>9</b> |
| Principles of adaptive filter – FIR adaptive filter – <b>Newton's Steepest descent algorithm</b> – <b>LMS algorithm</b> – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers.                                                                                                          |                                         |          |
| <b>UNIT V</b>                                                                                                                                                                                                                                                                                                 | <b>WAVELET TRANSFORM</b>                | <b>9</b> |
| <b>Multiresolution analysis, Continuous and discrete wavelet transform</b> , Short Time Fourier Transform, Application of wavelet transform, Cepstrum and Homomorphic filtering.                                                                                                                              |                                         |          |

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Explain the parametric methods for power spectrum estimation.
- Discuss adaptive filtering techniques using LMS algorithm and the applications of adaptive filtering.
- Analyze the wavelet transforms.

#### **TEXTBOOKS:**

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, Fourth 2007.
3. Dwight F. Mix, "Random Signal Processing", Prentice Hall, 1995.

#### **REFERENCE:**

1. Sophocles J. Orfanidis, "Optimum Signal Processing, An Introduction", Mc Graw Hill, 1990.

**CS6401**

**OPERATING SYSTEMS**

**L T P C**  
**3 0 0 3**

#### **OBJECTIVES:**

**The student should be made to:**

- Study the basic concepts and functions of operating systems.
- Understand the structure and functions of OS.
- Learn about Processes, Threads and Scheduling algorithms.
- Understand the principles of concurrency and Deadlocks.
- Learn various memory management schemes.
- Study I/O management and File systems.
- Learn the basics of Linux system and perform administrative tasks on Linux Servers.

|                                                                                                                                                                                                                                                                                                                                                                                                         |                                   |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|----------|
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                           | <b>OPERATING SYSTEMS OVERVIEW</b> | <b>9</b> |
| Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot. |                                   |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                          | <b>PROCESS MANAGEMENT</b>         | <b>9</b> |
| Processes-Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads- Overview, Multicore Programming, Multithreading Models; Windows 7 - Thread and SMP Management. Process Synchronization - Critical Section Problem, Mutex Locks, Semaphores, Monitors; CPU Scheduling and Deadlocks.                                                                        |                                   |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>STORAGE MANAGEMENT</b>         | <b>9</b> |
| Main Memory-Contiguous Memory Allocation, Segmentation, Paging, 32 and 64 bit architecture Examples; Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.                                                                                                                                                                                     |                                   |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                          | <b>I/O SYSTEMS</b>                | <b>9</b> |
| Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage-File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation- File System Structure, Directory Structure, Allocation Methods, Free Space Management, I/O Systems.                                                                                                              |                                   |          |
| <b>UNIT V</b>                                                                                                                                                                                                                                                                                                                                                                                           | <b>CASE STUDY</b>                 | <b>9</b> |
| Linux System- Basic Concepts;System Administration-Requirements for Linux System Administrator, Setting up a LINUX Multifunction Server, Domain Name System, Setting Up Local Network Services; Virtualization- Basic Concepts, Setting Up Xen,VMware on Linux Host and Adding Guest OS.                                                                                                                |                                   |          |

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

**At the end of the course, the student should be able to:**

- Design various Scheduling algorithms.
- Apply the principles of concurrency.
- Design deadlock, prevention and avoidance algorithms.
- Compare and contrast various memory management schemes.
- Design and Implement a prototype file systems.
- Perform administrative tasks on Linux Servers.

#### **TEXT BOOK:**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9<sup>th</sup> Edition, John Wiley and Sons Inc., 2012.

#### **REFERENCES:**

1. William Stallings, "Operating Systems – Internals and Design Principles", 7<sup>th</sup> Edition, Prentice Hall, 2011.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001.
3. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata Mc Graw Hill Education", 1996.
4. D M Dhamdhare, "Operating Systems: A Concept-Based Approach", Second Edition, Tata Mc Graw-Hill Education, 2007.
5. <http://nptel.ac.in/>.

**OBJECTIVES:**

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.

**UNIT I BASIC CONCEPTS**

9

Definition and origin of robotics – different types of robotics – various generations of robots – **degrees of freedom** – **Asimov's laws of robotics** – **dynamic stabilization of robots.**

**UNIT II POWER SOURCES AND SENSORS**

9

**Hydraulic, pneumatic and electric drives** – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

**UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS**

9

Construction of manipulators – **manipulator dynamics and force control** – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

**UNIT IV KINEMATICS AND PATH PLANNING**

9

Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill Climbing Techniques – **robot programming languages**

**UNIT V CASE STUDIES**

9

Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – **selection of robot.**

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon completion of the course, the student should be able to:**

- Explain the basic concepts of working of robot
- Analyze the function of sensors in the robot
- Write program to use a robot for a typical application
- Use Robots in different applications

**TEXT BOOKS:**

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

**REFERENCES:**

1. Deb. S.R., "Robotics Technology and flexible Automation", John Wiley, USA 1992.
2. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi, 1994.
3. Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.
4. Issac Asimov "Robot", Ballantine Books, New York, 1986.
5. Barry Leatham - Jones, "Elements of industrial Robotics" PITMAN Publishing, 1987.
6. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications ", McGraw Hill Book Company 1986.
7. Fu K.S. Gonzalez R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence" McGraw Hill International Editions, 1987.



## UNIT V PROPAGATION OF RADIO WAVES

9

Modes of propagation , Structure of atmosphere , Ground wave propagation , Tropospheric propagation , Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation

**TOTAL: 45 PERIODS**

### OUTCOMES:

**Upon completion of the course, students will be able to:**

- Explain the various types of antennas and wave propagation.
- Write about the radiation from a current element.
- Analyze the antenna arrays, aperture antennas and special antennas such as frequency independent and broad band

### TEXT BOOK:

1. John D Kraus, "Antennas for all Applications", 3<sup>rd</sup> Edition, Mc Graw Hill, 2005.

### REFERENCES:

1. Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006
2. R.E.Collin,"Antennas and Radiowave Propagation", Mc Graw Hill 1985.
3. Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.
4. Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.
5. S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
6. Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.
7. H.Sizun "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.

## EC6611

## COMPUTER NETWORKS LABORATORY

L T P C  
0 0 3 2

### OBJECTIVES:

**The student should be made to:**

- Learn to communicate between two desktop computers.
- Learn to implement the different protocols
- Be familiar with socket programming.
- Be familiar with the various routing algorithms
- Be familiar with simulation tools.

### LIST OF EXPERIMENTS:

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of Stop and Wait Protocol and sliding window
3. Implementation and study of Goback-N and selective repeat protocols
4. Implementation of High Level Data Link Control
5. Study of Socket Programming and Client – Server model
6. Write a socket Program for Echo/Ping/Talk commands.
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Network Topology - Star, Bus, Ring
9. Implementation of distance vector routing algorithm



10. Implementation of Link state routing algorithm
11. Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS
12. Encryption and decryption.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to**

- Communicate between two desktop computers.
- Implement the different protocols
- Program using sockets.
- Implement and compare the various routing algorithms
- Use simulation tool.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

**SOFTWARE**

- C / C++ / Java / Equivalent Compiler
- Network simulator like NS2/ NS3 / Glomosim/OPNET/ Equivalent 30

**HARDWARE**

Standalone desktops 30 Nos

**EC6612**

**VLSI DESIGN LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To learn Hardware Descriptive Language(Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarise fusing of logical modules on FPGAs
- To provide hands on design experience with professional design (EDA) platforms.

**LIST OF EXPERIMENTS**

**FPGA BASED EXPERIMENTS.**

1. HDL based design entry and simulation of simple counters, state machines, adders (min 8 bit) and multipliers (4 bit min).
2. Synthesis, P&R and post P&R simulation of the components simulated in (I) above. Critical paths and static timing analysis results to be identified. Identify and verify possible conditions under which the blocks will fail to work correctly.
3. Hardware fusing and testing of each of the blocks simulated in (I). Use of either chipscope feature (Xilinx) or the signal tap feature (Altera) is a must. Invoke the PLL and demonstrate the use of the PLL module for clock generation in FPGAs.

**IC DESIGN EXPERIMENTS: (BASED ON CADENCE / MENTOR GRAPHICS / EQUIVALENT)**

4. Design and simulation of a simple 5 transistor differential amplifier. Measure gain, ICMR, and CMRR
5. Layout generation, parasitic extraction and resimulation of the circuit designed in (I)
6. Synthesis and Standard cell based design of an circuits simulated in 1(I) above. Identification of critical paths, power consumption.

7. For expt (c) above, P&R, power and clock routing, and post P&R simulation.
8. Analysis of results of static timing analysis.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to**

- Write HDL code for basic as well as advanced digital integrated circuits.
- Import the logic modules into FPGA Boards.
- Synthesize, Place and Route the digital IPs.
- Design, Simulate and Extract the layouts of Analog IC Blocks using EDA tools.

**LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

|                                                     |                 |
|-----------------------------------------------------|-----------------|
| Xilinx or Altera FPGA                               | 10 nos          |
| Xilinx software                                     |                 |
| Cadence/MAGMA/Tanner or equivalent software package | 10 User License |
| PCs                                                 | 10 No.s         |

**GE6674**

**COMMUNICATION AND SOFT SKILLS- LABORATORY BASED**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

To enable learners to,

- Develop their communicative competence in English with specific reference to speaking and listening
- Enhance their ability to communicate effectively in interviews.
- Strengthen their prospects of success in competitive examinations.

**UNIT I LISTENING AND SPEAKING SKILLS**

**12**

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

**UNIT II READING AND WRITING SKILLS**

**12**

Reading different genres of texts ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

**UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS**

**12**

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service(Language related)- Verbal Ability.

**OBJECTIVES:**

- To inculcate understanding of the basics required for circuit representation of RF networks.
- To deal with the issues in the design of microwave amplifier.
- To instill knowledge on the properties of various microwave components.
- To deal with the microwave generation and microwave measurement techniques

**UNIT I TWO PORT NETWORK THEORY****9**

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behavior of Resistors, Capacitors and Inductors.

**UNIT II RF AMPLIFIERS AND MATCHING NETWORKS****9**

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks, Microstrip Line Matching Networks.

**UNIT III PASSIVE AND ACTIVE MICROWAVE DEVICES****9**

Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottky diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MIC.

**UNIT IV MICROWAVE GENERATION****9**

Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

**UNIT V MICROWAVE MEASUREMENTS****9**

Measuring Instruments : Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Explain the active & passive microwave devices & components used in Microwave communication systems.
- Analyze the multi- port RF networks and RF transistor amplifiers.
- Generate Microwave signals and design microwave amplifiers.
- Measure and analyze Microwave signal and parameters.

**TEXT BOOKS:**

1. Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design: Theory and Applications", Pearson Education Inc., 2011
2. Robert E Colin, "Foundations for Microwave Engineering", John Wiley & Sons Inc, 2005

## REFERENCES:

1. David M. Pozar, "Microwave Engineering", Wiley India (P) Ltd, New Delhi, 2008.
2. Thomas H Lee, "Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits", Cambridge University Press, 2004.
3. Mathew M Radmanesh, "RF and Microwave Electronics", Prentice Hall, 2000.
4. Annapurna Das and Sisir K Das, "Microwave Engineering", Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.

**EC6702**

**OPTICAL COMMUNICATION AND NETWORKS**

**L T P C**

**3 0 0 3**

## OBJECTIVES:

- To Facilitate the knowledge about optical fiber sources and transmission techniques
- To Enrich the idea of optical fiber networks algorithm such as SONET/SDH and optical CDMA.
- To Explore the trends of optical fiber measurement systems.

### UNIT I INTRODUCTION TO OPTICAL FIBERS

**9**

Evolution of fiber optic system- Element of an Optical Fiber Transmission link-- Total internal reflection-Acceptance angle –Numerical aperture – Skew rays Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts-Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure.

### UNIT II SIGNAL DEGRADATION OPTICAL FIBERS

**9**

Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength.

### UNIT III FIBER OPTICAL SOURCES AND COUPLING

**9**

Direct and indirect Band gap materials-LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition -Rate equations -External Quantum efficiency -Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, Lencing schemes, Fiber -to- Fiber joints, Fiber splicing-Signal to Noise ratio , Detector response time.

### UNIT IV FIBER OPTIC RECEIVER AND MEASUREMENTS

**9**

Fundamental receiver operation, Pre amplifiers, Error sources – Receiver Configuration– Probability of Error – Quantum limit.Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber Numerical Aperture Measurements – Fiber diameter measurements.

## UNIT V OPTICAL NETWORKS AND SYSTEM TRANSMISSION

9

Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks –Wavelength Routed Networks – Non linear effects on Network performance –Link Power budget -Rise time budget- Noise Effects on System Performance-Operational Principles of WDM Performance of WDM + EDFA system – Solutions – Optical CDMA – Ultra High Capacity Networks.

**TOTAL: 45 PERIODS**

### OUTCOMES:

**Upon completion of the course, students will be able to:**

- Discuss the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber.
- Explain the various optical sources and optical detectors and their use in the optical communication system.
- Analyze the digital transmission and its associated parameters on system performance.

### TEXT BOOKS:

1. Gerd Keiser, "Optical Fiber Communication" Mc Graw -Hill International, 4<sup>th</sup> Edition., 2010.
2. John M. Senior, "Optical Fiber Communication", Second Edition, Pearson Education, 2007.

### REFERENCES:

1. Ramaswami, Sivarajan and Sasaki "Optical Networks", Morgan Kaufmann, 2009.
2. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3<sup>rd</sup> Edition, 2008.
3. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

**EC6703**

**EMBEDDED AND REAL TIME SYSTEMS**

**L T P C**

**3 0 0 3**

### OBJECTIVES:

**The student should be made to:**

- Learn the architecture and programming of ARM processor.
- Be familiar with the embedded computing platform design and analysis.
- Be exposed to the basic concepts of real time Operating system.
- Learn the system design techniques and networks for embedded systems

## UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS

9

Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries - ARM Processor – CPU: programming input and output-supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

## UNIT II EMBEDDED COMPUTING PLATFORM DESIGN

9

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

### **UNIT III      PROCESSES AND OPERATING SYSTEMS      9**

Introduction – Multiple tasks and multiple processes – **Multirate systems**- Preemptive real-time operating systems- **Priority based scheduling**- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.

### **UNIT V      SYSTEM DESIGN TECHNIQUES AND NETWORKS      9**

Design methodologies- **Design flows** - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- **Distributed embedded systems** – MPSoCs and shared memory multiprocessors.

### **UNIT V      CASE STUDY      9**

Data compressor - **Alarm Clock** - Audio player - Software modem-**Digital still camera** - Telephone answering machine-Engine control unit – Video accelerator.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Describe the architecture and programming of ARM processor.
- Outline the concepts of embedded systems
- Explain the basic concepts of real time Operating system design.
- Use the system design techniques to develop software for embedded systems
- Differentiate between the general purpose operating system and the real time operating system
- Model real-time applications using embedded-system concepts

#### **TEXT BOOK:**

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

#### **REFERENCES:**

1. Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.
2. David. E. Simon, “An Embedded Software Primer”, 1<sup>st</sup> Edition, Fifth Impression, Addison-Wesley Professional, 2007.
3. Raymond J.A. Buhr, Donald L.Bailey, “An Introduction to Real-Time Systems- From Design to Networking with C/C++”, Prentice Hall, 1999.
4. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, Mc Graw Hill 1997
5. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, Dream Tech Press, 2005.
6. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc Graw Hill, 2004.

**OBJECTIVES:**

- To understand the basics of satellite orbits.
- To understand the satellite segment and earth segment.
- To analyze the various methods of satellite access.
- To understand the applications of satellites.

**UNIT I SATELLITE ORBITS****9**

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility –eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

**UNIT II SPACE SEGMENT AND SATELLITE LINK DESIGN****9**

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation- performance impairments-system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.

**UNIT III EARTH SEGMENT****9**

Introduction – Receive – Only home TV systems – Outdoor unit – Indoor unit for analog (FM) TV – Master antenna TV system – Community antenna TV system – Transmit – Receive earth stations – Problems – Equivalent isotropic radiated power – Transmission losses – Free-space transmission – Feeder losses – Antenna misalignment losses – Fixed atmospheric and ionospheric losses – Link power budget equation – System noise – Antenna noise – Amplifier noise temperature – Amplifiers in cascade – Noise factor – Noise temperature of absorptive networks – Overall system noise temperature – Carrier-to- Noise ratio – Uplink – Saturation flux density – Input back off – The earth station - HPA – Downlink – Output back off – Satellite TWTA output – Effects of rain – Uplink rain– Fade margin – Downlink rain – Fade margin – Combined uplink and downlink C/N ratio – Inter modulation noise.

**UNIT IV SATELLITE ACCESS****9**

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression – encryption.

**UNIT V SATELLITE APPLICATIONS****9**

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- Analyze the satellite orbits.
- Analyze the earth segment and space segment.
- Design various satellite applications

**TEXT BOOK:**

1. Dennis Roddy, "Satellite Communication", 4<sup>th</sup> Edition, Mc Graw Hill International, 2006.



## REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. N. Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Boston London, 1997.
4. Tri T. Ha, "Digital Satellite Communication", II<sup>nd</sup> edition, 1990.
5. Emanuel Fthenakis, "Manual of Satellite Communications", Mc Graw Hill Book Co., 1984.
6. Robert G. Winch, "Telecommunication Trans Mission Systems", Mc Graw-Hill Book Co., 1983.
7. Brian Ackroyd, "World Satellite Communication and earth station Design", BSP professional Books, 1990.
8. G.B. Bleazard, "Introducing Satellite communications", NCC Publication, 1985.
9. M. Richharia, "Satellite Communication Systems-Design Principles", Macmillan 2003.

EC6005

ELECTRONIC TESTING

L T P C  
3 0 0 3

## OBJECTIVES:

- To understand the basics of testing and the testing equipments
- To understand the different testing methods

### UNIT I INTRODUCTION

9

Test process and automatic test equipment, test economics and product quality, fault modeling

### UNIT II DIGITAL TESTING

9

Logic and fault simulation, testability measures, combinational and sequential circuit test generation.

### UNIT III ANALOG TESTING

9

Memory Test, DSP Based Analog and Mixed Signal Test, Model based analog and mixed signal test, delay test, IIDQ test.

### UNIT IV DESIGN FOR TESTABILITY

9

Built-in self-test, Scan chain design, Random Logic BIST, Memory BIST, Boundary scan test standard, Analog test bus, Functional Microprocessor Test, Fault Dictionary, Diagnostic Tree, Testable System Design, Core Based Design and Test Wrapper Design, Test design for SOCs

### UNIT V LOADED BOARD TESTING

9

Unpowered short circuit tests, unpowered analog tests, Powered in-circuit analog, digital and mixed signal tests, optical and X-ray inspection procedures, functional block level design of in-circuit test equipment

**TOTAL: 45 PERIODS**

## OUTCOMES:

Upon completion of the course, students

- Explain different testing equipments.
- Design the different testing schemes for a circuit.
- Discuss the need for test process

## TEXT BOOK:

1. Michael L. Bushnell and Vishwani D. Agarwal, "Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits", Springer, 2006.



**REFERENCE:**

1. Dimitris Gizopoulos , “Advances in Electronic Testing” , Springer 2006.

**EC6006****AVIONICS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the needs for avionics for both Civil and military aircraft.
- To introduce various digital electronic principles and working operations of digital circuit.
- To integrate the digital electronics with cockpit equipments
- To understand the various principles in flight disk and cockpit panels.
- To study the communication and navigation equipment
- To study certificate aspects of the Avionics system

**UNIT I INTRODUCTION TO AVIONICS****9**

Basics of Avionics-**Basics of Cockpits**-Need for Avionics in civil and military aircraft and space systems – Integrated Avionics Architecture –**Military and Civil system** – Typical avionics System and Sub systems – Design and Technologies.

**UNIT II DIGITAL AVIONICS BUS ARCHITECTURE****9**

Avionics Bus architecture-**Data buses MIL**-RS 232- RS422-RS 485-AFDX/ARINC-664-MIL STD 1553 B-ARINC 429-ARINC 629- **Aircraft system Interface**

**UNIT III FLIGHT DECK AND COCKPITS****9**

Control and display technologies CRT, LED, LCD, EL and plasma panel - **Touch screen** - Direct voice input (DVI) – **ARINC 818**-Civil cockpit and military cockpit: MFDS, PFDS-HUD, HMD, HMI

**UNIT IV AVIONICS SYSTEMS****9**

Communication Systems - **Navigation systems** - Flight control systems - **Radar electronic Warfare** - Utility systems Reliability and maintainability Fundamentals- Certification-Military and civil aircrafts.

**UNIT V ON BOARD NAVIGATION SYSTEMS****9**

Over view of navigational aids, **Flight planning**, Area navigation, required time of arrival, RNAV architecture , performance aspects, approach and landing challenges, regulatory and safety aspects, **INS, GPS and GNSS characteristics.**

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of the course, students will:**

- Describe the hardware required for aircraft.
- Explain the communication and navigation techniques used in aircrafts.
- Discuss about the autopilot and cockpit display related concepts.

**TEXT BOOK:**

1. R.P.G. Collinson, “Introduction to Avionics”, Chapman & Hall Publications, 1996.

## REFERENCES:

1. Cary R .Spitzer, "The Avionics Handbook", CRC Press, 2000.
2. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
4. Brain Kendal, "Manual of Avionics", The English Book House, 3<sup>rd</sup> Edition, New Delhi, 1993
5. Jim Curren, "Trend in Advanced Avionics", IOWA State University, 1992.

CS6012

SOFT COMPUTING

L T P C  
3 0 0 3

## OBJECTIVES:

The student should be made to:

- Learn the various soft computing frame works
- Be familiar with design of various neural networks
- Be exposed to fuzzy logic
- Learn genetic programming.
- Be exposed to hybrid systems.

## UNIT I INTRODUCTION

9

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications.

Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

## UNIT II NEURAL NETWORKS

9

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self organizing feature maps, LVQ – CP networks, ART network.

## UNIT III FUZZY LOGIC

9

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

## UNIT IV GENETIC ALGORITHM

9

Genetic algorithm and search space - general genetic algorithm – operators - Generational cycle - stopping condition – constraints - classification - genetic programming – multilevel optimization – real life problem- advances in GA

**OBJECTIVES:**

- To introduce speech production and related parameters of speech.
- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
- To understand different speech modeling procedures such as Markov and their implementation issues.

**UNIT I BASIC CONCEPTS****10**

**Speech Fundamentals: Articulatory Phonetics** – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-**Time Fourier Transform**, Filter-Bank and LPC Methods.

**UNIT II SPEECH ANALYSIS****10**

Features, Feature Extraction and Pattern Comparison Techniques: **Speech distortion measures** – mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, **Likelihood Distortions**, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – **Alignment Paths**.

**UNIT III SPEECH MODELING****8**

Hidden Markov Models: Markov Processes, **HMMs – Evaluation**, Optimal State Sequence – Viterbi Search, **Baum-Welch Parameter Re-estimation**, Implementation issues.

**UNIT IV SPEECH RECOGNITION****8**

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – **acoustics and language models** – n-grams, context dependent sub-word units; **Applications and present status**.

**UNIT V SPEECH SYNTHESIS****9**

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, **sub-word units for TTS**, intelligibility and naturalness – role of prosody, **Applications and present status**.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Model speech production system and describe the fundamentals of speech.
- Extract and compare different speech parameters.
- Choose an appropriate statistical speech model for a given application.
- Design a speech recognition system.
- Use different speech synthesis techniques.

**TEXTBOOKS:**

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2002.
3. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1997.

## REFERENCES:

1. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing, 1997.
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education, 2004.
3. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
4. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006.

EC6008

WEB TECHNOLOGY

L T P C

3 0 0 3

## OBJECTIVES:

- To design and create user interfaces using Java frames and applets.
- To have a basic idea about network programming using Java.
- To create simple Web pages and provide client side validation.
- To create dynamic web pages using server side scripting

### UNIT I JAVA FUNDAMENTALS

9

Java Data types – Class – Object – I / O Streams – File Handling concepts – Threads – Applets – Swing Framework – Reflection

### UNIT II JAVA NETWORKING FUNDAMENTALS

9

Overview of Java Networking - TCP - UDP - InetAddress and Ports - Socket Programming - Working with URLs - Internet Protocols simulation - HTTP - SMTP - POP - FTP - Remote Method Invocation - Multithreading Concepts

### UNIT III CLIENT SIDE TECHNOLOGIES

9

XML - Document Type Definition - XML Schema - Document Object Model - Presenting XML - Using XML Parsers: DOM and SAX – JavaScript Fundamentals - Evolution of AJAX - AJAX Framework - Web applications with AJAX - AJAX with PHP - AJAX with Databases

### UNIT IV SERVER SIDE TECHNOLOGIES

9

Servlet Overview - Life cycle of a Servlet - Handling HTTP request and response - Using Cookies - Session tracking - Java Server Pages - Anatomy of JSP - Implicit JSP Objects – JDBC - Java Beans - Advantages - Enterprise Java Beans - EJB Architecture - Types of Beans - EJB Transactions

### UNIT V APPLICATION DEVELOPMENT ENVIRONMENT

9

Overview of MVC architecture - Java Server Faces: Features - Components - Tags - Struts: Working principle of Struts - Building model components - View components - Controller components - Forms with Struts - Presentation tags - Developing Web applications - Hibernate: Configuration Settings - Mapping persistent classes - Working with persistent objects - Concurrency - Transactions - Caching - Queries for retrieval of objects - Spring: Framework - Controllers - Developing simple applications.

**TOTAL: 45 PERIODS**

## OUTCOMES:

Upon completion of the course, students will be able to:

- Have knowledge about the fundamental Java networking technologies.
- Design their own web services using the client server concepts
- Describe the techniques involved to support real-time Software development.

**TEXT BOOK:**

1. Deitel, Deitel, Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education, 2006.

**REFERENCES:**

1. Marty Hall and Larry Brown, "Core Servlets and Javasever Pages", Second Edition
2. Bryan Basham, Kathy Siegra, Bert Bates, "Head First Servlets and JSP", Second Edition
3. Uttam K Roy, "Web Technologies", Oxford University Press, 2011.

**EC6009****ADVANCED COMPUTER ARCHITECTURE****L T P C  
3 0 0 3****OBJECTIVES:****The student should be made to:**

- Understand the micro-architectural design of processors
- Learn about the various techniques used to obtain performance improvement and power savings in current processors

**UNIT I FUNDAMENTALS OF COMPUTER DESIGN****9**

Review of Fundamentals of CPU, Memory and IO – Trends in technology, power, energy and cost, Dependability - Performance Evaluation

**UNIT II INSTRUCTION LEVEL PARALLELISM****9**

ILP concepts – Pipelining overview - Compiler Techniques for Exposing ILP – Dynamic Branch Prediction – Dynamic Scheduling – Multiple instruction Issue – Hardware Based Speculation – Static scheduling - Multi-threading - Limitations of ILP – Case Studies.

**UNIT III DATA-LEVEL PARALLELISM****9**

Vector architecture – SIMD extensions – Graphics Processing units – Loop level parallelism.

**UNIT IV THREAD LEVEL PARALLELISM****9**

Symmetric and Distributed Shared Memory Architectures – Performance Issues –Synchronization – Models of Memory Consistency – Case studies: Intel i7 Processor, SMT & CMP Processors

**UNIT V MEMORY AND I/O****9**

Cache Performance – Reducing Cache Miss Penalty and Miss Rate – Reducing Hit Time – Main Memory and Performance – Memory Technology. Types of Storage Devices – Buses – RAID – Reliability, Availability and Dependability – I/O Performance Measures.

**TOTAL: 45 PERIODS****OUTCOMES:****At the end of the course, the student should be able to:**

- Evaluate performance of different architectures with respect to various parameters
- Analyze performance of different ILP techniques
- Identify cache and memory related issues in multi-processors

**TEXT BOOK:**

1. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, Fifth Edition, 2012.

## REFERENCES:

1. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", Mc Graw-Hill International Edition, 2000.
2. Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.

EC6010

ELECTRONICS PACKAGING

L T P C  
3 0 0 3

## OBJECTIVES:

- To give a comprehensive introduction to the various packaging types used along with the associated same the thermal, speed, signal and integrity power issues.
- To introduce about CAD used in designing wiring boards

### UNIT I OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING

9

Definition of a system and history of semiconductors, **Products and levels of packaging**, Packaging aspects of handheld products, **Definition of PWB**, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, **Wire bonding**, TAB and flip chip.

### UNIT II SEMICONDUCTOR PACKAGES

9

Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; **Thermal mismatch in packages**; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; **Electrical Design considerations in systems packaging**, Resistive, Capacitive and Inductive Parasitics, Layout guidelines and the Reflection problem, **Interconnection**.

### UNIT III CAD FOR PRINTED WIRING BOARDS

9

Benefits from CAD; **Introduction to DFM, DFR & DFT**, Components of a CAD package and its highlights, Beginning a circuit design with schematic work and component, layout, DFM check, list and design rules; **Design for Reliability**, Printed Wiring Board Technologies: Board-level packaging aspects, Review of CAD output files for PCB fabrication; Photo plotting and mask generation, Process flow-chart; Vias; PWB substrates; Surface preparation, Photoresist and application methods; UV exposure and developing; Printing technologies for PWBs, PWB etching; PWB etching; Resist stripping; **Screen-printing technology**, through-hole manufacture process steps; Panel and pattern plating methods, Solder mask for PWBs; Multilayer PWBs; Introduction to, microvias, Microvia technology and Sequential build-up technology process flow for high-density, interconnects

### UNIT IV SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS

9

SMD benefits; Design issues; Introduction to soldering, **Reflow and Wave Soldering methods to attach SMDs**, Solders; Wetting of solders; Flux and its properties; Defects in wave soldering, Vapour phase soldering, BGA soldering and Desoldering/Repair; SMT failures, SMT failure library and Tin Whisker, Tin-lead and lead-free solders; Phase diagrams; **Thermal profiles for reflow soldering**; Lead free Alloys, **Lead-free solder considerations**; Green electronics; RoHS compliance and e-waste recycling, Issues, Thermal Design considerations in systems packaging (L. Umanand, Thermal Design considerations in systems packaging

**UNIT V EMBEDDED PASSIVES TECHNOLOGY****9**

Introduction to embedded passives; Need for embedded passives; Design Library; Embedded resistor processes, **Embedded capacitors**; Processes for embedding capacitors; Case study examples.

**TOTAL: 45 PERIODS****OUTCOMES:**

Given an electronic system PCB or integrated circuit design specifications, the student should be in a position to recommend the appropriate packaging style to be used, and propose a design a design procedure and solution for the same.

**TEXT BOOK:**

1. Rao R. Tummala, "Fundamentals of Microsystems Packaging", McGraw Hill, NY, 2001

**REFERENCE:**

1. William D. Brown, "Advanced Electronic Packaging", IEEE Press, 1999.

**EC6011 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY****L T P C  
3 0 0 3****OBJECTIVES:**

- To tutor the basics of EMI, EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques
- To impart comprehensive insight about the current EMC standards and about various measurement techniques

**UNIT I BASIC THEORY****8**

Introduction to EMI and EMC, **Intra and inter system EMI**, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, **EMC Testing categories**, EMC Engineering Application.

**UNIT II COUPLING MECHANISM****9**

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, **Impedance coupling**, Inductive and Capacitive coupling, Radiative coupling, **Ground loop coupling**, Cable related emissions and coupling, Transient sources, Automotive transients.

**UNIT III EMI MITIGATION TECHNIQUES****10**

Working principle of Shielding and Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, **Choice of Materials for H, E, and free space fields**, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

**UNIT IV STANDARDS AND REGULATION****9**

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, **Product Standards**, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, **MIL461E Standards**.



## UNIT V EMI TEST METHODS AND INSTRUMENTATION

9

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber, **Shielded anechoic chamber**, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, **Current probes**, MIL -STD test methods, Civilian STD test methods.

**TOTAL: 45 PERIODS**

### OUTCOMES:

**Upon completion of the course, students will be able to:**

- Find solution to EMI Sources, EMI problems in PCB level / Subsystem and system level design.
- To measure emission immunity level from different systems to couple with the prescribed EMC standards

### TEXT BOOK:

1. Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2006

### REFERENCES:

1. V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, Newyork, 2001.
2. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009
3. Daryl Gerke and William Kimmel, "EDN's Designer's Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002
4. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.
5. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005,

EC6012

## CMOS ANALOG IC DESIGN

L T P C  
3 0 0 3

### OBJECTIVES:

- To study designs with better precision in data conversion
- To study various ADC and DAC circuit architectures

## UNIT I SAMPLE AND HOLD

9

Properties of MOS Switches, **multiplexed input architectures**, recycling architecture, open and closed loop sampling architectures, switched capacitor and current mode architectures.

## UNIT II BUILDING BLOCK OF DATA CONVERSION CIRCUITS:

9

Amplifiers, open loop and closed loop amplifiers, gain boosting, **common mode feedback**, bipolar, CMOS and BiCMOS comparators.

## UNIT III PRECISION TECHNIQUES

9

Comparator cancellation, **input and output offset storage principles**, comparators using offset cancelled latches, opamp offset cancellation, ADC and DAC calibration techniques.

## UNIT IV ADC/DAC ARCHITECTURES

9

DAC Performance metrics, reference multiplication and division, switching and logical functions of DACs, Current steering architectures, **DAC Performance metrics**, Flash ADC architecture, Gray encoding, thermometer encoding and metastability.



## UNIT V OVER SAMPLING CONVERTERS

9

Delta sigma modulators, alternative modulator architectures, quantization and noise shaping, decimation filtering, implementation of Delta sigma modulators, delta sigma DACs,

**TOTAL: 45 PERIODS**

### OUTCOMES:

Upon completion of the course, the student should be able to:

- Build Data Conversion circuits.
- Discuss calibration techniques
- Analyze ADC/DAC Architecture and Performance

### TEXT BOOK:

1. B.Razavi "Data Conversion System Design" IEEE Press and John Wiley, 1995.

### REFERENCE:

1. Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Second Edition, Oxford University Press, 2004.

EC6013

## ADVANCED MICROPROCESSORS AND MICROCONTROLLERS

L T P C  
3 0 0 3

### OBJECTIVES:

- To expose the students to the fundamentals of microprocessor architecture.
- To introduce the advanced features in microprocessors and microcontrollers.
- To enable the students to understand various microcontroller architectures.

## UNIT I HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM

9

CPU Architecture- Bus Operations – Pipelining – Branch predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

## UNIT II HIGH PERFORMANCE RISC ARCHITECTURE – ARM

9

Arcon RISC Machine – Architectural Inheritance – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors - ARM instruction set- Thumb Instruction set - Instruction cycle timings - The ARM Programmer's model – ARM Development tools – ARM Assembly Language Programming - C programming – Optimizing ARM Assembly Code – Optimized Primitives.

## UNIT III ARM APPLICATION DEVELOPMENT

9

Introduction to DSP on ARM –FIR filter – IIR filter – Discrete fourier transform – Exception handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Embedded Operating systems – Integrated Development Environment- STDIO Libraries – Peripheral Interface – Application of ARM Processor - Caches – Memory protection Units – Memory Management units – Future ARM Technologies.

## UNIT IV MOTOROLA 68HC11 MICROCONTROLLERS

9

Instruction set addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART.

## UNIT V PIC MICROCONTROLLER

9

CPU Architecture – Instruction set – interrupts- Timers- I<sup>2</sup>C Interfacing –UART- A/D Converter –PWM and introduction to C-Compilers.

**TOTAL: 45 PERIODS**

### OUTCOMES:

- The student will be able to work with suitable microprocessor / microcontroller for a specific real world application.

### TEXT BOOK:

1. Andrew N.Sloss, Dominic Symes and Chris Wright “ ARM System Developer’s Guide : Designing and Optimizing System Software” , First edition, Morgan Kaufmann Publishers, 2004.

### REFERENCES:

1. Steve Furber , “ARM System –On –Chip architecture”, Addison Wesley, 2000.
  2. Daniel Tabak , “Advanced Microprocessors”, Mc Graw Hill. Inc., 1995
  3. James L. Antonakos , “ The Pentium Microprocessor”, Pearson Education, 1997.
  4. Gene .H.Miller, “Micro Computer Engineering”, Pearson Education , 2003.
  5. John .B.Peatman , “Design with PIC Microcontroller”, Prentice Hall, 1997.
  6. James L.Antonakos, “An Introduction to the Intel family of Microprocessors”, Pearson Education, 1999.
  7. Barry.B.Brey, “The Intel Microprocessors Architecture, Programming and Interfacing”, PHI, 2002.
  8. Valvano, "Embedded Microcomputer Systems", Thomson Asia PVT LTD first reprint 2001.
- Readings: Web links [www.ocw.nit.edu](http://www.ocw.nit.edu) [www.arm.com](http://www.arm.com)

EC6014

COGNITIVE RADIO

L T P C  
3 0 0 3

### OBJECTIVES:

The student should be made to:

- Know the basics of the software defined radios.
- Learn the design of the wireless networks based on the cognitive radios
- Understand the concepts of wireless networks and next generation networks

## UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO

9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

## UNIT II SDR ARCHITECTURE

9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules,.

## UNIT III INTRODUCTION TO COGNITIVE RADIOS

9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

#### UNIT IV COGNITIVE RADIO ARCHITECTURE

9

Cognitive Radio - functions, components and design rules, **Cognition cycle** - orient, plan, decide and act phases, **Inference Hierarchy**, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

#### UNIT V NEXT GENERATION WIRELESS NETWORKS

9

The XG Network architecture, **spectrum sensing**, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

**TOTAL: 45 PERIODS**

#### OUTCOMES:

**Upon completion of the course, students will be able to**

- Describe the basics of the software defined radios.
- Design the wireless networks based on the cognitive radios
- Explain the concepts behind the wireless networks and next generation networks

#### TEXT BOOKS:

1. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.
2. Thomas W. Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE .2009.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
4. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.

#### REFERENCES:

1. Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.
2. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications , Jan 2008.
3. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
4. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
5. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010.

**EC6015**

**RADAR AND NAVIGATIONAL AIDS**

**L T P C**  
**3 0 0 3**

#### OBJECTIVES:

- To apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars
- To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers.
- To understand principles of navigation, in addition to approach and landing aids as related to navigation

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|----------|
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>INTRODUCTION TO RADAR EQUATION</b> | <b>9</b> |
| Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies – <b>Applications of Radar</b> – The Origins of Radar - Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- <b>Radar Cross Section of Targets</b> - Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Other Radar Equation Considerations                                                                                                                                                                                                                                    |                                       |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>MTI AND PULSE DOPPLER RADAR</b>    | <b>9</b> |
| Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) – <b>Pulse Doppler Radar</b> – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing - Limitations to Tracking Accuracy - <b>Low-Angle Tracking</b> - Tracking in Range - Other Tracking Radar Topics - Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT).                                                                                                                                                                                                |                                       |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>DETECTION OF SIGNALS IN NOISE</b>  | <b>9</b> |
| Matched –Filter Receiver –Detection Criteria – Detectors –Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - <b>The Radar operator</b> - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays<br><b>Radar Transmitters and Receivers</b> - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - <b>Crossed Field Amplifiers</b> - Other RF Power Sources – Other aspects of Radar Transmitter.- The Radar Receiver - Receiver noise Figure – <b>Super heterodyne Receiver</b> - Duplexers and Receiver Protectors- Radar Displays. |                                       |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>RADIO DIRECTION AND RANGES</b>     | <b>9</b> |
| Introduction - Four methods of Navigation .- The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - <b>The Goniometer</b> - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - <b>Automatic Direction Finders</b> – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders - The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments.<br><b>Hyperbolic Systems of Navigation (Loran and Decca)</b> - Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System              |                                       |          |
| <b>UNIT V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>SATELLITE NAVIGATION SYSTEM</b>    | <b>9</b> |
| <b>Distance Measuring Equipment</b> - Operation of DME - TACAN - TACAN Equipment - Instrument Landing System - Ground Controlled Approach System - Microwave Landing System(MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization - Doppler Spectrum - <b>Components of the Doppler Navigation System</b> - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation - Principles of Operation - Navigation Over the Earth – Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems - Accuracy of Inertial Navigation Systems-The Transit System - Navstar Global Positioning System (GPS)                                                                         |                                       |          |
| <b>TOTAL:45 PERIODS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                       |          |

**OUTCOMES:**

Upon completion of the course, students will be able to:

- Explain principles of navigation, in addition to approach and landing aids as related to navigation
- Derive and discuss the Range equation and the nature of detection.
- Describe about the navigation systems using the satellite.

**TEXTBOOKS:**

1. Merrill I. Skolnik, "Introduction to Radar Systems", 3<sup>rd</sup> Edition Tata Mc Graw-Hill 2003.
2. N.S.Nagaraja, "Elements of Electronic Navigation Systems", 2<sup>nd</sup> Edition, TMH, 2000.

**REFERENCES:**

1. Peyton Z. Peebles, "Radar Principles", John Wiley, 2004
2. J.C Toomay, "Principles of Radar", 2<sup>nd</sup> Edition –PHI, 2004

**EC6016****OPTO ELECTRONIC DEVICES****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the basics of solid state physics.
- To understand the basics of display devices.
- To understand the optical detection devices.
- To understand the design of optoelectronic integrated circuits.

**UNIT I ELEMENTS OF LIGHT AND SOLID STATE PHYSICS****9**

Wave nature of light, Polarization, Interference, Diffraction, **Light Source**, review of Quantum Mechanical concept, **Review of Solid State Physics**, Review of Semiconductor Physics and Semiconductor Junction Device.

**UNIT II DISPLAY DEVICES AND LASERS****9**

Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, LED, Plasma Display, **Liquid Crystal Displays**, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, **Classes of Lasers**, Mode Locking, laser applications.

**UNIT III OPTICAL DETECTION DEVICES****9**

Photo detector, Thermal detector, Photo Devices, **Photo Conductors**, Photo diodes, Detector Performance.

**UNIT IV OPTOELECTRONIC MODULATOR****9**

Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustoptic devices, Optical, **Switching and Logic Devices**.

**UNIT V OPTOELECTRONIC INTEGRATED CIRCUITS****9**

Introduction, **hybrid and Monolithic Integration**, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to

- To design display devices.
- To design optoelectronic detection devices and modulators.
- To design optoelectronic integrated circuits.

**TEXTBOOKS:**

1. Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
2. Jasprit Singh, "Opto Electronics – As Introduction to Materials and Devices", Mc Graw-Hill International Edition, 1998

**REFERENCES:**

1. S C Gupta, Opto Electronic Devices and Systems, Prentice Hal of India, 2005.
2. J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall, 1995

**EC6017****RF SYSTEM DESIGN****L T P C****3 0 0 3****OBJECTIVES:**

**The student should be made to:**

- Be familiar with RF transceiver system design for wireless communications.
- Be exposed to design methods of receivers and transmitters used in communication systems

**UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9**

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, **Homodyne Receiver**, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, **Two step up conversion Transmitter**

**UNIT II IMPEDANCE MATCHING AND AMPLIFIERS 9**

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, **OC Time constants in bandwidth estimation and enhancement**, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

**UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9**

Stability of feedback systems: Gain and phase margin, Root-locus techniques, **Time and Frequency domain considerations**, Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearization Techniques, Efficiency boosting techniques, ACPR metric, Design considerations

**UNIT IV PLL AND FREQUENCY SYNTHESIZERS 9**

Linearised Model, Noise properties, Phase detectors, **Loop filters and Charge pumps**, Integer-N frequency synthesizers, Direct Digital Frequency synthesizers

**OBJECTIVES:**

**The student should be made to:**

- Learn the working of ARM processor
- Understand the Building Blocks of Embedded Systems
- Learn the concept of memory map and memory interface
- Know the characteristics of Real Time Systems
- Write programs to interface memory, I/Os with processor
- Study the interrupt performance

**LIST OF EXPERIMENTS**

1. Study of ARM evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
7. Mailbox.
8. Interrupt performance characteristics of ARM and FPGA.
9. Flashing of LEDS.
10. Interfacing stepper motor and temperature sensor.
11. Implementing zigbee protocol with ARM.

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Write programs in ARM for a specific Application
- Interface memory and Write programs related to memory operations
- Interface A/D and D/A convertors with ARM system
- Analyse the performance of interrupt
- Write programmes for interfacing keyboard, display, motor and sensor.
- Formulate a mini project using embedded system

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS (3 students per batch)**

1. Embedded trainer kits with ARM board 10 No.s
2. Embedded trainer kits suitable for wireless communication 10 No.s
3. Adequate quantities of Hardware, software and consumables

**OBJECTIVES:**

**The student should be made to:**

1. Understand the working principle of optical sources, detector, fibers and microwave components
2. Develop understanding of simple optical communication link.
3. Learn about the characteristics and measurements in optical fiber
4. Know about the behavior of microwave components.



5. Practice microwave measurement procedures

## LIST OF EXPERIMENTS

### OPTICAL EXPERIMENTS

1. DC Characteristics of LED and PIN Photo diode
2. Mode Characteristics of Fibers
3. Measurement of connector and bending losses
4. Fiber optic Analog and Digital Link- frequency response(analog) and eye diagram (digital)
5. Numerical Aperture determination for Fibers
6. Attenuation Measurement in Fibers

### MICROWAVE EXPERIMENTS

1. Reflex klystron or Gunn diode characteristics and basic microwave parameter measurement such as VSWR, frequency, wavelength.
2. Directional Coupler Characteristics.
3. Radiation Pattern of Horn Antenna.
4. S-parameter Measurement of the following microwave components (Isolator, Circulator, E plane Tee, H Plane Tee, Magic Tee)
5. Attenuation and Power Measurement

**TOTAL: 45 PERIODS**

### LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

1. Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter. – 2 Nos
2. Trainer kit for determining the mode characteristics, losses in optical fiber.- 2 Nos
3. Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope. - 2 Nos
4. Kit for measuring Numerical aperture and Attenuation of fiber - 2 Nos
5. MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors - 2 set
6. LEDs with ST / SC / E2000 receptacles – 650 / 850 nm - 2 set
7. PIN PDs with ST / SC / E2000 receptacles – 650 / 850 nm - 2 set
8. Microwave test Bench at X band to determine Directional coupler characteristics. - 2 Nos
9. Microwave test Bench at X band and Antenna turn table to measure Radiation pattern of Horn antenna, 2 Horn antennas. - 2 Nos
10. Microwave test Bench at X band to determine VSWR for Isolator and Circulator, VSWR meter, Isolator, Circulator, E Plane Tee, H plane Tee. - 2 Nos
11. Microwave test Bench at X band, Variable attenuator, Detector and 20 MHz Digital / Analog Oscilloscope. - 2 Nos

**Note:** Microwave test bench comprises of Reflex klystron or Gunn diode with power supply, Gunn oscillator, PIN modulator, Isolator, Fixed and Variable Attenuator, frequency meter, Slotted section, Wave guides, detector with mount, Termination, Movable short, Slide screw tuner, Horn antenna, Directional coupler and 20 MHz Digital / Analog Oscilloscope.

### OUTCOMES:

**At the end of the course, the student should be able to:**

- Analyze the performance of simple optical link.
- Test microwave and optical components.
- Analyse the mode characteristics of fiber
- Analyse the radiation of pattern of antenna.



## REFERENCES:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
2. Upena Dalal, "Wireless Communication", Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2000.

EC6802

**WIRELESS NETWORKS**

**L T P C**  
**3 0 0 3**

## OBJECTIVES:

- To study about Wireless networks, protocol stack and standards.
- To study about fundamentals of 3G Services, its protocols and applications.
- To study about evolution of 4G Networks, its architecture and applications.

### UNIT I WIRELESS LAN

9

Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum -IEEE802.11: System architecture, **protocol architecture, physical layer, MAC layer**, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security - IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX

### UNIT II MOBILE NETWORK LAYER

9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6- Network layer in the internet- **Mobile IP session initiation protocol** - mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing

### UNIT III MOBILE TRANSPORT LAYER

9

TCP enhancements for wireless protocols - Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility - Classical TCP improvements: Indirect TCP, **Snooping TCP**, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP - TCP over 3G wireless networks.

### UNIT IV WIRELESS WIDE AREA NETWORK

9

Overview of UTM Terrestrial Radio access network-UMTS Core network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, **SMS-GMSC/SMS-IWMSC**, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)- LTE network architecture and protocol.

### UNIT V 4G NETWORKS

9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, **Smart antenna techniques**, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.

**TOTAL: 45 PERIODS**

## OUTCOMES:

**Upon completion of the course, the students will be able to**

- Conversant with the latest 3G/4G and WiMAX networks and its architecture.
- Design and implement wireless network environment for any application using latest wireless protocols and standards.

**OUTCOMES:**

Upon Completion of the course, the students will be able to

- To design display devices.
- To design optoelectronic detection devices and modulators.
- To design optoelectronic integrated circuits.

**TEXTBOOKS:**

1. Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
2. Jasprit Singh, "Opto Electronics – As Introduction to Materials and Devices", Mc Graw-Hill International Edition, 1998

**REFERENCES:**

1. S C Gupta, Opto Electronic Devices and Systems, Prentice Hal of India, 2005.
2. J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall, 1995

**EC6017****RF SYSTEM DESIGN****L T P C****3 0 0 3****OBJECTIVES:**

**The student should be made to:**

- Be familiar with RF transceiver system design for wireless communications.
- Be exposed to design methods of receivers and transmitters used in communication systems

**UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9**

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two step up conversion Transmitter

**UNIT II IMPEDANCE MATCHING AND AMPLIFIERS 9**

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

**UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9**

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearization Techniques, Efficiency boosting techniques, ACPR metric, Design considerations

**UNIT IV PLL AND FREQUENCY SYNTHESIZERS 9**

Linearised Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-N frequency synthesizers, Direct Digital Frequency synthesizers

**UNIT III      ROUTING PROTOCOLS AND TRANSPORT LAYER IN  
AD HOC WIRELESS NETWORKS**

**9**

Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

**UNIT IV      WIRELESS SENSOR NETWORKS (WSNS) AND  
MAC PROTOCOLS**

**9**

Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.

**UNIT V      WSN ROUTING, LOCALIZATION & QOS**

**9**

Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the student should be able to:**

- Explain the concepts, network architectures and applications of ad hoc and wireless sensor networks
- Analyze the protocol design issues of ad hoc and sensor networks
- Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues
- Evaluate the QoS related performance measurements of ad hoc and sensor networks

**TEXT BOOK:**

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.

**REFERENCES:**

1. Carlos De Moraes Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002.
3. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.
5. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

**GE6082**

**INDIAN CONSTITUTION AND SOCIETY**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To know about Indian constitution.
- To know about central and state government functionalities in India.
- To know about Indian society.

|                                                                                                                                                                                                                                                                                    |                                                     |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|----------|
| <b>UNIT I</b>                                                                                                                                                                                                                                                                      | <b>INTRODUCTION</b>                                 | <b>9</b> |
| Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.                     |                                                     |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                     | <b>STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT</b> | <b>9</b> |
| Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.                                                                                               |                                                     |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                    | <b>STRUCTURE AND FUNCTION OF STATE GOVERNMENT</b>   | <b>9</b> |
| State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.                                                                                                       |                                                     |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                     | <b>CONSTITUTION FUNCTIONS</b>                       | <b>9</b> |
| Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.                                                                                       |                                                     |          |
| <b>UNIT V</b>                                                                                                                                                                                                                                                                      | <b>INDIAN SOCIETY</b>                               | <b>9</b> |
| Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections. |                                                     |          |

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Understand the functions of the Indian government
- Understand and abide the rules of the Indian constitution.
- Understand and appreciate different culture among the people.

#### **TEXTBOOKS:**

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
2. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
3. Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
4. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

#### **REFERENCES:**

1. Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
3. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

**EC6018**

**MULTIMEDIA COMPRESSION AND COMMUNICATION**

**L T P C**  
**3 0 0 3**

#### **OBJECTIVES:**

- To have a complete understanding of error–control coding.
- To understand encoding and decoding of digital data streams.
- To introduce methods for the generation of these codes and their decoding techniques.
- To have a detailed knowledge of compression and decompression techniques.
- To introduce the concepts of multimedia communication.

|                                                                                                                                                                                                                                                                                                        |                                    |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------|
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                          | <b>MULTIMEDIA COMPONENTS</b>       | <b>9</b> |
| Introduction - Multimedia skills - <b>Multimedia components and their characteristics</b> - Text, sound, images, graphics, animation, video, hardware.                                                                                                                                                 |                                    |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                         | <b>AUDIO AND VIDEO COMPRESSION</b> | <b>9</b> |
| Audio compression–DPCM-Adaptive PCM – <b>adaptive predictive coding</b> -linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263-MPEG 1, 2, and 4.                                                                                                        |                                    |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                        | <b>TEXT AND IMAGE COMPRESSION</b>  | <b>9</b> |
| Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy encoding –source encoding - <b>text compression</b> –static Huffman coding dynamic coding – arithmetic coding –Lempel ziv-welsh Compression-image compression                                   |                                    |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                         | <b>VOIP TECHNOLOGY</b>             | <b>9</b> |
| Basics of IP transport, VoIP challenges, H.323/ SIP – <b>Network Architecture</b> , Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability                                                                                                     |                                    |          |
| <b>UNIT V</b>                                                                                                                                                                                                                                                                                          | <b>MULTIMEDIA NETWORKING</b>       | <b>9</b> |
| Multimedia networking -Applications-streamed stored and audio-making the best Effort service-protocols for real time interactive Applications- <b>distributing multimedia</b> -beyond best effort service-secluding and policing Mechanisms- <b>integrated services</b> -differentiated Services-RSVP. |                                    |          |

**TOTAL : 45 PERIODS**

#### **OUTCOMES:**

**Upon Completion of the course, the students will be able to**

- Describe various multimedia components
- Describe compression and decompression techniques.
- Apply the compression concepts in multimedia communication.

#### **TEXT BOOK:**

1. Fred Halshall "Multimedia communication - Applications, Networks, Protocols and Standards", Pearson Education, 2007.

#### **REFERENCES:**

1. Tay Vaughan, "Multimedia: Making it work", 7<sup>th</sup> Edition, TMH 2008 98
2. Kurose and W.Ross "Computer Networking "a Top Down Approach", Pearson Education 2005
3. Marcus Goncalves "Voice over IP Networks", Mc Graw hill 1999.
4. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007.
5. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education Ranjan Parekh, "Principles of Multimedia", TMH 2007.

## UNIT V      **DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**

9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management

### **TEXTBOOK:**

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.

### **REFERENCES**

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

**EC6019**

**DATA CONVERTERS**

**|| || L T P C**  
**3 0 0 3**

### **OBJECTIVES:**

- To explain the basic operational and design principles of CMOS Analog to Digital and Digital to Analog converter architectures.
- To introduce the design calculations for developing the various blocks associated with a typical CMOS AD or DA converter.
- To make students decide the dimensions and bias conditions of all the MOS transistors involved in the design.

## **UNIT I      SAMPLE AND HOLD CIRCUITS**

9

Sampling switches, Conventional open loop and closed loop sample and hold architecture, **Open loop architecture with miller compensation, multiplexed input architectures, recycling** architecture switched capacitor architecture.

**UNIT II SWITCH CAPACITOR CIRCUITS AND COMPARATORS 9**  
Switched-capacitor amplifiers, switched capacitor integrator, switched capacitor common mode feedback. Single stage amplifier as comparator, cascaded amplifier stages as comparator, latched comparators.

**UNIT III DIGITAL TO ANALOG CONVERSION 9**  
Performance metrics, reference multiplication and division, switching and logic functions in AC, Resistor ladder DAC architecture, current steering DAC architecture.

**UNIT IV ANALOG TO DIGITAL CONVERSION 9**  
Performance metric, Flash architecture, Pipelined Architecture, Successive approximation architecture, Time interleaved architecture.

**UNIT V PRECISION TECHNIQUES 9**  
Comparator offset cancellation, Op Amp offset cancellation, Calibration techniques, range overlap and digital correction.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the student should be able to:**

- Explain sample and hold circuits
- Design ADC/DAC circuits
- Analyze ADC/DAC Architecture and Performance
- Discuss calibration techniques

**TEXT BOOK:**

1. Behzad Razavi, "Principles of data conversion System Design", IEEE press, 1995.

**REFERENCES:**

1. Franco Maloberti, "Data Converters", Springer, 2007.
2. Rudy Van de Plassche, "CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters", Kluwer Academic Publishers, Boston, 2003.

**CS6701 CRYPTOGRAPHY AND NETWORK SECURITY L T P C**  
**3 0 0 3**

**OBJECTIVES:**

**The student should be made to:**

- Understand OSI security architecture and classical encryption techniques.
- Acquire fundamental knowledge on the concepts of finite fields and number theory.
- Understand various block cipher and stream cipher models.
- Describe the principles of public key cryptosystems, hash functions and digital signature.

**UNIT I INTRODUCTION & NUMBER THEORY 10**  
Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

## UNIT V

9+3

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

**TOTAL (L:45+T:15): 60 PERIODS**

### OUTCOMES:

#### Learners should be able to:

- Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- Read different genres of texts adopting various reading strategies.
- Listen/view and comprehend different spoken discourses/excerpts in different accents.

### TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

### REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008

### EXTENSIVE Reading (Not for Examination)

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

### WEBSITES:

1. <http://www.usingenglish.com>
2. <http://www.uefap.com>

### TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.