III-I

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **III – I** | **9CC08** | **Digital Signal Processing** | **2** | **1** | **0** | **3** |

***Course objectives***: To develop skills for analyzing and synthesizing algorithms and systems that process discrete time signals, with emphasis on realization and implementation.

***Course outcomes****:*

After studying this course, the students will be able to

**CO1.** Distinguish between CT and DT signals and systems and understand the growing need of DSP. **(UNIT- I)**

**CO2.** Represent periodic DT signals as a Fourier series, non-periodic DT signals as a Fourier Transform and use a powerful mathematical tool called DFT. Also Compute the Fourier Transform of DT signals using the FFT algorithms. **(UNIT- II & III)**

**CO3.** Realize a digital IIR filter and FIR filters in several forms and structures for a given transfer function H(z)and can design IIR filter as per specifications. **(UNIT- IV & V)**

**CO4.** Understand the need and implement the multi-rate sampling techniques. **(UNIT- VI)**

**UNIT I : INTRODUCTION:**

Introduction to Digital Signal Processing: Discrete time signals & sequences, Periodicity, linear shift invariant systems, stability, and causality, Linear constant coefficient difference equations- Block diagram representation, Frequency domain representation of discrete time signals and systems.

**Applications: Contents form the foundation for DSP.**

**UNIT II : DISCRETE FOURIER TRANSFORM:**

Discrete Fourier series representation of periodic sequences, Discrete-Time Fourier Transform (DTFT), Discrete Fourier transform (DFT): Properties of DFT, Relation between Z-transform and DFT, Convolution: Linear and circular convolutions, Overlap add and Overlap save methods, Computation of DFT.

**Applications: Analysis of DT signals-Periodic and Aperiodic.**

**UNIT III : FAST FOURIER TRANSFORMS:**

Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.

**Applications: Design of spectrally efficient system such as OFDM system.**

**UNIT IV: INFINITE IMPULSE RESPONSE (IIR) FILTERS**:

Analog Filter Approximations – Butterworth Approximation, Chebyshev Approximation and their Comparison

IIR Digital Filters: Design of IIR Digital filters from analog filters-Impulse Invariance, Step invariance and Bilinear Transformation methods, Design Examples, Analog to Digital transformations. Basic structures of IIR systems.

**Applications: Design of IIR digital filter conforming to given specifications.**

**UNIT V: FINITE IMPULSE RESPONSE (FIR) FILTERS**:

FIR Digital Filters: Characteristics of FIR Digital Filters, frequency response, Design of FIR Digital Filters using Fourier series method, Windowing Technique-Rectangular, Triangular (Bartlett), Hamming, Hanning and Blackman window, Frequency Sampling technique, Comparison of IIR and FIR filters. Basic structures of FIR systems

**Applications: Design of FIR digital filter conforming to given specifications.**

**UNIT VI: MULTI-RATE DIGITAL SIGNAL PROCESSING**:

Decimation, Interpolation, Sampling Rate Conversion. Introduction to DSP Processors.

**Applications of Multirate Digital Signal processing: Design of digital filter banks and quadrature mirror filters etc**.

**TEXT BOOKS:**

1. Digital Signal Processing – Alan V. Oppenheim, Ronald W. Schafer, PHI Ed., 2006
2. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
3. Digital Signal Processing: A Modern Introduction, Ashok Ambardar, 9th Indian Reprint, 2012, Cengage Learning.

**REFERENCE BOOKS:**

* + - 1. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006
      2. Digital Signal Processing: MH Hayes, Schaum’s Outlines, TATA Mc-Graw Hill, 2007.
      3. DSP Primer - C. Britton Rorabaugh, Tata McGraw Hill, 2005.
      4. Fundamentals of Digital Signal Processing using MatLab – Robert J. Schilling, Sandra L. Harris, Thomson, 2007

5. Discrete Time Signal Processing – A.V.Oppenheim

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **III – I** | **9CC09** | **IC Applications** | **3** | **0** | **0** | **3** |

**Course Objectives**

* To maintain the right blend of theory and practice in analyzing and designing a wide variety of applications using IC 741 op-amps
* To acquaint the learners with a wide variety of IC logic families, and their applications.

**Course Outcomes**

**After studying this course, the students will be able to**

1. Demonstrate the concepts of Differential Amplifier and Operational Amplifier and their characteristics.
2. Design the basic circuits using IC 741 op-amp.
3. Explore, design and analyze active filters, timers, oscillators, voltage controlled oscillator DACs and ADCs, and IC regulators.
4. Classify and characterize the TTL/ECL/CMOS Logic Families and design of various logic gates using them.

**UNIT – I** [Lecture hrs – 9]

**OPAMP & ITS CHARACTERISTICS [T1] [CO1]**

Differential Amplifiers and its Characteristics.Op-Amp Block Diagram, Ideal OP-AMP Characteristics, DC and AC Characteristics.741 Op-Amp and its Features and Characteristics. Parameters Measurement: Offset Voltage and Current, Slew Rate and CMRR. Frequency Compensation.

**UNIT – II** [Lecture hrs – 9]

**BASIC APPLICATIONS OF OP-AMPs [T1] [CO2]**

Adder/Subtractor, Difference Amplifier, Instrumentation Amplifier, Differentiator, Integrator, V/I & I/V Converters, Comparators, Multivibrators, Square and Triangular Waveform Generators, Clippers, Clampers, Peak Detector, S/H circuit.

**UNIT – III** [Lecture hrs – 9]

**FILTERs, TIMERs & PLLs [T1] [CO3]**

Filters: Introduction, Butterworth Filters- First and Second Order Active Filters- LPF, HPF, BPF, BRF. Introduction to 555 Timer, Functional Block, 555 timers as Monostable and Astable Multi vibrators and Applications, Schmitt Trigger. Voltage Controlled Oscillator (IC 566), Phase Locked Loop.

**Applications: Design of visitors counter using 555 timer.**

**UNIT – IV** [Lecture hrs – 9]

**OSCILLATORS, D/A AND A/D CONVERTERS, IC REGULATORS [T1] [CO3]**

Oscillators: Introduction, Design and Analysis of Wein Bridge, RC Phase shift Oscillators using op-amp. D/A Converters: Introduction, Characteristic Parameters, R-2R Ladder, Weighted Resistor, Inverter R-2R type D/A Converter, A/D Converters: Introduction, Characteristic Parameters, Counter Type, Dual Slope, Successive Approximation and Flash types A/D Converters, IC REGULATORS: Three terminal voltage regulators 7805, 7809, 7912, IC 723.

**UNIT – V** [Lecture hrs – 9]

**LOGIC FAMILIES [T2] [CO4]**

Classification of IC Logic Families, Multi emitter transistor logic. Standard TTL NAND & NOR Gate-Analysis & TTL Open Collector Outputs ,Tristate TTL. Unsaturated logic- ECL logic family ,ECL Inverter/Buffer, ECL NOR/OR logic. Electrical characteristics of logic gates.

**UNIT – VI** [Lecture hrs – 9]

**MOS & CMOS LOGIC FAMILY [T2] [CO4]**

NMOS & PMOS logic- Logic gates implementation, Passive pull up & active pull up .CMOS logic family- Design of logic gates and Boolean functions. CMOS Open Drain and Tristate Outputs. Comparison of Various Logic Families.IC interfacing, TTL driving CMOS & CMOS driving TTL.

**Applications: Design of 4x1 MUX using CMOS**

**Text Books**

1. D. Roy Chowdhary, Linear Integrated Circuits , New Age Publications (P) Ltd, 2nd Edition, 2003.
2. John F. Wakerly, Digital Design Principles & Practices, PHI/ Pearson Education Asia, 3rd Ed., 2005.

**References**

1. Ramakanth A. Gayakwad, Op-Amps & Linear ICs, PHI,1987.
2. Sergio Franco, Design with Operational Amplifiers & Analog Integrated Circuits, McGraw Hill, 1988.
3. R.F. Coughlin & Fredrick Driscoll, Operational Amplifiers & Linear Integrated Circuits, PHI, 6th Edition.
4. K. Lal Kishore, Linear Integrated Circuit Application, Pearson Educations,2005.

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| **III – I** | **9C510** | **Antennas and Wave Propagations** | **3** | **0** | **0** | **3** |

***Prerequisites:*** *EMTL*

***Course Objectives:***

*The objectives of this course are*

* *To study and learn various antennas, their working principle, arrays and radiation patterns of antennas.*
* *To understand various techniques involved in various antenna parameter measurements.*
* *To understand the radio wave propagation in the atmosphere*

***Course Objectives****: After studying this course, the students will be able to*

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| *CO1* | *Learning the radiation mechanism of antenna and antenna parameters* |
| *CO2* | *Design and analyze wire antennas and antenna arrays* |
| *CO3* | *Evaluate knowledge on Horn, Parabolic and Lens antennas.* |
| *CO4* | *Analysis of Horizontal Polarized antennas, Helical antennas , Patch antennas etc.* |
| *CO5* | *Understand the propagation mechanisms of ground wave, sky wave and space wave concepts.* |
| *CO6* | *Analysetheconcepts of sky wave propagation .* |

***Syllabus Content***

**Unit-I:**

**FUNDAMENTAL PARAMETERS OF ANTENNAS**

Review of Electromagnetic Theory: Vector Potential, Solution of Wave Equation, Retarded Case, Hertizian Dipole. Antenna Characteristics: Radiation Pattern, Beam Solid Angle, Directivity, Gain, Input Impedance, Polarization, Bandwidth, Reciprocity, Equivalence of Radiation Patterns, Equivalence of Impedances, Effective Aperture, Vector Effective Length, Antenna efficiency.

**Unit-II:**

**LINEAR WIRE ANTENNAS AND ARRAYS**

Wire Antennas: Short Dipole, Radiation Resistance and Directivity, Half Wave Dipole, Monopole, Small Loop Antennas. Antenna Arrays: Linear Array and Pattern Multiplication, Two-Element Array, Uniform Array, BSA and EFA, EFA With increased Directivity. BSA with Non- uniform Amplitude Distributions and Binomial Arrays.

**Unit-III:**

**APERTUREAND REFLECTOR ANTENNAS**

Magnetic Current and its Fields, Uniqueness Theorem, Field Equivalence Principle, Duality Principle, Method Of Images, Pattern Properties, Slot Antenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna-Flat Reflector, Corner Reflector, Common Curved Reflector Shapes, Lens Antenna.

***Applications: Design of parabolic reflector for DTH.***

**Unit-IV:**

Long Wire, V and Rhombic Antenna, Yagi-Uda Antenna, Turnstile Antenna, Helical Antenna- Axial Mode Helix, Normal Mode Helix, Biconical Antenna, Log Periodic Dipole Array, Spiral Antenna, Microstrip Patch Antennas. Antenna Measurements: Radiation Pattern Measurement, Gain and Directivity.

**Applications: Design of a 3-element Yagiguda Antenna for given specifications**

**Unit-V:**

Surface Wave Propagation-Modes of Wave Propagation-Surface Wave Propagation and Surface Wave Tilt-Plane Earth Reflection, Reflection and Refraction of Waves-Field Strength due to Ground Wave-Multi-Hop Transmission. Tropospheric and Space Wave Propagation

**UNIT VI:**

Ionospheric Propagation: Structure of Ionosphere-Measures of Ionosphere Propagation-Critical Frequency-Angle of Incidence-MUF And LUF ,Optimum Working Frequency-Skip Distance, Virtual Height , Refractive Index of The Ionosphere, Effect of the Earth Magnetic Field and Fading

**TEXT BOOKS -**

1. John D. Kraus and Ronald J. Marhefka, *Antennas for All Applications* –TMH, 3rd Edn., 2003.
2. E.C. Jordan and K.G. Balmain ,*Electromagnetic Waves and Radiating Systems* –, PHI, 2nd ed., 2000. .

**REFERENCES –**

1. C.A. Balanis, *Antenna Theory -*John Wiley & Sons, 2nd ed., 2001.
2. K.D. Prasad, *Antennas and Wave Propagation* –, SatyaPrakashan, Tech India Publications, New Delhi, 2001.
3. E.V.D. Glazier and H.R.L. Lamont ,*Transmission and Propagation* –, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.
4. F.E. Terman*Electronic and Radio Engineering* –, McGraw-Hill, 4th edition, 1955.

John D. Kraus, *Antennas* – McGraw-Hill, 2nd ed, 1988.

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| **III – I** | **9AC07** | **Linear Control systems** | **3** | **0** | **0** | **3** |

**Course Objective:** Students learn about fundamental concepts of time and frequency domain analysis of a given system.

**Course Outcomes:** Students

1. Learn basic concepts of control systems.
2. Study about time response analysis.
3. Learn basic concepts of stability and root locus method.
4. Study about frequency response analysis.
5. Learn basic concepts stability analysis in frequency domain.
6. Learn fundamentals of state space analysis.

**UNIT – I INTRODUCTION:**

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer functions – Translational and Rotational mechanical systems

**Transfer function representation:**

Transfer Function of Synchro transmitter and Receiver, Block diagram representation of systems considering electrical systems as examples -Block diagram algebra – Representation by Signal flow graph - Reduction using Mason’s gain formula.

**UNIT-II TIME RESPONSE ANALYSIS:**

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems, PID controllers.

**UNIT – III STABILITY ANALYSIS IN S-DOMAIN:**

The concept of stability – Routh’s stability criterion – qualitative stability and conditional stability – limitations of Routh’s stability.

**Root Locus Technique:** The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

**UNIT – IV FREQUENCY RESPONSE ANALYSIS:**

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots.

**UNIT – V STABILITY ANALYSIS IN FREQUENCY DOMAIN:**

Polar Plots-Nyquist Plots-Stability Analysis.

**CLASSICAL CONTROL DESIGN TECHNIQUES:** Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain.

**UNIT – VI STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS:**

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its Properties.

**TEXT BOOKS:**

1. Automatic Control Systems 8th edition –B. C. Kuo 2003– John wiley and sons.

2. Control Systems Engineering – I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.

**REFERENCES:**

1. Modern Control Engineering – Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.

2. Control Systems – N.K. Sinha, New Age International (P) Limited Publishers, 3rd Edition, 1998.

3. Control Systems Engg. – NISE 3rd Edition – John wiley.

4. “Modeling & Control of Dynamic Systems” – Narciso F. Macia George J. Thaler, Thomson Publishers.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **III – I** | **9EC41** | **Artificial Intelligence** | **2** | **-** | **-** | **-** |

**Course objective:**

To learn the distinction between optimal reasoning vs human like reasoning. To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities. To learn different knowledge representation techniques. To understand the applications of AI, namely game playing, theorem proving, and machine learning.

**COUR****SE OUTCOMES:**

**At the end of this course the student will be able to**

1. Learn the distinction between optimal reasoning Vs human like reasoning and formulate an efficient problem space for a problem expressed in natural language. Also select a search algorithm for a problem and estimate its time and space complexities.
2. Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.
3. Learn different knowledge representation techniques.
4. Understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
5. Comprehend the applications of Probabilistic Reasoning and Bayesian Networks.
6. Analyze Supervised Learning Vs. Learning Decision Trees

**UNIT - I**

Introduction to AI, Intelligent Agents, Problem-Solving Agents, Searching for Solutions, Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

**UNIT-II**

Games, Optimal Decisions in Games, Alpha–Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

**UNIT-III**

Representation, Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

**UNIT-IV**

Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multi agent planning.

**UNIT-V**

Acting under Uncertainty, Basic Probability Notation Bayes’ Rule and Its Use, Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First- Order Probability, Other Approaches to Uncertain Reasoning; Dempster-Shafer theory.

**Unit-VI**

Learning: Forms of Learning, Supervised Learning, Learning Decision Trees.

**TEXT BOOKS**:

1. Artificial Intelligence A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

**REFERENCES:**

1. Artificial Intelligence, 3rd Edn., E. Rich and K. Knight(TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education.

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| **III – I** | **9CC75** | **Digital Signal Processing Lab** | **0** | **0** | **4** | **2** |

***Prerequisites:****SS,PTSP, Basic Simulation Lab*

***Course Objectives****: After completing this course, the students will be able to demonstrate*

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| *CO1* | *the frequency response of a given systems* |
| *CO2* | *Design of FIR & IIR filters and Transforming an analog filter to its digital equivalent* |
| *CO3* | *Sampling rate conversion, Interpolation and decimation* |
| *CO4* | *TMS320c6713 for different algorithms* |

***Mapping of Course Outcomes with Program Outcomes***

***Syllabus Content***

**Tools to be used:** MATLAB, CC Studio, TMS320C6713

1. Impulse response of first order and second order systems.
2. Program to find frequency response of LP/HP filters (difference equation/ transfer function).
3. To find Circular convolution of given sequence with and without built in function.
4. To find the DFT/IDFT, FFT of given DT signals with and without built in functions.
5. To find Power Spectral Density of a sequence.
6. To implement IIR filter (LP/HP/BP)
7. Butterworth filter
8. Chebyshev Type-I and Type-II filters
9. To design FIR filter (LP/HP) using windowing technique
10. Using rectangular window
11. Using triangular window
12. Using Kaiser Window
13. Down sampling and up sampling of given sequence by specified factor.
14. Conversion of Analog filter to Digital Filter.
15. impulse invariant transformation
16. bilinear transformation
17. Generation of DTMF signals
18. Noise removal: Add noise above 3 KHz and then remove, interference suppression using 400 Hz tone.

The following experiments are to be implemented using CCS

1. Study the architecture of DSP chips-TMS 320C 5X/6X Instructions
2. To find Linear convolution of given sequence.
3. To find Circular convolution of given sequence
4. To find the DFT & FFT of given sequence
5. Generation of DTMF Signals
6. Implementation of Decimation Process & Interpolation Process.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – I | **9CC76** | **IC Applications Lab** | **0** | **0** | **3** | **1.5** |

**Prerequisites:** EDC, DLD, DLD Lab, ECNA.

**Course Objectives:**

The objectives of this course are

* To Design and analyze the various circuits and systems using IC 741 Op-Amp.
* To Design and analyze the various circuits and systems using Analog ICs.

**Course Outcomes**: After studying this course, the students will be able to

CO1. Explore the operating modes of IC 741 OP-AMP and design applications using 741Op-Amp.

CO2. Implement applications using 555 Timers

CO3. Design D to A converters and IC voltage regulators

**Syllabus Content**

**(IC Application Lab)**

**Design and testing of**

1. OP AMP Modes(-vefeed back) – Inverting ,Non inverting, Differential amp, Unity gain.
2. OP AMP Applications – Adders, Subtractor.
3. OP AMP Applications – Comparator Circuits.
4. OP AMP Applications – Clipper Circuits.
5. Square wave generator using OP AMP
6. Triangular wave generator using OP AMP
7. Active Filter Applications – LPF, HPF (first order)
8. Oscillators-RC phase shift ,Wein bridge.
9. IC 555 Timer – Monostable
10. IC 555 Timer -Astable
11. 4 bit DAC using OP AMP.
12. IC 723 voltage regulator

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – I | **9C578** | **Antenna Simulation Lab** | **0** | **0** | **3** | **1.5** |

***Prerequisites:***

*AWP, EMTL*

***Course Objectives:***

*The objectives of this lab is*

* *To perform laboratory experiments on designing of various antennas and measure the performance parameters.*

***Course Outcomes****: After studying this laboratory course, the students will be able to*

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| *CO1* | *Understand the design of dipole antenna for various frequencies.* |
| *CO2* | *Understand the design of monopole antenna for variation in radius of the wire* |
| *CO3* | *Design of Microstrip patch antenna in different shapes* |
| *CO4* | *Understand the design of standard horn antenna* |
| *CO5* | *Analyze the characteristics of yagi-uda antenna* |
| *CO6* | *Verify the radiation pattern of different types of antenna* |

***Mapping of Course Outcomes with Program Outcomes***

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| **CO** | **Antenna Simulation Lab (8C678)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | *Understand the design of dipole antenna for various frequencies.* | 3 | 3 | 3 | 3 | 3 |  |  |  | 3 |  |  |  | 3 | 2 |  |
| CO2 | *Understand the design of monopole antenna for variation in radius of the wire* | 3 | 3 | 3 | 3 | 3 |  |  |  | 3 |  |  |  | 3 | 2 |  |
| CO3 | *Design of Microstrip patch antenna in different shapes* | 3 | 3 | 3 | 3 | 3 |  |  |  | 3 |  |  |  | 3 | 2 |  |
| CO4 | *Understand the design of standard horn antenna* |  | 2 | 2 | 2 | 2 |  |  |  | 2 |  |  |  | 2 | 1 |  |
| CO5 | *Analyze the characteristics of yagi-uda antenna* | 2 | 2 | 2 | 2 | 2 |  |  |  | 2 |  |  |  | 2 | 1 |  |
| CO6 | *Verify the radiation pattern of different types of antenna* | 2 | 2 | 2 | 2 | 2 |  |  |  | 2 |  |  |  | 2 | 1 |  |
| CO | | 2 | 2 | 2 | 2 | 2 |  |  |  | 2 |  |  |  | 2 | 1 |  |

**Syllabus content:**

1. Dipole antenna
2. Dipole antenna with lambda variation
3. Monopole antenna
4. Monopole antenna with wire radius variation
5. Microstrip rectangular patch antenna
6. Microstrip circular patch antenna
7. Horn antenna
8. Yagi-uda antenna
9. Radiation pattern measurement of dipole antenna
10. Radiation pattern measurement of patch antenna
11. Radiation pattern measurement of yagi-uda antenna
12. Radiation pattern of broad side antenna array
13. Radiation pattern of End fire antenna array

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| III – I | **9C591** | **Summer Industry Internship-I** | **0** | **0** | **2** | **1** |

**Course Objective:**

The students undergo industrial training so that he/she become industry-ready.

**Course Outcomes:**

At the end of the training, the student is able to

* 1. Select the real-time problem in the industry.
  2. Analyze the requirements with respect to the problem statement
  3. Design the optimal solution for the problem.
  4. Implement the solution using the appropriate modern tools.
  5. Present and submit the report

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Summer Industry Internship-I (8C591)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 | PSO 3 |
| CO1 | Select the real-time problem in the industry. | 2 | 2 | 2 | 2 | 3 |  |  |  | 3 |  |  |  | 2 | 2 |  |
| CO2 | Analyze the requirements with respect to the problem statement |  | 3 | 2 | 2 | 3 |  |  |  | 3 |  |  |  | 2 | 2 |  |
| CO3 | Design the optimal solution for the problem. |  |  | 3 | 2 | 3 |  |  |  | 3 |  |  |  | 1 | 2 |  |
| CO4 | Implement the solution using the apropriate modern tools | 2 | 2 | 2 | 3 | 3 |  |  |  | 3 |  |  |  | 2 | 3 |  |
| CO5 | Present and submit the report | 3 | 3 | 3 | 3 | 3 |  |  |  | 3 |  |  |  | 3 | 3 |  |
| CO | Overall |  |  |  |  | 3 |  |  |  | 3 |  |  |  | 2 | 2 |  |

Student shall carryout the project in industry during summer vacation for 3-6 weeks. There is internal and external Evaluation. Internal Evaluation carries 40 marks and external Evaluation carries 60 marks, Total 100 marks.

III-II

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| **Syllabus for B. Tech (E.C.E.) – A22 regulation** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9C611** | **Microwave and Optical Communications** | **3** | **0** | **0** | **3** |

***Prerequisites:*** *EMWTL, AWP*

***Course Objectives:***

*The objectives of this course are*

* *To have fundamental understanding of microwave components and circuits in terms of scattering parameters, electrical characteristics of waveguides and transmission lines through electromagnetic field analysis*
* *To expose the students to the basics of signal propagation through optical fibers, optical sources and detectors.*

***Course Objectives****: After studying this course, the students will be able to*

|  |  |
| --- | --- |
| *CO1* | *Distinguish microwave frequencies and analyze Rectangular and circular wave guides.* |
| *CO2* | *Formulate various passive components with the help of scattering matrix* |
| *CO3* | *Explore different linear beam tubes* |
| *CO4* | *Analyze Cross field tubes and slow wave structures.* |
| *CO5* | *Analyze the propagation of light in optical fibers and to characterize various optical sources.* |
| *CO6* | *Understand the principle of various Losses, Dispersion and to characterize various Optical Detectors.* |

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Microwave and Optical Communications (8C613)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Distinguish microwave frequencies and analyze Rectangular and circular wave guides. |  | 2 | 2 |  | 2 | 2 | 2 |  |  |  |  | 2 | 3 | 2 |  |
| CO2 | Formulate various passive components with the help of scattering matrix |  | 2 |  | 2 | 2 |  | 3 |  |  |  |  | 2 | 3 | 2 |  |
| CO3 | Explore different linear beam tubes | 1 | 2 | 2 | 2 | 2 |  | 3 |  |  |  |  | 2 | 3 | 2 |  |
| CO4 | Analyze Cross field tubes and slow wave structures | 1 | 2 | 2 |  | 2 |  | 3 |  |  |  |  | 2 | 3 | 2 |  |
| CO5 | Analyze the propagation of light in optical fibers and to characterize various optical sources | 2 | 2 | 3 |  | 2 | 2 | 3 |  |  |  |  | 2 | 3 | 2 | 2 |
| CO6 | Understand the principle of various Losses, Dispersion and to characterize various Optical Detectors. | 2 | 2 | 3 |  | 2 | 2 | 3 |  |  |  |  | 2 | 3 | 2 | 2 |
| CO | Overall | 2 | 2 | 2 | 2 | 2 | 2 | 3 |  |  |  |  | 2 | 3 | 2 | 2 |

**UNIT-I**

Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides – TE/TM mode analysis, Cut-off Frequencies, Dominant Modes, Mode Characteristics – Phase and Group Velocities, Wavelength and Impedance Relations; Dominant and evanescent modes; Power Transmission and Power Losses in Rectangular Wave Guide, Related Problems.

**UNIT-II**

Introduction to micro strip lines, losses, Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide irises, Tuning Screws and Posts. Matched Load, Waveguide Attenuators, Phase Shifters. Waveguide Multiport Junctions – E and H plane Tees, Magic Tee, Hybrid Ring; Directional Couplers. Scattering Matrix– Significance, Formulation and Properties, Directional Coupler, Magic Tee, Circulator and Isolator. Related Problems.

Ferrite Components: Ferrite Characteristics, Faraday rotation, Gyrator, Isolator, and Circulator

**UNIT-III**

Limitations and Losses of conventional tubes at microwave frequencies. Microwave tubes – O type and M type classifications. O-type tubes: 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process. O/P Power and Efficiency, Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Bunching process, Power Output, Efficiency Electronic Admittance; Oscillating Modes and o/p Characteristics, Related Problems.

**UNIT-IV**

Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.four propagation constants.

**M-TYPE TUBES:** Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron operations and o/p characteristics. PI mode and its significance. – Hull Cut-off Condition.

**UNIT-V**

Introduction, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays.Fibers- Modes, V Number, Mode Coupling, Step Index Fibers, Graded Index Fibers. Single Mode Fibers- Cut off Wavelength, Mode Field Diameter, Effective Refractive Index.

**Optical Sources:** Construction and working principles of LED and LASER diaodes.

**UNIT-VI**

Transmission Characteristics Of Optical Fiber -Attenuation - Material Losses absorption in silica glass fiber - Linear and Non Linear Scattering Losses - Intra and Inter-Modal Dispersion - All Over Fiber Dispersion - Optical fiber connectors, fiber alignment and Joint Losses - Fiber Splicer - Fiber Connectors - Expanded Beam Connectors - Fiber Couplers.

**Optical Detectors:** Physical principles of PIN and APD, Comparison of Photo detectors.

**TEXT BOOKS**

* + - 1. Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition, 1994.
      2. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.
      3. Optical Fiber Communications – Gerd Keiser, McGraw-Hill International edition, 3rd Edition, 2000.

4. Micro Wave and Radar Engineering – M. Kulkarni, Umesh Publications, 1998

**REFERENCES**

* + - 1. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
      2. Microwave Circuits and Passive Devices – M.L. Sisodia and G.S.Raghuvanshi, Wiley Eastern Ltd., New Age International Publishers Ltd., 1995.
      3. Microwave Engineering, RaghuvanshiG.S. , 1st edition, Cengage Learning
      4. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI, 1999.
      5. Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4th ed., 1955.
      6. Elements of Microwave Engineering – R. Chatterjee, Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
      7. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9C612** | **VLSI Technology and Design** | **3** | **0** | **0** | **3** |

***Prerequisites:****EDC,STLD, LDICA*

***Course Objectives****:*

*The objectives of this course are to provide the students an in-depth knowledge on various aspects of VLSI circuits and their design including testing.*

***Course Outcomes****: Upon completing this course, students will be able to:*

|  |  |
| --- | --- |
| *CO1* | *Comprehend current device technologies and the integrated circuit (IC) fabrication process.* |
| *CO2* | *Investigate and evaluate the electrical properties of CMOS devices.* |
| *CO3* | *Design basic logic gates, combinational and sequential circuits using CMOS logic.* |
| *CO4* | *Assess the impact of parasitic elements on IC power consumption and performance.* |
| *CO5* | *Design memory cells and basic data path units.* |
| *CO6* | *Recognize the importance of testing and design verification in VLSI circuits.* |

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **VLSI Technology and Design (8C510)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 | PSO 3 |
| CO1 | Understand the existing device technologies and IC fabrication process |  | 3 |  | 3 | 2 |  | 2 |  |  |  |  | 2 | 3 | 2 |  |
| CO2 | Explore and analyze the electrical properties of the devices of CMOS device. |  | 2 | 2 |  | 2 |  | 2 |  |  |  |  |  | 2 | 1 |  |
| CO3 | Design basic logic gates, combinational and sequential circuits using CMOS logic. |  |  | 2 | 1 | 3 |  | 2 |  |  |  |  |  | 2 | 3 |  |
| CO4 | Analyze the effects of parasitic on IC power and performance. |  | 3 | 3 |  | 2 |  | 2 |  |  |  |  | 2 | 2 | 3 | 3 |
| CO5 | Design memory cells and basic data path units. |  | 3 | 3 | 2 | 2 |  | 2 |  |  |  |  | 2 | 1 | 3 | 2 |
| CO6 | Explore the need for testing and design verification of VLSI circuits. |  | 3 |  | 2 | 2 |  | 2 |  |  |  |  | 2 | 1 | 3 |  |
| CO | Overall |  | 3 | 3 | 2 | 2 |  | 2 |  |  |  |  | 2 | 2 | 3 | 3 |

**Syllabus Content**

**UNIT I**

**INTRODUCTION TO MOS TECHNOLOGIES**: MOS, PMOS, NMOS, CMOS &BiCMOS

**INTRODUCTION TO IC TECHNOLOGY AND FABRICATION PROCESS**: VLSI Design Flow, Oxidation, Lithography, Diffusion, Ion Implantation, Metallisation, Encapsulation, Probe testing, Integrated Resistors and Capacitors [T1-CH1, 2 & 3].

**Application – CMOS IC Manufacturing**

**UNIT II**

**BASIC ELECTRICAL PROPERTIES:** Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, Figure of Merit (ωo), Zpu/Zpd, Latch-Up in CMOS, Pass Transistors [T1-CH2]

**INVERTERS**: NMOS Inverter, Various Pull-Ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters [T1-CH2]

**UNIT III**

**CIRCUIT DESIGN PROCESSES:** MOS Layers, Stick Diagrams, Lamda-based CMOS Design rules for Wires, Contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling. [T1-CH3]

**GATES**: CMOS Logic Gates and Structures, Switch logic, Layout Diagrams Gates [T1-CH5]

**Application – IC Physical Design – NAND and NOR**

**UNIT IV**

**DELAYS:** Sheet Resistance Rs and its concept to MOS, Area Capacitance Units, Calculations - Cg,

τ-Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out [T1- CH 4 & 5, T2-CH4]

**Semiconductor Integrated circuit Design:** PLD’s, Introduction to CPLD’s and FPGA’s.

**UNIT V**

**MEMORY AND SUBSYSTEM DESIGN:** Latches and Registers [T2-CH7]**,** Clocking strategies (Single Phase) [T1-CH5.5],Memory cells (SRAM & DRAM), Adders, Shifter, Multipliers and ALUs [T1- CH8]

**Applications – SRAM Based FPGAs and Multiply and Accumulate (MAC) Units**

**UNIT VI**

**INTRODUCTION TO CMOS TESTING:** CMOS Testing, Need for testing, Test Principles, Design Strategies for Test, Chip level Test Techniques, System-level Test Techniques [T1-CH7]

**Applications – Implementation of basic ATPG**

**TEXTBOOKS**:

1. Basic VLSI Design –Douglas A. Pucknell, Kamran Eshraghian, PHI, 3rd Edition,2005.
2. Principles of CMOS VLSI Design - Weste and Eshraghian, Pearson Education, Second Edition, 2009.

.

**REFERENCES:**

1. Chip Design for Submicron VLSI: CMOS Layout & Simulation, - John P. Uyemura, Thomson Learning.
2. Introduction to VLSI Circuits and Systems - John .P. Uyemura, JohnWiley, 2003.
3. Digital Integrated Circuits: A Design Perspective - John M. Rabaey, 2/E, 2002
4. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.
5. VLSI Technology – S.M. SZE, 2nd Edition, TMH, 2003.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9CC15** | **Microprocessors and Microcontrollers** | **2** | **1** | **0** | **3** |

***Course objectives***: To develop skills for programming and interfacing using 8086 Microprocessor, 8051 Microcontroller and ARM processor.

***Course outcomes****:*

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

1. *Understand Architecture and operating modes of 8086; addressing modes and instruction set.*
2. *Write basic assembly language programs and explore the interfacing of memories, and I/O devices using 8255*
3. *Understand Architecture of 8051 microcontroller.*
4. *Understand instructions of 8051 and to Interface I/0 devices with 8051*
5. *Understand the architecture and operating modes of ARM processor.*
6. *Analyze and understand the ARM an Thumb instruction set and programming with ARM*

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| CO | **Microprocessors, and Microcontrollers (8DC05**  **)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | *Understand Architecture and operating modes of 8086; addressing modes and instruction set.* | 3 | 2 | 2 | 1 | 1 |  |  |  |  |  |  | 3 | 3 | 1 |  |
| C02 | *Write basic assembly language programs and explore the interfacing of memories, and I/O devices using 8255* | 1 | 3 | 3 | 3 | 2 |  |  |  |  |  |  | 2 | 2 | 3 |  |
| CO3 | *Understand Architecture of 8051 microcontroller.* | 3 | 2 | 3 | 1 | 1 |  |  |  |  |  |  | 2 | 3 | 3 |  |
| CO4 | *Understand instructions of 8051 and to Interface I/0 devices with 8051* | 2 | 3 | 3 | 3 | 2 |  |  |  |  |  |  | 3 | 2 | 3 |  |
| CO5 | *Understand the architecture and operating modes of ARM processor.* | 3 | 3 | 2 | 2 |  |  |  |  |  |  |  | 3 | 2 | 2 |  |
| C06 | *Analyze and understand the ARM an Thumb instruction set and programming with ARM* | 2 | 2 | 3 | 3 | 3 |  |  |  |  |  |  | 3 | 3 | 3 |  |
| CO | Overall | 2 | 3 | 3 | 2 | 2 |  |  |  |  |  |  | 3 | 3 | 3 |  |

**UNIT - I**

**Architecture of 8086 Microprocessor:** Memory segmentation, BIU and E.U General purpose registers. 8086 flag register and function of 8086 Flags. Pin diagram of 8086-Minimum mode and maximum mode of operation. Timing Diagram, Addressing modes, Instruction set.

**UNIT - II**

**Assembly Programming:** Assembly language programs involving logical, Branch & Call instructions, sorting, evaluation of arithmetic expressions, string manipulation

**Interfacing with 8086:** Interfacing with RAMs, ROMs 8255 PPI – various modes of operation. Interfacing with key boards, ADCs, and DACs Stepper Motor, Interrupt structure of 8086. Vector interrupt table. Interrupt service routines. 8259 PIC Architecture.

**UNIT - III**

**8051 microcontroller**: Architecture – Memory organization, pin configuration - addressing modes - instruction set – programming - timers – counters - Programming - interrupts- communication interfaces -

**UNIT – IV**

**Instruction set of 8051:** Programming the 8051, Data Transfer and Logical Instructions. Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions, Simple programs. Programs based on SFRs on Timers, Interrupts, interfacing with DAC, ADC, stepper motor.

**UNIT – V**

**Introduction to ARM Processors**: Harvard and Von Neumann architectures, CISC & RISC Architecture CPU Registers, CPU Operating Modes, The ARM 7 TDMI architecture-ARM organization and implementation.

**UNIT – VI**

**Programming with ARM**: ARM instruction set, Barrel shifter, Data processing, Branch, Load-store, SWI and Program Status Register instruction. Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb, ARM Thumb Interworking, Simple ALP programs on Arithmetic & logical operations.

**Text books:**

1. Advanced microprocessor & Peripherals - A.K.Ray&K.M.Bhurchandi, TMH, 2000.
2. 8051 Microcontroller–Kenneth J. Ayala, Penram International/ Thomson, 3rd Edition, 2005.
3. ARM System-on-chip Architecture by Steve Furber, Pearson Education, 2012

**Reference books:**

1. Microprocessors and interfacing – Douglas V. Hall, TMH, 2nd Edition, 1999.
2. The 8051 Microcontroller And Embedded Systems Using Assembly And C – Mazidi, Pearson.
3. ARM System Developer’s guide –Andrew N. SLOSS, ELSEVIER Publications,ISBN 978-81-8147-646-3, 2016

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9FC78** | **Cyber Security** | **2** | **-** | **-** | **-** |

**Course Objectives:**

* To familiarize with network security, network security threats, security services, and countermeasures.
* To be aware of computer security and Internet security.
* To study the defensive techniques against these attacks.
* To familiarize with cyber forensics.
* To be aware of cyber crime related to mobile and laptop etc.
* To acquire knowledge relating to Cyberspace laws and Cyber crimes.
* To understand ethical laws of computer for different countries, Offences under the Cyberspace and Internet in India.

**Course Outcomes:**

**At the end of this course the student will be able to**

1. The students will be able to understand cyber-attacks, types of cybercrimes.
2. Realize the importance of cyber security and various forms of cyber attacks and countermeasures.
3. Get familiar of cyber forensics.
4. Get familiar with obscenity and pornography in cyber space and understand the violation of Right of privacy on Internet.
5. Cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks.
6. Elucidate the various chapters of the IT Act 2008, power of Central and State Government to make rules under IT Act 2008.

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| **CO** | **CYBER SECURITY (8FC24)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | The students will be able to understand cyber-attacks, types of cybercrimes. |  | 2 |  |  |  | 2 |  |  |  |  |  |  | 1 |  |  |
| CO2 | Realize the importance of cyber security and various forms of cyber attacks and countermeasures |  | 2 |  |  |  | 2 |  |  |  |  |  |  | 1 |  |  |
| CO3 | Get familiar of cyber forensics |  | 2 |  |  |  | 2 |  |  |  |  |  |  | 1 |  |  |
| CO4 | Get familiar with obscenity and pornography in cyber space and understand the violation of Right of privacy on Internet |  | 2 |  |  |  | 2 |  |  |  |  |  |  | 1 |  |  |
| CO5 | Cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks |  | 2 |  |  |  | 2 |  |  |  |  |  |  | 1 |  |  |
| CO6 | Elucidate the various chapters of the IT Act 2008, power of Central and State Government to make rules under IT Act 2008 |  | 2 |  |  |  | 2 |  |  |  |  |  |  | 1 |  |  |
| CO | |  | 2 |  |  |  | 2 |  |  |  |  |  |  | 1 |  |  |

**UNIT-I: Introduction to cyber Security**

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc.,

**UNIT-II: Cyber Forensics:**

Introduction to cyber forensic, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

**UNIT-III: Cybercrime: Mobile and Wireless Devices:**

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops and desktop.

**UNIT-IV: Cyber Security: Organizational Implications:**

Introduction cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.

**Cybercrime and Cyber terrorism:** Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

**UNIT-V: Privacy Issues:**

Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

**UNIT-VI: Cyberspace and the Law &Miscellaneous provisions of IT Act.**

Introduction to Cyber Security Regulations, International Law. The INDIAN Cyberspace, National Cyber Security Policy. Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threats.

Other offences under the Information Technology Act in India, The role of Electronic Evidence and miscellaneous provisions of the IT Act.2008.

**Cybercrime: Examples and Mini-Cases**

Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

**TEXT BOOKS:**

1. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

1. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

**REFERENCE BOOKS:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

3. Debby Russell and Sr. G.T Gangemi, "Computer Security Basics (Paperback)”, 2ndEdition, O’ Reilly Media, 2006.

4. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, New Delhi, 2006.

5. Cyberspace and Cybersecurity, George Kostopoulos, Auerbach Publications, 2012.

6. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes, Second Edition, Albert Marcella, Jr., Doug Menendez, Auerbach Publications, 2007.

7. Cyber Laws and IT Protection, Harish Chander, PHI, 2013

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9C679** | **Microwave and Optical Communications Lab** | **0** | **0** | **4** | **2** |

***Prerequisites:*** *MWOC*

***Course Objectives:***

*The objective of this course is to provide the students an in-depth knowledge and practice about the microwave and optical components and in analyzing the microwave and optical equipments.*

***Course Objectives****: After studying this course, the students will be able to*

|  |  |
| --- | --- |
| *CO1* | *Analyze the characteristics of RKO and GUNN diode* |
| *CO2* | *Understand the principles governing attenuation and working of DC* |
| *CO3* | *Measure the K, S, Z and f at microwave frequencies.* |
| *CO4* | *Analyse the design principles of circulator and magic Tee* |
| *CO5* | *Understand the basic characteristics of LED and LASER* |
| *CO6* | *Measure the Numerical aperture and bending Losses* |

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Micro Wave and Optical Communications Lab (8C782)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Analyze the characteristics of RKO and GUNN diode |  | 2 |  | 2 |  |  |  |  | 2 |  |  |  | 2 |  |  |
| CO2 | Understand the principles governing attenuation and working of Directional coupler |  | 2 |  |  |  |  |  |  | 2 |  |  |  | 2 |  |  |
| CO3 | Measure the K, S, Z and f at microwave frequencies. | 1 | 2 | 2 |  |  | 2 |  |  | 2 |  |  |  | 2 |  |  |
| CO4 | Analyse the design principles of circulator and magic Tee | 1 | 2 |  |  |  |  |  |  | 2 |  |  |  | 2 |  |  |
| CO5 | Understand the basic characteristics of LED and LASER | 2 | 2 | 3 |  |  | 2 |  |  | 2 |  |  |  | 3 |  | 2 |
| CO6 | Measure the Numerical aperture and bending Losses | 2 | 2 | 3 | 2 |  | 3 |  |  | 2 |  |  |  | 3 |  | 2 |
| CO | Overall | 2 | 2 | 3 | 2 |  | 2 |  |  | 2 |  |  |  | 2 |  | 2 |

**Part – A (Any 8 Experiments)**

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation Measurement.
4. Directional Coupler Characteristics.
5. VSWR Measurement.
6. Impedance and Frequency Measurement.
7. Waveguide parameters measurement.
8. Scattering parameters of Circulator.
9. Scattering parameters of Magic Tee.

**Part-B**

1. Characterization of LED.
2. Characterization of Laser Diode.
3. Intensity modulation of Laser output through an optical fiber.
4. Measurement of NA
5. Measurement of Bending loss

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| **Syllabus for B. Tech (E.C.E.) – A22 regulation** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9C677** | **VLSI Technology and Design Lab** | **0** | **0** | **3** | **1.5** |

***Prerequisites:*** *EDC, STLD, LDICA*

***Course Outcomes****: After studying this course, the students must have demonstrated*

|  |  |
| --- | --- |
| *CO1* | *An ability to use VLSI CAD Tools.* |
| *CO2* | *An ability to understand and implement digital logic gates and circuits using SPICE and Verilog HDL.* |
| *CO3* | *An ability to perform physical design- layouts using EDA Tool.* |
| *CO4* | *An ability to implement combinatorial and sequential designs on FPGA boards (SPARTAN 3) using Xilinx tools.* |
| *CO5* | *An ability to use VLSI CAD Tools.* |

***Mapping of Course Outcomes with Program Outcomes***

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| **CO** | **VLSI Technology and Design Lab (8C577)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | *An ability to use VLSI CAD Tools.* | 3 | 3 | 3 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO2 | *An ability to understand and implement digital logic gates and circuits using SPICE and Verilog HDL.* | 3 | 3 | 3 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO3 | *An ability to perform physical design- layouts using EDA Tool.* | 3 | 3 | 3 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO4 | *An ability to implement combinatorial and sequential designs on FPGA boards (SPARTAN 3) using Xilinx tools.* | 3 | 3 | 3 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO5 | *An ability to use VLSI CAD Tools.* | 3 | 3 | 3 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO | | 3 | 3 | 3 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |

***Syllabus Content***

**PART A**

**The following designs are to be simulated in Xilinx Vivado2017.1 using Verilog HDL (Front-end) and implement it on 7 series FPGA.**

Write HDL program and simulate using testbench program for the following digital circuits

1. Logic Gates.
2. Adders(Half Adder,FullAdder,Parallel Adder).
3. 3-8 Decoder & 8-3 Encoder.
4. 8\*1Multiplexer & 1\*8 Demultiplexer.
5. Flip-flops: D, SR, JK and T.
6. 4-bit Comparator.

**PART B**

**Design, simulate and verify the following circuits using EDA tool (Back-end)**

1. CMOS Inverter
2. 2-input CMOS AND/NAND Gate.
3. 2-input CMOS OR/NOR Gate.
4. 2-input CMOS Ex-OR/Ex-NOR Gate.
5. Design and Simulate the Layout diagram for CMOS Inverter using 180nm Technology.

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| III – II | **9CC85** | **Microprocessors and Microcontrollers Lab** | **0** | **0** | **3** | **1.5** |

***Course Objectives:***

*The objective of this course is to develop the Assembly language programming skills and real-time applications of Microprocessor as well as microcontroller.*

***Course Outcomes****: After studying this course, the students will be able to*

|  |  |
| --- | --- |
| *CO1* | *Explore to write the Assembly Language Programs using MASM for 8086* |
| *CO2* | *Explore to write the Assembly Language Programs using Keil µVision for 8051* |
| *CO3* | *Explore to write the Assembly Language Programs using Keil µVision for ARM processor* |

***Prerequisites:****STLD,LDICA*

***Syllabus Content***

**Introduction to MASM/TASM Assemblers, Keil µVision**

**Familiarization with 8086, 8051 Kits**

**CYCLE 1**

**I 8086 Based Programming**

1. Assembly language programs based on Arithmetic, Logical instruction and decimal arithmetic set
2. Assembly language programs based on branch and loop instructions (sorting an array in Ascending and Descending order)
3. Assembly language programs based on strings instructions (String comparison and scanning)
4. Interfacing :Stepper motor, DAC

**II 8051 Based** language Programs based on timer and serial communication

1. To create a square wave with 50% duty cycle on the P1.5
2. To generate a delay
3. To transfer the letter at a given baud rate

**CYCLE 2**

**III ARM Based Programming**

1. ARM based Assembly language programs to
2. Perform Arithmetic operations on 32/64 bit numbers
3. Convert Hexadecimal values to ASCII
4. Add first 10 integers
5. ARM based Assembly Programs based on branch and loop instructions
6. To arrange 32 bit numbers in ascending or descending order
7. To count the number of 1s in a 32-bit number
8. To find Factorial of a number

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| III – II | **9C662** | **Comprehensive Viva Voce** | **0** | **1** | **0** | **1** |

**Pre-Requisites:** All Courses till this semester

*On completion****:***

* 1. Comprehend the concepts in the core and elective courses.
  2. Exhibit technical knowledge to face interviews.
  3. Exhibit lifelong Learning skills for higher education and to pursue Professional practice.

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Comprehensive Viva Voce (8C668)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Assess the relevant courses they have undergone till the completion of that academic year. Comprehend the concepts in the core subjects and the elective subjects, to make them ready to face technical interviews which improve their employability skills. They are asked to comprehend the concepts in the core subjects and the elective subjects, to make them ready to face technical interviews which improve their employability skills. Assessment is done in the relevant courses they have undergone till the completion of that academic year. | 3 | 2 |  |  |  |  |  |  |  | 2 |  |  | 3 |  |  |
| CO | Overall | 3 | 2 |  |  |  |  |  |  |  | 2 |  |  | 3 |  |  |

Comprehensive Viva Voce will be conducted in Third year second semester i.e in Semester VI for 100 marks. Two internal exams (oral) of 50 marks each will be considered for CIE. There will be no SEE for this course. A student must secure 40% of the total marks to obtain a pass grade.

IV-I

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C713** | **Internet of Things and Applications** | **2** | **1** | **0** | **3** |

***Course Objectives: The student will learn about***

1. *Terminology, technology and applications of IoT*
2. *Sensors and Actuators required to build an IoT system*
3. *Necessary Wireless Networks and protocols*
4. *Raspberry PI3 as a hardware platform for IoT sensor interfacing and*
5. *Various IoT application as case studies*

***Course Outcomes: After completing this course, student shall be able to***

1. *Build a simple IoT System for a given application*
2. *Describe and utilize necessary protocols for communication and management of an IoT system*
3. *Design, Develop and Illustrate IoT applications using Raspberry PI platform and Python Scripting*

***Mapping of Course Outcomes with Program Outcomes***

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| CO | Internet of Things and Applications(**8C714)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Able to learn Sensors and Actuators required to build an IoT system |  |  |  | 1 | 2 |  |  |  |  |  |  | 2 | 2 | 2 | 2 |
| CO2 | Build a simple IoT System for a given application |  |  | 2 |  | 3 |  |  |  |  |  |  | 3 | 2 | 3 | 3 |
| CO3 | Describe and utilize necessary protocols for communication and  management of an IoT system |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO4 | Design, Develop and Illustrate IoT applications using Raspberry PI platform and Python Scripting |  |  | 2 |  | 3 |  |  |  |  |  |  | 3 | 2 | 3 | 3 |
| CO5 | Able to understand the design methodology of IOT application development |  |  | 2 |  |  |  |  |  |  |  |  | 3 | 2 |  | 3 |
| CO6 | Design of case studies using IOT for Manufacturing, health care, Agriculture and entertainment. |  |  | 2 | 2 | 3 | 2 |  |  |  |  |  | 3 | 2 | 3 | 3 |
| CO | Overall |  | 2 | 2 | 2 | 3 | 2 |  |  |  |  |  | 3 | 2 | 3 | 3 |

**Unit – 1- Introduction to IoT**

Part A - Introduction

IoT terms and basic definitions, IoTvs M2M, Characteristics of IoT, IoT Eco-System, IoT applications and marketplace and IoT Reference Model

Part B – Sensor and Actuators

Introduction to transducers, sensors and actuators, Sensor – classification and types, Actuators – Classification and types.

**Unit 2–Embedded Platform for IoT – Rpi 3**

Embedded Platform brief introduction - Ardiuno, Raspberry Pi 3 and Intel Galileo

RPI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

**Unit 3 – IoT Wireless Networks**

Introduction to WSN and its architecture – Network topologies, Issues, Challenges and Security, WSN Technologies and its application - WiFi, Bluetooth, Zigbee, LoRa.

**Unit 4 –** IoT Protocol

Characteristics and Architecture of MQTT, XMP, DDS, AMQP, COAP and REST and their comparison

**Unit 5 - IoT Design Methodology**

Process and requirement, Level Specification, Domain model and service specification, IoT application Development

**Unit 6: Case Studies Illustrating IoT Application**

Home Automation – Smart Lighting, Home intrusion detection, Cities – Smart parking, Environment – Weather monitoring system, Weather reporting bot, Air pollution monitoring, Forest fire detection, Agriculture – Smart irrigation,

**Text Books**

* + - 1. Internet of Things, Author(s): Srinivasa K.G. | Siddesh G.M. | HanumanthaRaju R, ISBN: 9789386858955, Cengage Publications, 2018
      2. Internet of Things A Hands on Approach by ArshdeepBahga, Vijay Madisetti Publisher Universities Press. ISBN – 978 81 7371 954 7

**Reference books**

Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014.

Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI

Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118- 47347-4, Willy Publications

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| IV – I | **9C714** | **Advanced Communications and Networks** | **3** | **0** | **0** | **3** |

Prerequisites: Signals and Systems, Communication Theory or equivalent

After studying this course, the students will be able to

1. *wireless communication systems and Modern wireless communication systems with examples*.
2. *Characterise Multiple Access Techniques for Wireless Communication and calculate capacity of cellular systems*..
3. *Explain Traffic routing in wireless networks, Wireless data services, Common channel signaling*
4. *Describe about Mobile IP And Wireless Access Protocol*.
5. *Develop different Wireless LAN protocols*.
6. *Define About Fundamentals Of 3G Services, Its Protocols And Applications.*

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| CO | **Advanced Communications and Networks (8C715)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | *Explain wireless communication systems and Modern wireless communication systems with examples* |  | 2 |  |  |  |  |  |  |  |  |  |  | 3 |  |  |
| CO2 | *Characterise Multiple Access Techniques for Wireless Communication and calculate capacity of cellular systems*. |  | 3 |  |  | 1 |  |  |  |  |  |  |  | 2 | 1 |  |
| CO3 | *Explain Traffic routing in wireless networks, Wireless data services, Common channel signaling* |  | 2 |  | 1 |  |  |  |  |  |  |  |  | 2 |  |  |
| CO4 | *Describe about Mobile IP And Wireless Access Protocol* |  | 2 |  |  |  |  |  |  |  |  |  |  | 2 |  |  |
| CO5 | *Develop different Wireless LAN protocols* |  | 3 | 2 | 1 |  |  |  |  |  |  |  |  | 2 |  | 1 |
| CO6 | *Define About Fundamentals Of 3G Services, Its Protocols And Applications.* |  | 2 | 2 | 1 |  | 1 |  |  |  |  |  |  |  |  | 1 |
| CO | Overall |  | 2 | 2 | 1 | 1 | 1 |  |  |  |  |  |  | 2 | 1 | 1 |

**Unit-I:**

Spread Spectrum Communications:–Spreading sequences- Properties of Spreading Sequences,Pseudo- noise sequence, Gold sequences, Kasami sequences, Walsh Sequences, Orthogonal Variable Spreading Factor Sequences, Barker Sequence, Complementary Codes

Digital Modulation DQPSK ,8PSK, 16PSK, 8QAM, 16QAM,

Direct sequence spread spectrum:

DS-CDMA Model, Conventional receiver, Rake Receiver ,Synchronization in CDMA, Power Control, Soft handoff, Multiuser detection – Optimum multiuser,detector, Liner multiuser detection.

**Unit-II:**  
**Wireless Networking**: Introduction, Differences between wireless and fixed telephone networks,Development of wireless networks, Traffic routing in wireless networks, Wireless data services, Common channel signalling, ISDN, SS7.  
Applications: Ethernet

**Unit-III**

**Mobile IP And Wireless Access Protocol:** Mobile IP: IP Packet Delivery, Agent Discovery, Tunneling And Encapsulation, IPV6-Network Layer In The Internet- Mobile IP Session Initiation Protocol WAP Architecture-overview, WML scripts, WAP service, WAP session protocol, Wireless transaction, Wireless datagram protocol.

**Unit-IV:**.  
**Wireless LANs:** Introduction, Fundamentals of WLANs, Network Architecture, IEEE802.11standards, WiFi Protocols – 802.11b, 802.11g, 802.11a, 802.11n, 802.11ac; Frequency allocation - 802.11b, 802.11g, 802.11a; Modulation and coding schemes - 802.11b, 802.11g, 802.11a, 802.11n; Security, Hot spots, Virtual private networks, HIPERLAN standard.

**Unit-V:**

Wireless PANs/IEEE 802.15x: Introduction to IEEE 802.15x Technologies: Wireless PAN  
Applications and Architecture, IEEE 802.15.1 Physical Layer Details, Bluetooth Link Controllers  
Basics, Bluetooth Link.

Broad Band Wireless MANs/IEEE 802.16x: Introduction to WMAN/IEEE 802.16x Technology, IEEE  
802.16Wireless MANs, IEEE 802.16 MAC Layer Details

**Unit-VI:**Orthogonal Frequency Division Multiplexing and MIMO System

Basic Principles of Orthogonality, Single vs Multicarrier Systems, OFDM Block Diagram and Its Explanation, FDM Signal Mathematical Representation, Selection parameter for ModulationPulse shaping in OFDM, Space DiversityandSystem,MIMO Based System Architecture, Long-Term Evolution:, LTE Architecture, Enhanced Node B, Core network, Radio channel components, TD-LTE,VoLTE.

**TEXT BOOKS:**  
1. Data Communication and Computer Networking - B. A.Forouzan, 3rd ed., 2008, TMH.   
2. Advanced Electronic Communication Systems - W. Tomasi, 5 ed., 2008, PEI.

3.Wireless Communications by S.Rappaport.

4.Wireless Networks by Clint Smith and Daniel Collins

**REFERENCES:**1. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.   
2. Data and Computer Communications - William Stallings, 8th ed., 2007, PHI.   
3. Data Communication and Tele Processing Systems - T. Housely, 2nd Edition, 2008, BSP.   
4. Data Communications and Computer Networks- Brijendra Singh, 2nd ed., 2005, PHI.

5.Telecommunication System Engineering – Roger L. Freeman, 4/ed., Wiley-Interscience, John Wiley & Sons, 2004.

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| IV – I | **9EC05** | **Computer Networks** | **3** | **0** | **0** | **3** |

**Course Objective:**

1. The objective of the course is to equip the students with a general overview of the concepts and fundamentals of computer networks.

2. Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols and functions of the various layers.

**Course Outcomes:**

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

1 Classify network topologies and apply the same to different networks with the knowledge acquired from the network reference models and fundamentals of computer networks

2 Illustrate the design issues of data link layer and detect the transmission errors and flow control problems

3 Categorize the Channel allocation issues, MAC protocols such as ALOHA, CSMA and CSMA/CD and MAC addresses with IEEE 802.X and wireless LAN.

4 Distinguish the knowledge of the several routing algorithms and Internetworking concepts.

5 Obtain and use the skills of subnetting and routing mechanisms

6 Distinguish the knowledge of the functions of transport and application layer

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| CO | **Computer Networks (8EC47)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Classify network topologies and apply the same to different networks with the knowledge acquired from the network reference models and fundamentals of computer networks |  | 3 |  | 2 |  |  |  |  |  |  |  |  | 3 |  |  |
| CO2 | Illustrate the design issues of data link layer and detect the transmission errors and flow control problems |  | 3 |  | 2 |  |  |  |  |  |  |  |  | 2 |  |  |
| CO3 | Categorize the Channel allocation issues, MAC protocols such as ALOHA, CSMA and CSMA/CD and MAC addresses with IEEE 802.X and wireless LAN |  | 3 |  | 2 |  |  |  |  |  |  |  |  | 2 |  |  |
| CO4 | Distinguish the knowledge of the several routing algorithms and Internetworking concepts |  | 3 |  | 2 |  |  |  |  |  |  |  |  |  |  |  |
| CO5 | Obtain and use the skills of subnetting and routing mechanisms |  | 3 |  | 2 |  |  |  |  |  |  |  |  | 2 |  |  |
| CO6 | Distinguish the knowledge of the functions of transport and application layer |  | 3 |  | 2 |  |  |  |  |  |  |  |  | 2 |  | 2 |
| CO | Overall |  | 3 |  | 2 |  |  |  |  |  |  |  |  | 2 |  | 2 |

**UNIT I**

**Introduction:** Uses of Computer Networks, Types of networks: WAN, LAN, MAN, Network Topologies, Reference models: OSI, TCP/IP.

**Physical Layer:** Transmission media: magnetic media, twisted pair, coaxial cable, fiber optics, wireless transmission.

**UNIT II**

**Data link layer**: Design issues in data link layer: framing, flow control, error control, Error Detection and Correction: Parity, CRC checksum, Hamming code, Flow Control: Sliding Window Protocols, Applications: Data link layer protocols HDLC, PPP.

**UNIT III**

**Medium Access sub layer:** Channel allocation problem, MAC Protocols: ALOHA, CSMA, CSMA/CD, MAC addresses, IEEE 802.X, Standard Ethernet, Wireless LANS. Bridges, Types of Bridges.

**UNIT IV**

**Network Layer:** Design issues in Network Layer, Virtual circuit and Datagram subnets-Routing algorithm: Shortest path routing, Flooding, distance vector routing, Link state routing, Hierarchical routing, Broad casting, Multi casting, Routing for mobile hosts.

Internetworking: Concatenated Virtual Circuits, Connectionless internetworking, Tunneling, Internetwork routing, Fragmentation

**UNIT V**

Network layer in internet: IPv4, IP addresses, Sub netting, Super netting, NAT.Internet control protocols: ICMP, ARP, RARP, DHCP**.**

Congestion Control: Principles of Congestion, Congestion Prevention Policies.

Congestion Control in datagram Subnet: Choke packet, load shedding, jitter control.

Quality of Service: Leaky Bucket algorithm and token bucket algorithm.

**UNIT VI**

**Transport Layer:** Transport Services, Connection establishment, Connection release and TCP and UDP protocols.

**Application Layer**: Domain name system, FTP, HTTP, SMTP, WWW.

## Textbook & Course Materials

### Required Textbooks

1. Computer Networks — Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI

2. Data Communications and Networking – Behrouz A. Forouzan.Third Edition TMH.

3.Data Communication and Networks-BhushanTrivedi-OXFORD Publications.

### Recommended Textbooks & Other Readings

1. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education

2. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson

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| IV – I | **9C780** | **Internet of Things and Applications Lab** | **0** | **0** | **2** | **1** |

Course objectives:

Course outcomes:

CO1: *Able to understand application areas of IOT*

CO2: *Able to understand revolution of internet using Raspberry Pi with python*

CO3: *Able to understand building blocks of IOT and characteristic*

***Mapping of Course Outcomes with Program Outcomes***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **Internet of Things and Applications Lab (8C780)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | *Able to understand application areas of IOT* |  | 2 |  | 2 | 2 |  | 2 |  |  |  |  |  | 2 | 1 |  |
| CO2 | *Able to understand revolution of internet using Raspberry Pi with python* | 2 | 3 | 3 | 3 | 3 |  | 2 |  |  |  |  |  | 3 | 2 |  |
| CO3 | *Able to understand building blocks of IOT and characteristic* | 2 | 3 | 3 | 3 | 3 |  | 2 |  |  |  |  |  | 3 | 2 |  |
| CO | |  | 2 | 3 | 2 | 2 | 2 |  | 2 |  |  |  |  | 3 | 2 |  |

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| **Sl. No.** | **Lab Experiment** |
| 1 | Study and Configure Raspberry Pi 3   1. Installing Debian OS for Raspberry pi3 2. Flashing and Booting for the Rpi3 for the first time |
| 2 | Introduction to Linux Environment – Practice Linux commands and simple python programs on Rpi3   1. Write a Program for arithmetic operation in Python. 2. Write a Program for looping statement in Python. 3. Programming and Interfacing GPIOS – Blink LEDStart/Stop with Switch |
| 3 | Weather monitoring with DHT11 and data storage on cloud (ThingSpeak) |
| 4 | Write a program to store senor data in Rpi3 by creating database system. |
| 5 | Write a program to send sensor data to Cloud using Node Red service to  perform Data Analytics using Rpi3 |
| 6 | 1. Interface and recording pictures and videos using Rpi3 2. Simple program for Colour object detector and tracker |
| 7 | Smart Home Application – Security System - Write a program to detect intruder with proximity sensor,record pictures and send alerts |
| 8 | Smart City Application – Street lighting System - Write a program to control street lights based on the ambience lighting |
| 9 | 1. Writing python Code to implement of MQTT protocol on Rpi3 – Publisher 2. Writing python Code to implement of MQTT protocol on Rpi3 – Subscriber |
| 10 | Writing python Code to implement of MQTT protocol on Rpi3 with multiple Publisher and Subscriber |
| **Internet of Things Students Lab Projects** | |

**IoT Lab Kit Content**

|  |
| --- |
| • Raspberry Pi 3 model B (Wireless, Bluetooth ) |
| •  Micro SD memory card 8 GB  •  SD memory card adapter |
| • DHT 11 Sensor • Resistor, |
| • LED • Switch • Breadboard • Connecting wires |
| •  HDMI to VGA Cable  •  Power Adapter and Micro USB cable |

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| **Syllabus for B. Tech (E.C.E.) – A22 regulation** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C781** | **Advanced Communications and Networks Lab** | **0** | **0** | **2** | **1** |

The objectives of this course are

* To Design and analyze.
* To Design and analyze.

**Course Outcomes**: After studying this course, the students will be able to

* To explore.
* To
* To understand
* To design

**Mapping of Course Outcomes with Program Outcomes andProgram specific outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO | **Advanced Communications and Networks Lab (8C781)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Understand the practical concepts of converting analog signal to digital signal by using PCM, DM, ADM circuits of modulator and demodulator. |  |  | 3 |  |  |  |  |  | 2 |  |  |  | 3 | 3 |  |
| CO2 | Design and analyze ASK, FSK, PSK, DPSK, QPSK modulators and demodulators. |  |  | 3 |  |  |  |  |  | 2 |  |  |  | 3 | 3 |  |
| CO3 | Design and evaluate the performances of Linear Block Codes. |  |  | 3 |  |  |  |  |  | 2 |  |  |  | 3 | 3 |  |
| CO4 | Understand the practical concepts of Digital modulation techniques DPSK and QPSK |  |  | 3 |  |  |  |  |  | 2 |  |  |  | 3 | 3 |  |
| CO5 | Design of modulator and demodulator circuits using MAT Lab Simulation Tool. |  |  | 3 |  |  |  |  |  | 2 |  |  |  | 3 | 3 |  |
| CO6 | Design and implementation of Compander and Data Scrambler/Descrambler using Matlab. |  |  | 3 |  |  |  |  |  | 2 |  |  |  | 3 | 3 |  |
| CO | Overall |  |  | 3 |  |  |  |  |  | 2 |  |  |  | 3 | 3 |  |

**Syllabus Content**

**Syllabus Content**

1. FSK Modulation and Demodulation technique

2.MSK –Modulation and Demodulation technique

3.DPSK -Modulation and Demodulation technique

4. QPSK Modulation and Demodulation technique

5. DQPSK Modulation and Demodulation technique

6 8QAM- Modulation and Demodulation technique

7.OFDM - Modulation and Demodulation technique

8. Convolution Encoding and Decoding technique

9. Study of CDMA-DSSS Communication System with BER Measurement

10. BER performance of AWGN wireless systemusing MAT LAB software

11. Simulation of RAKE Receiver for CDMA communication using MAT LAB software.

12. Simulate and test various types of PN codes, chip rate, spreading factor and processing gain on performance of DSSS in CDMA using MAT LAB software.

13. Simulation of OFDM system using MATLAB software.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C792** | **Summer Industry Internship - II** | **0** | **0** | **2** | **1** |

**Course Objective:**

The students undergo industrial training so that he/she become industry-ready.

**Course Outcomes:**

At the end of the training, the student is able to

* 1. Select the real-time problem in the industry.
  2. Analyze the requirements with respect to the problem statement
  3. Design the optimal solution for the problem.
  4. Implement the solution using the appropriate modern tools.
  5. Present and submit the report

***Mapping of Course Outcomes with Program Outcomes***

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| CO | Summer Industry Internship – II (EVALUATION) (**8C793**) | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 | PSO 3 |
| CO1 | Select the real-time problem in the industry. | 2 | 2 | 2 | 2 | 3 |  |  |  | 3 |  |  |  | 2 | 2 |  |
| CO2 | Analyze the requirements with respect to the problem statement |  | 3 | 2 | 2 | 3 |  |  |  | 3 |  |  |  | 2 | 2 |  |
| CO3 | Design the optimal solution for the problem. |  |  | 3 | 2 | 3 |  |  |  | 3 |  |  |  | 1 | 2 |  |
| CO4 | Implement the solution using the apropriate modern tools | 2 | 2 | 2 | 3 | 3 |  |  |  | 3 |  |  |  | 2 | 3 |  |
| CO5 | Present and submit the report | 3 | 3 | 3 | 3 | 3 |  |  |  | 3 |  |  |  | 3 | 3 |  |
| CO | Overall | 2 | 3 | 2 |  | 3 |  |  |  | 3 |  |  |  | 2 | 2 |  |

Student shall carryout the project in industry during summer vacation for 3-6 weeks. There is internal and external Evaluation. Internal Evaluation carries 40 marks and external Evaluation carries 60 marks, Total 100 marks.

IV-II

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – II | **9C893** | **Project** | **0** | **0** | **20** | **10** |

**Prerequisite :** All Courses till this semester

**Course Objectives:**To enhance the knowledge on selecting a project, learn related tools and enhance programming and communication skills for employability.

**Course Outcomes:**

**At the end of this course the student will be able to**

1. Develop plans with relevant people to achieve the project's goals
2. Break work down into tasks and determine handover procedures
3. Identify links and dependencies, and schedule to achieve deliverables
4. Estimate the human and physical resources required, and make plans to obtain the necessary resources
5. Allocate roles with clear lines of responsibility and accountability with team spirit.

6.     Design and develop the software or prototype to meet societal needs

***Mapping of Course Outcomes with Program Outcomes***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO | **Major Project (8C894)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Develop plans with relevant people to achieve the project's goals  . | 3 | 3 | 2 | 2 | 2 | 1 | 1 |  | 2 |  | 1 | 2 | 3 | 2 | 2 |
| CO2 | Break work down into tasks and determine handover procedures  . | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO3 | Identify links and dependencies, and schedule to achieve deliverables | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 |
| CO4 | Estimate the human and physical resources required, and make plans to obtain the necessary resources | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| CO5 | Allocate roles with clear lines of responsibility and accountability with team spirit. |  | 1 |  |  | 2 | 1 |  | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 |
| CO6 | Design and develop the software or prototype to meet societal needs |  | 1 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO | Overall | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |

A project shall be carried out by a group of students consisting of 2 to 3 in number in fourth year second semester. This work shall be carried out under the guidance of the faculty assigned as internal guide and shall involve design, fabrication, software development or any other significant activity. This can be of interdisciplinary nature also.

Out of total 100 marks for project work (in the final year second semester), 40 marks shall be for Internal Evaluation and 60 marks for the External Evaluation at the end of the Semester.

External Evaluation of the project (viva-voce) shall be conducted by a committee appointed by the Chief Superintendent. The committee consists of an external examiner, HOD, a Senior Faculty Member, Project Coordinator and Internal Guide.

**Division of marks for internal assessment – 30 marks**

|  |  |  |
| --- | --- | --- |
| **Sl.No** | **Description** | **Marks** |
| 1 | Abstract seminar at the end of 3 weeks | 5 marks |
| 2 | Design Seminar at the end of 8 weeks | 5 marks |
| 3 | Implementation/Demonstration of Seminar At the end of 12 weeks | 10 marks |
| 4 | Evaluation of project by internal guide | 10 marks |
| 5 | Project Report | 10 marks |
|  | **Total** | **40 marks** |

**Division of Marks for External Evaluation – 70 Marks**

|  |  |  |
| --- | --- | --- |
| **Sl.No** | **Description** | **Marks** |
| 1 | Final Project Report | 10 marks |
| 2 | Presentation | 20 marks |
| 3 | Demonstration / Defense of Project | 30 marks |
| 4 | **TOTAL** | **60 marks** |

**PROFESSIONAL ELECTIVES**

**(ECE)**

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – I | **9C516** | **Software Defined Radio**  **(Professional Elective- I)** | **3** | **0** | **0** | **3** |

**Course Objectives**

1. This course describes the fundamental radio components and how these components are implemented in software.
2. The principles of software architecture to support the SDR will be developed. Policy and cooperation mechanisms that enable SDR to interoperate will be developed.
3. Basic principles of Cognitive Radio (CR) which is an extended form of SDR will be introduced.
4. In this course you will study SDR & CR and investigate their role in future communication systems.

**Course Outcomes**

**Students who successfully complete this course will have**

1. *An ability to make system-level decisions for software-defined radio technology and products*
2. *An ability to implement smart antenna algorithms*
3. *Knowledge of digital hardware architectures and understanding of development methods*
4. *An understanding of middleware in SDR*
5. *Understanding of analog RF components&Understand the basic principles of Cognitive Radio*

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Software Defined Radio (9C516)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | An ability to make system-level decisions for software-defined radio technology and products | 2 | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO2 | An ability to implement smart antenna algorithms |  | 2 | 2 |  | 3 |  |  |  |  |  |  | 2 | 2 | 3 | 2 |
| CO3 | Knowledge of digital hardware architectures and understanding of development methods |  |  | 3 |  | 3 |  |  |  |  |  |  | 2 | 2 | 3 | 2 |
| CO4 | An understanding of middleware in SDR |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 | 2 | 2 |
| CO5 | Understanding of analog RF components&Understand the basic principles of Cognitive Radio |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO | Overall | 2 | 2 | 3 |  | 3 |  |  |  |  |  |  | 2 | 2 | 3 | 2 |

**UNIT I**

**Introduction to SDR**

What is a Software Radio? The need for Software Radios, Characteristics and benefits of a Software Radio, Design principles of Software Radio

**Unit-II**

**Radio frequency implementation issues**

The purpose of the RF Front-End, Dynamic range: The principal challenge of receiver design. RF receiver front-end topologies, Enhanced flexibility of the RF Chain with Software Radios, Importance of the components to overall performance, Transmitter architectures and their Issues, noise anddistortion in the RF Chain, ADC and DAC distortion

**Unit-III**

**Digital hardware choices**

Key hardware elements, DSP Processors, Field Programmable Gate Arrays, Trade-offs in using DSPs, FPGAs and ASICs, Power management issues, Combination of DSPs, FPGAs, and ASICs.

**Unit-IV**

**Digital generation of signals**

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Spurious components due to periodic jitter, Band pass signal generation, Performance of direct digital synthesis systems, Hybrid DDS-PLL Systems, Applications of Direct Digital Synthesis, Generation of random sequences.

**Unit-V**

**Analog to digital and digital to analog conversion**

Parameters of ideal data converters, Parameters of practical data converters, Techniques to improve data converter performance, Common ADC and DAC architectures

**Unit-VI**

**Introduction to Cognitive Radio**

Motivation of Cognitive Radio, Dynamic Spectrum Access, User hierarchy in cognitive radio networks, Usage scenarios for cognitive radio, Cognitive Cycle, Spectrum Management: spectrum sensing, spectrum decision, spectrum mobility, spectrum sharing, Classification of spectrum sensing techniques..

**Text Books:**

1. J.H. Reed, ‘*Software-Radio, A Modern Approach to Radio Engineering* ’, Prentice-Hall, 2002
2. [EzioBiglieri, Andrea. J. Goldsmith](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Ezio+Biglieri+Andrea.+J.+Goldsmith&search-alias=stripbooks), Larry J. Greenstein, Narayan B. Mandayam,H. Vincent Poor, ‘*Principles of Cognitive Radio’*, Cambridge University Press.

# References:

1. Joseph Mitola*‘Software Radio Architecture: Object-Oriented Approaches to Wireless Systems Engineering*’ Wiley-Interscience; 1st edition2000
2. Yong SooCho,Jaekwon Kim, Won YoungYang, Chung G. Kang ‘*MIMO-OFDM Wireless Communications with MATLAB*’ John Wiley & Sons (2010).
3. Mohamed Ibnkahla‘ Cooperative Cognitive Radio Networks, The Complete Spectrum Cycle’, CRC Press.

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| III – I | **9C517** | **Artificial Neural Networks**  **(Professional Elective- I)** | **3** | **0** | **0** | **3** |

***Course Objectives:***

*The objectives of this course are*

* *To study the concepts of Artificail intelligence and computer vision and also the applications of Neural networks*

***Course Outcomes****: After studying this course, the students will be able to*

|  |  |
| --- | --- |
| *CO1* | *Understand the concepts of* History of Neural Networks |
| *CO2* | *Illustrate the concepts of* Artificial Neuron Models |
| *CO3* | *I*llustrate Neural network Topologies |
| *CO4* | *Explain* Learning methods and Basic learning laws Artificial *neural networks* |
| *CO5* | *Illustrate concept of* Functional units of ANN for pattern recognition tasks |
| *CO6* | *Explain applications of Neural networks* |

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| **CO** | **Artificial Neural Networks (8C627**  **)** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | *Understand the concepts of Artificial Intelligence* | 3 | 2 | 2 | 2 |  |  |  |  |  |  |  |  | 3 |  |  |
| CO2 | *Illustrate the concepts of Artificial Neural system* | 2 | 2 | 3 | 2 |  |  |  |  |  |  |  |  | 3 |  |  |
| CO3 | *I*llustrate *computer vision* | 2 | 2 | 2 | 3 |  |  |  |  |  |  |  | 2 | 3 |  |  |
| CO4 | *Explain Probabilistic models and neural networks* | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 3 |  |  |
| CO5 | *Illustrate concept Neural language* | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 3 |  |  |
| CO6 | *Explain applications of Neural networks* | 2 | 2 | 3 | 3 |  |  |  |  |  |  |  | 2 | 3 |  |  |
| Overall PO mapping | | 2 | 2 | 2 | 3 |  |  |  |  |  |  |  | 2 | 3 |  |  |

**UNIT - I**

History of Neural Networks, Structure and functions of Biological Neural Networks, Performance comparison of computer and biological neural networks, Artificial neural networks: Terminology. Adaptive linear combiner.

**UNIT - II**

Artificial Neuron Models: Structure and functions, McCulloch-Pitts Model, AND, OR, NAND, NOR Logic gates realization using MP model of Neuron, Rosenblatt’s Perceptron model, ADALINE, MADALINE.

**UNIT - III**

Neural networks: Topology – Instar, Outstar, Group of instars, Group of outstars, Bidirectional associative memory, Auto associative memory, Neural network architectures, Single layer feedforward neural network, Multilayer feedforward neural network, Recurrent neural network. Characteristics of neural networks, Learning methods.

**UNIT - IV:**

Learning methods, Basic learning laws: Hebb’s law, Perceptron learning law, Delta learning law, Widraw and Hoff LMS learning law, Correlation learning law, Instar learning law, Outstar learning law.

**UNIT - V**

Functional units of ANN for pattern recognition tasks: Functional units - feedforward ANN, Feedback ANN, Competitive learning ANN. Pattern recognition tasks performed by feedforward ANN: Pattern association, Pattern classification, Pattern mapping. Pattern recognition tasks performed by Feedback ANN: Auto association, Pattern storage, Pattern environment storage. Pattern recognition tasks performed by Competitive learning ANN: Pattern storage, Pattern clustering, Feature map.

**UNIT - VI**

Radial basis functions, Types of Radial Basis Function, The concept of the RBF Network, Counter propagation neural networks, Basic idea of CPN, Architecture of simple forward CPN, Neocognitron: Network structure, Layers, Recurrent neural networks.

Text Books:

1. Artificial Neural Networks by B.Yegnarayana, Prentice Hall of India Private Ltd, 2006.
2. Elements of Artificial Neural Networks, KishanMehrotra, Chilukuri K. Mohan, Sanjay Ranka.

References:

1. Introduction to Neural Networks using MATLAB 6.0.
2. Understanding Neural Networks and Fuzzy logic: Basic concepts and Applications by Stamatios V. Kartalopoulos, Prentice Hall of India Private Ltd, 2005.

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| III – I | **9C518** | **CMOS Analog IC Design**  **(Professional Elective- I)** | **3** | **0** | **0** | **3** |

Course Outcomes:

* Model various components in CMOS process to estimate their performance in circuits.
* Analyze and design of MOS and different current mirror circuits including Wilson, cascade current mirror.
* Design of CMOS Amplifiers including Differential, Cascode and high gain amplifier architectures.
* Design of CMOS Operational amplifiers and to measure the characteristics of cascade operational-amplifier.
* Apply and analyze the performance of open loop and discrete time capacitor circuits

**UNIT –I**

**MOS Devices:** Introduction to MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout

**UNIT –II**

CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

**UNIT –III**

**Analog CMOS Sub-Circuits:** MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

**UNIT –IV**

**CMOS Amplifiers**: Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

**UNIT –V**

**CMOS Operational Amplifiers:** Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power-Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OPAmp.

**UNIT –VI**

**Comparators:** Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

**TEXT BOOKS**:

1. Philip E. Allen and Douglas R. Holberg, “CMOS Analog Circuit Design”, Oxford University Press, International 2nd Edition/Indian Edition, 2010.
2. Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley India, 5th Edition, 2010.

**REFERENCE BOOKS**:

* David A. Johns, Ken Martin, “Analog Integrated Circuit Design”, Wiley Student Edition, 2013.
* Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, TMH Edition.
* Baker, Li and Boyce, “CMOS: Circuit Design, Layout and Simulation”, PHI.

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| III – I | **9C519** | **Computer Organization and Architecture**  **(Professional Elective- I)** | **3** | **0** | **0** | **3** |

**Course Objectives:**

* *The purpose of the course is to introduce principles of computer organization and the basic architectural concepts.*
* *It begins with basic organization, design, and programming of a simple digital computer and introduces simple register transfer language to specify various computer operations.*
* *Topics include computer arithmetic, instruction set design, micro programmed control unit, pipelining and vector processing, memory organization and I/O systems, and multiprocessors*

**Course Outcomes:**

* *Understand the basics of instructions sets and their impact on processor design.*
* *Demonstrate an understanding of the design of the functional units of a digital computer system.*
* *Evaluate cost performance and design trade-offs in designing and constructing a computer*
* *processor including memory.*
* *Design a pipeline for consistent execution of instructions with minimum hazards.*
* *Recognize and manipulate representations of numbers stored in digital computers*

**UNIT - I**

**Digital Computers:** Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.

**Register Transfer Language and Micro operations:** Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.

**Basic Computer Organization and Design:** Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt.

**UNIT - II**

**Microprogrammed Control:** Control memory, Address sequencing, micro program example, design of control unit.

**Central Processing Unit:** General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

**UNIT - III**

**Data Representation:** Data types, Complements, Fixed Point Representation, Floating Point Representation.

**Computer Arithmetic:** Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

**UNIT - IV**

**Input-Output Organization:** Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.

**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

**UNIT - V**

**Reduced Instruction Set Computer:** CISC Characteristics, RISC Characteristics.

**Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor.

**UNIT - VI**

**Multi Processors:** Characteristics of Multiprocessors, Interconnection Structures, Interprocessor arbitration, Interprocessor communication and synchronization, Cache Coherence.

**TEXT BOOKS:**

1. Computer System Architecture – M. Moris Mano, Third Edition, Pearson/PHI.

**REFERENCES:**

1. Computer Organization – Car Hamacher, Zvonks Vranesic, Safea Zaky, V th Edition, McGraw Hill.

2. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.

3. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9C620** | **Satellite Communication**  **(Professional Elective- II)** | **3** | **0** | **0** | **3** |

***Prerequisites:*** *MWOC*

***Course objectives****:*

*The course objectives of this course are*

* *To introduce the working principles and various design aspects of satellite sub-systems.*
* *To get acquinted with the multiple access techniques and the working principle of GPS systems.*

***Course Objectives****: After studying this course, the students will be able to*

|  |  |
| --- | --- |
| *CO1* | *Demonstrate the orbital mechanics.* |
| *CO2* | *Design the satellite subsystem.* |
| *CO3* | *Estimate the C/N and able to measure the relevant values.* |
| *CO4* | *Evaluate the satellite link.* |
| *CO5* | *Recall Multiple access concepts and discuss earth station technology* |
| *CO6* | *Apply the knowledge of GPS in real time applications.* |

***Mapping of Course Outcomes with Program Outcomes***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| CO | **Satellite communications (8C628)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | *Demonstrate the orbital mechanics.* | 3 | 3 | 3 | 3 |  |  |  |  | 3 |  |  |  | 3 | 3 |  |
| CO2 | *Design the satellite subsystem* | 2 | 3 | 3 | 3 |  |  |  |  | 3 |  |  |  | 3 | 3 |  |
| CO3 | *Estimate the C/N and able to measure the relevant values* | 3 | 2 | 2 | 3 |  |  |  |  | 3 |  |  |  | 2 | 3 |  |
| CO4 | *Evaluate the satellite link.* | 3 | 2 | 3 | 3 |  |  |  |  | 3 |  |  |  | 3 | 3 |  |
| CO5 | *Recall Multiple access concepts and discuss earth station technology* | 3 | 3 | 3 | 2 |  |  |  |  | 3 |  |  |  | 3 | 2 |  |
| CO6 | *Apply the knowledge of GPS in real time applications* | 2 | 3 | 3 | 2 |  |  |  |  | 3 |  |  |  | 3 | 3 |  |
| CO | overall | 3 | 3 | 3 | 3 |  |  |  |  | 3 |  |  |  | 3 | 3 |  |

***Syllabus Content***

**UNIT-I**

**INTRODUCTION**

Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Kepler’s laws of orbital motion. Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

**ORBITAL MECHANICS AND LAUNCHERS**

Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems’ performance

**UNIT-II**

**SATELLITE SUBSYSTEMS**

Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.

**UNIT-III**

**SATELLITE LINK DESIGN**

Basic transmission theory, system noise temperature and G/T ratio, Design of down link and up link.

**UNIT-IV**

**MULTIPLE ACCESS**

Frequency division multiple access (FDMA) Intermediation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA. Onboard processing, DAMA, Code Division Multiple access (CDMA),Spread Spectrum transmission and reception.

***Applications: Design of a Remote sensing satellite in IRS-4.***

**UNIT-V**

**EARTH STATION TECHNOLOGY**

Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

**Low Earth Orbit And Geo-Stationary Satellite Systems:** Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations.

**UNIT VI**

**SATELLITE NAVIGATION & THE GLOBAL POSITIONING SYSTEM**

Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS.

**TEXT BOOKS**

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, *Satellite Communications –* WSE, Wiley Publications, 2nd Edition, 2003.
2. Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, *Satellite Communications Engineering –*2nd Edition, Pearson Publications, 2003.

**REFERENCES**

1. M. Richharia, *Satellite Communications Design Principles –* BS Publications, 2nd Edition, 2003.
2. D.C Agarwal, *Satellite Communication -* Khanna Publications, 5th Ed.
3. 3K.N. Raja Rao, *. Fundamentals of Satellite Communications –*  PHI, 2004
4. Dennis Roddy, *Satellite Communications –* McGraw Hill, 2nd Edition.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9C621** | **Digital Image Processing**  **(Professional Elective- II)** | **3** | **0** | **0** | **3** |

**Course Objectives:**

This course aims to:

1. Understand the image formation and its digital representation.

2. Learn representation of images in frequency domain and enhancement techniques.

3. Students would be able to solve the problems related to image compression and restoration.

**Course Outcomes:**

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

1. Describe basic concepts of image processing system.

2. Summarize and compare various digital image transform techniques.

3. Demonstrate and survey digital image enhancement in practical applications.

4. Analyse the case study related to various techniques of image restoration.

5. Apply compression techniques on digital image.

**UNIT-1: DIGITAL IMAGE FUNDAMENTALS**

Elements of digital image processing systems, an image model, Basic relationships between pixels and basic transformation, Image acquisition, sampling and quantization, Image file formats, Two dimensional convolutions, Two dimensional correlation, and Two dimensional frequency responses.

**UNIT-2: IMAGE TRANSFORMS**

Study analysis with examples of 2D transforms, Transforms:, DFT, DCT Walsh, Hadamard, Slant, Haar, KLT, Radon, Hough

**UNIT-3: IMAGE ENHANCEMENT**

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering infrequency domain, image smoothing, image sharpening, Selective filtering.

**UNIT-4: IMAGE RESTORATION**

Image Degradation model, Algebraic approach to restoration, inverse filtering, Least meansquare filter - Wiener filtering, Constrained least square restoration

**UNIT-5: IMAGE SEGMENTATION AND RECOGNITION**

Edge detection, Image segmentation: Region growing, Region splitting and merging, Edge linking, Morphological operations: Dilation, Erosion, Opening, Closing, Image recognition: Patterns and pattern classes, Matching by minimum distance classifier, Statistical classifier, Matching by correlation.

**UNIT-6: IMAGE COMPRESSION**

Need for image compression, Image coding, Huffman coding, Run length encoding, Arithmetic coding, Vector Quantization, Block truncation coding, Transform coding, Image compression standards

**TEXT BOOKS:**

1. Rafeel C Gonzalez, Richard E Woods, ‘Digital Image Processing’, Pearson education, Inc., second edition, 2004.

2. Anil K Jain, ‘Fundamentals of Digital Image Processing’, Prentice hall of India

3. William K Pratt, ‘Digital Image Processing’ , John Wiley, New York, 2002

**REFERENCES:**

1. Lim JS, ‘Two Dimensional Signal and Image Processing’, Prentice - hall New Jersey, 1990

2. Sid Ahmed M A, ‘Image processing Theory, Algorithms and architectures’, McGraw Hill, 1995

3. J T Tou and R.C. Gonzalez, ‘pattern Recognition Principles’, Addison Wesley publishing company

4. E. Gose and R. Johnson Bough, ‘pattern Recognition and Image Analysis’, Prentice hall of India

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| III – II | **9C622** | **VLSI Physical Design**  **(Professional Elective- II)** | **3** | **0** | **0** | **3** |

This course is introduced to help VLSI career aspirants in the field of VLSI Physical Design. It coverscomplete details from VLSI design specification till VLSI IC physical design flow, helps to acquiresufficient skills as needed by Industry.

Course modules cover industry needed in depth knowledge to handle challenges in VLSI Back EndFlow. Students will learn complete knowledge from netlist to GDS2, by working on advancedlowernanometer technology nodes.

The course will benefit VLSI Engineers seeking to enter into VLSI backend design job. In this role

engineers will be working for Block & full chip level Physical Design Implementation.

The main focus of the course is to make students understand physical design of IC from netlistthrough GDSII, creating physical layout representation for each logical functions within blocks toenable IC fabrication process. Through this course emphasis will be given on learning throughpractical backed by theoretical concepts taught during class room & extended lab sessions.

**Prerequisite Courses** - Digital Logic Design, VLSI and Digital Design Through Verilog

**CAD Tool** - Cadence - Innovus, Tempus, Genus, Xcelium, and Others..

**Units 1 - Introduction**

Overview of ASIC/SOC design flow, Digital Design Concepts and Physical Design flow setup.

Review of ASIC fundamentals & fabrication methodologies. Design Strategies - a) Simulation

and synthesis issues, b) RTL design strategies, c) Static timing analysis.

**Units 2 - Design Standard Cell Libraries**

Design of combinational circuits, Implementation and analysis of combinational circuits like, adders, comparator, multiplier etc., Design of sequential circuits (Synchronous and Asynchronus), Design of Finite State Machines (FSM).

Design data preparation, process technologies and standard cell libraries. Understanding of standard cell technology parameters, netlist generation and technology mapping. Reviewing timing constraints and IO constraints. Low power and low area design concepts Exercises on Cadence Tool - Writing RTL for ASIC design flow, Understand ASIC Design Flow

with 4-bit Counter Design

**Units 3 - Static Timing Analysis**

Introduction to STA, Comparison with DTA, Timing Path and Constraints, Different types of clocks, Clock domain and Variations, Clock Distribution Networks, How to fix timing failure, Introductions to timing static and dynamic hazards, Path delay, Gate delay, Metastability states, Sequential timing delays like set-up time, hold time, Maximum frequency, violations, slew, slack, Delay analysis, Sequential logic pad to set up, pad to pad, clk to next Reg, Reg to o/p and Reg to Reg. Violations wrt sequential circuit.

**Units 4 - Design Floor Planning - Power Planning**

Design plan for hierarchical and flat design implementation, better partition techniques and flowsetup. Special cells and IO cells usage planning, congestion removal techniques and implementation constraint setup. Understanding various floor planning techniques, setting up guidelines for better floor planning and meeting design goals. IO PAD placement planning, powerplanning. Adding power rings and power mesh.

**Units 5 - Clock Tree Synthesis and Routing**

Implementation of clock tree in placed design, understanding various aspects of timing parameters like clock setup/hold, skew and latency issues, Adding buffers in clock tree and implementing clock tree. Analyzing timing reports after clock tree synthesis and fixing issues. Various types of routing, trial route, special route, global routing and detailed routing. Analyzing routed design checking post routed design issues, DRC checks, timing checks, optimization of routing constraints

**Units 6 - Design Checks and Signoff**

Doing complete path and module based timing analysis, checking timing optimizer reports, identifying failing paths, fixing issues. Extracting capacitor table values for the design. IR drop and electro migration analysis. Perform DRC, Logical Equivalence checking, generating detailed timing/power reports, generating power reports. GDS-II generation.

**Books**

Physical Design Essentials: An ASIC Design Implementation Perspective by *Khosrow*

*Golshan,* ISBN 0-387-36642-3

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| III – II | **9C623** | **Embedded C Programming**  **(Professional Elective- II)** | **3** | **0** | **0** | **3** |

***Course Objectives:***

*The objectives of this course are*

* *To provide basic knowledge in embedded system design using Embedded C.*
* *To make the learners understand concept and applications of Embedded C Programming in various fields including industrial automation..*

***Course Outcomes****: After studying this course, the students will be able to*

|  |  |
| --- | --- |
| *CO1* | *Demonstrate the use of development software for a particular application and choosing appropriate OS.* |
| *CO2* | *Understanding and building basic embedded system using 8051.Understanding its design* |
| *CO3* | *Design of embedded systems and implementation of switch reading.* |
| *CO4* | *Demonstrate the concepts of OOP’s theory inheritance and functions in embedded C to support modular programming.* |
| *CO5* | *Learning the need for realtime implementation in Embedded C..* |
| *CO6* | *Case study of ‘Intruder Alarm” toachihve real time hands on.* |

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Embedded C Programming (8C624)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | *Demonstrate the use of development software for a particular application and choosing appropriate OS.* | 3 | 2 | 2 |  | 1 |  |  |  |  |  |  | 3 | 3 |  |  |
| CO2 | *Understanding and building basic embedded system using 8051.Understanding its design* | 1 | 3 | 3 |  |  |  |  |  | 3 |  |  |  |  |  |  |
| CO3 | *Design of embedded systems and implementation of switch reading.* | 1 | 2 | 3 | 3 | 3 | 3 |  |  | 3 |  |  |  |  | 3 |  |
| CO4 | *Demonstrate the concepts of OOP’s theory inheritance and functions in embedded C to support modular programming* | 3 | 2 | 2 |  | 1 |  |  |  |  |  |  | 3 | 3 |  |  |
| CO5 | *Learning the need for realtime implementation in Embedded C.* | 1 | 2 | 3 |  |  |  |  |  | 3 |  |  |  |  |  |  |
| CO6 | *Case study of ‘Intruder Alarm” toachihve real time hands on* | 2 |  | 3 | 3 | 3 | 3 |  |  | 3 |  |  |  |  | 3 |  |
| CO | overall | 2 | 2 | 3 | 3 | 2 | 3 |  |  | 3 |  |  | 3 | 3 | 3 |  |

***Syllabus Content***

**UNIT – I:**

**Programming Embedded Systems in C**

Introduction ,What is an embedded system, Which processor should you use, Which programming language should you use, Which operating system should you use, How do you develop embedded software, Conclusions

**UNIT – II:**

**Introducing the 8051 Microcontroller Family**

Introduction, What’s in a name, The external interface of the Standard 8051, Reset requirements ,Clock frequency and performance, Memory issues, I/O pins, Timers, Interrupts, Serial interface, Power consumption ,Conclusions

**UNIT – III:**

**Reading Switches**

Introduction, Basic techniques for reading from port pins, Example: Reading and writing bytes, Example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), Example: Counting goats, Conclusions

**UNIT – IV:**

**Adding Structure to the Code**

Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: Restructuring the ‘Hello Embedded World’ example, Example: Restructuring the goat-counting example, Further examples, Conclusions

**UNIT – V:**

**Meeting Real-Time Constraints**

Introduction, Creating ‘hardware delays’ using Timer 0 and Timer 1, Example: Generating a precise 50 ms delay, Example: Creating a portable hardware delay, Why not use Timer 2?, The need for ‘timeout’ mechanisms, Creating loop timeouts, Example: Testing loop timeouts, Example: A more reliable switch interface, Creating hardware timeouts, Example: Testing a hardware timeout, Conclusions

**UNIT – VI:**

**Case Study: Intruder Alarm System**

Introduction, The software architecture, Key software components used in this example, running the program, the software, Conclusions

**TEXT BOOKS:**

1. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008

**REFERENCE BOOKS:**

1. PICmicro MCU C-An introduction to programming, The Microchip PIC in CCS C - Nigel Gardner

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C724** | **Ad hoc and Wireless Sensor Networks (Professional Elective- III)** | **3** | **0** | **0** | **3** |

**Pre-requisites:**

Probability & Stochastic process, Cellular mobile Communications

Course Objectives**:**

This course is intended to impart to the students the principlesof

1. To study about the basics of wireless networks
2. To understand the challenges in wired vs. wireless domain in computer networks.
3. To study about various types of wireless networks, i.e cellular networks, Bluetooth, Ad hoc networks and wireless sensor networks.
4. To study about various network security attacks and key management.

# Course Outcome:

Upon completion of this module, students will be able to:   
1. Understand the under lying technologies of wireless networks.   
2. Specify and identify deficiencies in existing wireless protocols for MAC layer and Network layer, and then go onto formulate new and better protocols.   
3. Understand the technology behind the cellular network, installation of base station, Bluetooth etc.   
4. To master the concepts of ad hoc networks and the design / performance issues in wireless local area networks and wide area networks.   
5. To be familiar with contemporary issues in networking technologies.

**UNIT 1:** Ad Hoc Wireless Networks: Introduction, Issues in Ad Hoc Wireless Networks, Ad Hoc Wireless Internet.

**UNIT 2:** MAC Protocols for Ad Hoc Wireless Networks: Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols. Contention-based protocols.

**UNIT 3:** Routing Protocols for Ad Hoc Wireless Networks: Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, DSDV, DSR, AODV and ZRP. Differences between Table-driven and On-demand routing protocols.

**UNIT 4:** Multi-cast routing in Ad Hoc Wireless Networks: Issues in Designing a Multicast Routing Protocol, Classifications of Multicast Routing Protocols, MAODV, ODMRP, Differences between Tree- and Mesh-based protocols.

**UNIT 5:**

Transport layer in Ad Hoc Wireless Networks: Introduction, Issues in Designing a Transport layer protocol, why does TCP not perform well in Ad-hoc wireless networks.

Security in Ad Hoc Wireless Networks: Introduction, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management.

QoS in Ad-hoc Wireless Networks: Introduction, Issues and challenges in providing QoS in Ad-hoc wireless networks, classifications of QoS solutions.

**UNIT 6:** Energy Management in Ad Hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks. Classification of Energy Management Schemes.Battery Management Schemes – DLL solutions. Transmission Power Management Schemes – DLL solutions, Network layer solutions, Higher layer solutions.

Text Books:

1. C. S. Ram Murthy, B. S. Manoj, *Ad Hoc Wireless Networks: Architectures and Protocols*, Prentice Hall of India , 2nd Edition, 2005
2. RaminHekmat, *Ad-hoc Networks: Fundamental Properties and Network Topologies*, Springer , 1st Edition, 2006
3. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
4. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

# References:

1. C. S. Ram Murthy, B. S. Manoj, *Ad Hoc Wireless Networks: Architectures and Protocols*, Prentice Hall of India , 2nd Edition, 2005
2. RaminHekmat, *Ad-hoc Networks: Fundamental Properties and Network Topologies*, Springer, 1st Edition, 2006.
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
4. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
5. T. Camp, J. Boleng, and V. Davies “ A Survey of Mobility Models for Ad-hoc Network” Research, “Wireless Commun, and Mobile Comp. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.
6. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M. bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **IV – I** | **9C725** | **Electronics and Instrumentation**  **(Professional Elective- III)** | **3** | **0** | **0** | **3** |

Prerequisite: Fundamental concepts of Network Theory and Electronic Circuits.

Course Objectives:

This course aims to:

1. Explain basic concepts, definitions and error analysis in measurement.

2. Identify the details of instrumentation and devices intended for a particular application.

3. Elaborate discussion about the importance of signal display devices and analyzers in measurement and

describe the various bridge configurations and their applications.

Course Outcomes:

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

1. Define the characteristics and analyze the errors of measurement systems.

2. Select the appropriate passive or active transducers for measurement of physical phenomenon.

3. Relate and apply the appropriate measuring techniques to real time applications.

4. Interpret the usage of DVM, Spectrum Analyzer and DSO instruments for appropriate measurements.

5. Develop an understanding of construction and working of different AC and DC bridges and their applications.

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| CO | **Electronics and Instrumentation (8CC51)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Define the characteristics and analyze the errors of measurement systems | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO2 | Select the appropriate passive or active transducers for measurement of physical phenomenon | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO3 | Relate and apply the appropriate measuring techniques to real time applications | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO4 | Interpret the usage of DVM, Spectrum Analyzer and DSO instruments for appropriate measurements | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO5 | Develop an understanding of construction and working of different AC and DC bridges and their applications | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO | Overall | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |

UNIT– I

Error - Absolute error, Relative error and Accuracy, Precision - conformity and significant figures, limiting errors, Propagation of errors, Errors in measurement-gross, systematic and random errors,

UNIT – II

Loading effect, Statistical analysis of measurement data and probable error, Resolution, Sensitivity, Calibration. Classification of transducers, Strain gauges - gauge factor, bonded, un-bonded and semiconductor stain gauges

UNIT – III

LVDT - principle, construction and displacement measurement, Capacitive transducer - principle and thickness measurement, Piezo-electric transducer and different modes of operation, Photo- electric transducers.

UNIT – IV

Characteristics, pressure, power and intensity levels of sound, Microphones, Temperature measurement - resistance wire thermometers, semiconductor thermometers and thermocouples.

UNIT – V

DVMs- ramp, dual-slope integration, integrating and successive-approximation types, digit, resolution, sensitivity and general specifications, Spectrum analyzers, Digital storage oscilloscope, Introduction to Virtual Instrumentation

UNIT – VI

Introduction to Bridges, DC Bridges - Wheatstone’s bridge, Kelvin’s bridge, AC bridges - introduction, general balance equation for four arm bridge, capacitance comparison bridge, inductance comparison bridge, Maxwell’s bridge, Wien’sbridge, Wagner’s earth connection.

Text Books:

1. Albert D. Helfric, and William D. Cooper, “Modern Electronic Instrumentation and Measurement

Techniques”, PHI, 2010.

2. D V S Murthy, “Transducers and Instrumentation”, 2nd Edition, PHI, 2013.

3. Nakra B.C, and Chaudhry K.K., “Instrumentation, Measurement and Analysis”, 3rdEdition, TMH, 2013.

Reference Books:

1. David A. Bell, “Electronic Instrumentation and Measurements”, 2nd Edition, PHI, 2003.

2. H S Kalsi, “Electronic Instrumentation”, 3rdEdition, TMH, 2011.

3. A.K.Sawhney, “Electrical & Electronic Measurement and Instruments”, DhanpatRai& Co. Publications, 2005.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C726** | **Design Verification using System Verilog (Professional Elective- III)** | **3** | **0** | **0** | **3** |

**Course Description:**

This course gives a student an in-depth introduction to the main SystemVerilog enhancements to the Verilog hardware description language (HDL), discusses the benefits of the new features, and demonstrates how design and verification can be more efficient and effective when using SystemVerilog constructs.

The course is broken down into two modules: The Design module examines improvements for RTL design and synthesis; the Verification module explores verification enhancements such as object-oriented design, assertions and randomization.

### **Prerequisites:**

* A working knowledge of Verilog HDL
* The ability to navigate a file system and use a text editor
* A basic understanding of digital hardware design and verification

***Course Outcomes***

|  |  |
| --- | --- |
| *CO1* | *Understand the UVM concepts* |
| *CO2* | *Explore the class instances and functions* |
| *CO3* | *Comprehend the UVM Configurations* |
| *CO4* | *Analyzing UVM sequences and Modeling in UVM* |
| *CO5* | *Developing Reusable Test benches using UVM and Analyzing the Case studies of Layered test bench for SPI, APB and AXI.* |

***Mapping of Course Outcomes with Program Outcomes***

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| **CO** | **Digital Design and Verification with System Verilog (8C735)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | *Understand the UVM concepts* | 2 | 2 | 3 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| CO2 | *Explore the class instances and functions* | 1 | 3 | 1 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO3 | *Comprehend the UVM Configurations* | 3 | 3 | 1 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO4 | *Analyzing UVM sequences and Modeling in UVM* | 3 | 1 | 1 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO5 | *Developing Reusable Test benches using UVM* | 1 | 3 | 1 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| CO6 | *Analyzing the Case studies of Layered test bench for SPI, APB and AXI.* | 1 | 3 | 1 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO | | 2 | 1 | 3 | 1 | 1 | 2 |  |  |  | 2 | 1 | 1 | 2 | 3 | 2 |

**Syllabus Contents:**

**Unit-1 : Introduction to Functional Verification:**What is Verification?, What do we verify?,

Verification Abstractions, Behavioral level, Transaction level, Functional / RTL level, Gate level, Transaction level; Importance of (Functional) Verification in Chip design life cycle, Verification goals; Overview of various Functional Verification techniques: Simulations, FPGA Prototyping, Emulation, HW/SW Co-verification, Formal Verification, Semiformal Verification, Models of Functional Verification. Black box, White box, Gray box, Verification Hierarchy: Chip-level, Cluster / Subsystem level, IP level, Module / Unit level.

**Unit-** 2 : Overview of SoC Architectures and Functional Verification Environment: What is an SoC ?, Advantages of SoCs over conventional ASICs?, Typical components of an SoCs, Sample SoC Architectures, Typical SoC based Testbench environment , Stimuli Generators, Hard coded, Direct Stimuli from the environment, Stimuli from the model of the environment (BFMs), Random Stimuli Generation; Predictors: Golden/Reference Model, More Abstract (Functional, Transaction Level), Hardwired response, Response database; Transactors, Monitors , Scoreboards , Coverage Collectors - Coverpoints, Property Checkers - Assertions.

**Unit-**3 :SystemVerilog Language Concepts: Evolution of SystemVerilog : Differences between Verilog and System Verilog HDL, New features added in System Verilog (New Data type additions, Arrays - Fixed, Packed, Dynamic, Queues, Associated, Structures & Unions, New Operators, New additions to Subroutines, New additions to Procedural statements & Control flow, Concurrency: Fork.join, Fork..join\_any, Fork..join\_none, Automatic Variables, Interfaces, Program block);

**Unit-**4 : Object Oriented Programming Concepts-I: Classes : Encapsulating properties & methods, Object memory creation, Working with Object handles, Object copying : Shallow and Deep copy, Object cloning, Object protection, Object variables Vs Class variables: Static keyword, Object Randomization, Randomization Seed - A deep look, Randomization variables, Constraint Block, Weighted Randomization, Controlling Randomization, Solve order, Inline Constraints - with constraints, Object Inheritance, Limitations of Inheritance, Polymorphism and Methods overriding ,

**Unit-**5: Object Oriented Programming Concepts-II: Virtual Interfaces, Inter thread Synchronization & Communication: Events, Semaphores, Mailboxes, Packages, Assertions, Immediate assertions, Procedural assertions, Temporal operators, Boolean operators, Sequences, Properties, Functional Coverage: Cover points & Bins, Covergroups, Cross coverage, Sampling coverpoints, Calculating functional coverage, Interfacing with C - DPI, Compiler Directives.

**Unit-**6 : Advanced Testbench Design using SystemVerilog: Introduction to Layered testbench, architecture, Driver, Monitor, Transactor, Generator, Configurations - Device, Transaction, Scoreboard, Reference models, Bus function models.

Textbooks:

1. SystemVerilogFor Verification: A Guide to Learning the Testbench Language Features*by Chris Spear & Greg Tumbush (3rd Edition/5th Edition).*

2.A Practical Guide ForSystemVerilog Assertions by SrikanthVijayaraghavan& MeyyappanRamanathan.

Reference Books:

1. A Practical Guide ForSystemVerilog Assertions by SrikanthVijayaraghavan& MeyyappanRamanathan.

2. Logic Design and verification using System Verilog by Donald Thomas

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C727** | **Embedded System Design using ARM (Professional Elective- III)** | **3** | **0** | **0** | **3** |

On completion of this course you should be able to:

1. Understand the basic architecture of Embedded System and their classification.
2. Explore the architecture of ARM processor.
3. Understand the addressing modes and data processing instructions of ARM processor.
4. Understand the ARM thumb instruction set and its capabilities.
5. Use both assembly and C language based ARM programming and Explore the memory management techniques in ARM.

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Embedded System Design using ARM (8C730)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Understand the basic architecture of Embedded System and their classification *.* | 3 | 2 | 2 |  | 1 |  |  |  |  |  |  | 3 | 3 |  |  |
| CO2 | Explore the architecture of ARM processor | 1 | 3 | 3 |  |  |  |  |  | 3 |  |  |  |  |  |  |
| CO3 | Understand the addressing modes and data processing instructions of ARM processor | 1 | 2 | 3 | 3 | 3 | 3 |  |  | 3 |  |  |  |  | 3 |  |
| CO4 | Understand the ARM thumb instruction set and its capabilities | 3 | 2 | 2 |  | 1 |  |  |  |  |  |  | 3 | 3 |  |  |
| CO5 | Use both assembly and C language based ARM programming | 1 | 2 | 3 |  |  |  |  |  | 3 |  |  |  |  |  |  |
| CO6 | Explore the memory management techniques in ARM | 2 |  | 3 | 3 | 3 | 3 |  |  | 3 |  |  |  |  | 3 |  |
| CO | overall | 2 | 2 | 3 | 3 | 2 | 3 |  |  | 3 |  |  | 3 | 3 | 3 |  |

**UNIT-I**

**Introduction to embedded system:**

Embedded system architecture, classifications of embedded systems, challenges and design issues in embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, fundamentals of VonNeuman/Harvard architectures, types of microcontrollers, selection of microcontrollers.

**UNIT –II:**

**ARM Architecture:**

ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

**UNIT –III:**

**ARM Programming Model – I:**

Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

**UNIT –IV:**

**ARM Programming Model – II:**

Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions

**UNIT –V:**

**ARM Programming:**

Simple C Programs usingFunction Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, ConditionalExecution and Loops.

**UNIT –VI:**

**Memory Management:**

Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access Permissions, Context Switch.

**TEXT BOOKS:**

1. ARM Systems Developer’s Guides- Designing & Optimizing System Software – Andrew N. Sloss, Dominic Symes, Chris Wright, 2008, Elsevier.

**REFERENCE BOOKS:**

Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes / Cole, 1999, Thomas Learning.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C728** | **MIMO OFDM System**  **(Professional Elective- IV)** | **3** | **0** | **0** | **3** |

**Pre-requisites:**

Probability & Stochastic process, Cellular mobile Communications

# Course Objectives:

This course is intended to impart to the students the principlesof

* + The fundamental concepts and design principles in “Multiple-Input Multiple-Output” (MIMO) wireless communications –channel capacity, antenna diversity, space-time coding.
  + The fundamental concepts in “Orthogonal Frequency-Division Multiplexing” (OFDM) communications – transmission, synchronization, peak-to-average power ratio (PAPR) reduction.
  + This fundamental concepts of massive MIMO will present a comprehensive analytical development of the various concepts in massive MIMO and mmWave MIMO technologies for 5G together with practical insights and problem solving.

# Course Outcome:

After Learning this course, the student will be able to gain knowledge and understanding of:

CO1. OFDM’s transceiver architecture

CO2. The problem of PAPR and how to reduce thePAPR.

CO3. To understand how the OFDM receiver performs synchronization

CO4. Channel modeling and propagation

CO5. MIMO Capacity, space-time coding

CO6. Massive MIMO and mmWave MIMO technologies for 5G

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| CO | **MIMO OFDM - PE-IV(8C738)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | OFDM’s transceiver architecture |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO2 | The problem of PAPR and how to reduce the PAPR. |  | 2 | 2 |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO3 | To understand how the OFDM receiver performs synchronization |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO4 | Channel modeling and propagation |  | 2 | 2 | 2 | 2 |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO5 | MIMO Capacity, space-time coding |  | 2 | 2 | 2 | 2 |  |  |  |  |  |  | 2 | 2 | 2 | 2 |
| CO6 | Massive MIMO and mmWave MIMO technologies for 5G |  |  |  |  |  |  |  |  |  |  |  | 2 | 2 | 2 | 2 |
| CO | Overall |  | 2 | 2 | 2 | 2 |  |  |  |  |  |  | 2 | 2 | 2 | 2 |

**UNIT 1:** Fast Fading Wireless Channel Modeling ,Rayleigh/Ricean Fading Channels ,BER Performance in Fading Channels ,Diversity modeling for Wireless Communications ,BER Performance Improvement with diversity ,Types of Diversity – Frequency, Time, Space.

**UNIT 2:** OFDM Basics I: Introduction to OFDM Effect- Multicarrier Modulation and Cyclic Prefix- Channel model and SNR performance- OFDM Issues of PAPR- Frequency and Timing Offset Issues.

**UNIT 3:Bit Error Rate Analysis:** BER Analysis for Space Time Coding, Transmit Beamforming , Receiver Selection Combining, Receiver Equal Combining, Receiver Maximal Ratio Combining.

**UNIT 4:** Introduction to MIMO, Beam forming Antennas, Diversity: Receive- antenna diversity; Transmit-antenna diversity, MIMO Diversity and applications ,MIMO Channel Capacity of ZF,LMMSE,MMSE .

**UNIT 5:Introduction to MIMO:** MIMO Channel Capacity-SVD and Eigen modes of the MIMO Channel-MIMO Spatial Multiplexing – BLAST-MIMO Diversity – Alamouti, OSTBC, MRT-MIMO ‐ OFDM.

**UNIT 6:Introduction to 5G Wireless Technologies:** Key specs and New Techniques for 5G,Introduction to MIMO Wireless Communication Systems ,Channel Estimation for MIMO Systems, Multi-user MIMO Wireless Systems ,Introduction to Massive MIMO Wireless Systems ,Generalized Spatial Modulation, mm Wave MIMO Wireless Systems and Challenges.

Text Books:

1. MIMO-OFDM for LTE, WiFi and WiMAX Li Wang, Ming Jiang, Lajos L. Hanzo, YosefAkhtman Weily2011
2. MIMO-OFDM Wireless Communications with MATLAB Yong SooCho,Jaekwon Kim, Won Young Yang, hung G. Kang John Wiley & Sons(2010)

# References:

1. OFDM for Wireless Communications Systems Ramjee Prasad, Artech House Publishers(2004).
2. MIMO Wireless Communications EzioBiglieri Robert Calderbank Anthony Constantinides Andrea Goldsmith Arogya swami Paulraj H. Vincent Cambridge University Press(2007)

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| IV – I | **9C729** | **Machine Learning & Deep Learning Techniques**  **(Professional Elective- IV)** | **3** | **0** | **0** | **3** |

**Course Objectives:**Learn the basic theory behind machine learning. Understand a range of machine learning algorithms along with their strengths and weaknesses; formulate machine learning techniques corresponding to various applications. Analyze the appropriate machine learning technique for a given problem.

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

1.       Formulate machine learning techniques corresponding to various applications.

2.       Understand the concepts of Classification and regression models and their applicability

3.       Learn the popular clustering algorithms and their parameters

4.       Understand basic computational Learning Theory using PAC Learnability and Instance Based Learning

5.       Apply machine learning algorithms for solving problems of moderate complexity using Gradient Descent Algorithm, Random Forest Algorithm for Predictive Analytics

6.       Understand the Explanation based Learning and Inductive analytical approach to learning.

**UNIT – I: INTRODUCTION to Learning**: Forms of learning, Induction learning, Learning Decision Tree, Statistical learning methods, Learning with complex data, learning with hidden variables, Instance based learning, Reinforcement Learning, Brief Introduction to Pruning and Neural Network Concepts

**UNIT II- SUPERVISED LEARNING**

Linear Models for Regression –  Linear Basis Function Models – The Bias – Variance Decomposition – Bayesian, Linear Regression – Bayesian Model Comparison. Linear Models for Classification – Discriminant Functions – Decision Trees – Classification Trees – Regression Trees ––– Feed-Forward Network Functions –BackPropagation – Regularization –– Radial Basis Function Networks – Ensemble methods – Bagging – Boosting.

**UNIT III- UNSUPERVISED LEARNING**

**Clustering** – K-means – Mixtures of Gaussians –EM Algorithm in General – Model Selection for Latent Variable Models – High Dimensional Spaces – The Curse of Dimensionality – Dimensionality Reduction – Factor Analysis – Principal Component Analysis – Probabilistic PCA - Independent Components Analysis.

**UNIT – IV Deep Learning**

Deep Feed Forward network, Training Deep Neural Networks using Back Propagation-Setup and initialization issues, vanishing and exploding Gradientproblems, Gradient- Descent Strategies, Overfitting and Generalizaton, Cross Validation, Feature Selection,Regularizations, Dropouts, Hyperparameters.

**UNIT – V :CNN**(Convolutional Neural Networks)

Basic structure of Convolutional Network, Shortcomings of Feature Selection - Full Description of the Convolutional Layer - Max Pooling-Full Architectural Description of Convolution Networks, Backpropagation in CNNs, Evolution of CNN Architectures for Image Classification, Fine tuning in CNN.

**UNIT – VI Auto-encoders**

Auto-encoders Neural Networks, Training, Undercomplete and Overcompleteautoencoders, Convolutional auto-encoders, De-convolution layer, Transposed convolution, Sparsely Regulated auto-encoders, Denoisingauto-encoders, Stacked auto-encoders, Variational auto-encoders.

**TEXT BOOK**

1. Tom Michel, Machine Learning. McGraw Hill. 1997
2. Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, O'Reilly Media, 2017.
3. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning (Adaptive omputation and Machine Learning series”, MIT Press, 2017.

**REFERENCE BOOKS**

1. Trevor Hustie, Robert Tibshirani& Jerome Friedman. The Elements of  Statically  Learning, Springer Verilag 2001
2. Chris Bishop, Neural Network for, Pattern Recognition, Oxford University Press. 1995
3. EthemAlpaydin, Introduction to Machine Learning”, MIT Press, Prentice Hall of India, 2005
4. CharuC.Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018
5. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

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| IV – I | **9C730** | **Low Power VLSI Design**  **(Professional Elective- IV)** | **3** | **0** | **0** | **3** |

Pre-Requisites: DLD, VLSI Design

**Course Objectives:** The objectives of the Low Power VLSI Design course are to equip students with comprehensive knowledge and practical skills in understanding power dissipation mechanisms, estimating and analyzing power consumption, implementing low power design techniques, and utilizing advanced tools and methodologies to design energy-efficient VLSI circuits and systems.

***Course Outcomes:***

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

CO1. Understand the low power design

CO2. Learn BiCMOS processes

CO3. Apply low power concepts for different logic circuits.

CO4. Differentiate low power latches and flipflops.

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **Low power VLSI design (8C841)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | understand the low power design | 2 | 2 |  | 2 |  |  |  |  |  |  |  |  | 2 | 1 |  |
| CO2 | Learn BiCMOS processes | 2 | 2 |  | 2 |  |  |  |  |  |  |  |  | 2 | 1 |  |
| CO3 | Apply low power concepts for different logic circuits | 2 | 2 |  | 2 |  |  |  |  |  |  |  |  | 2 | 1 |  |
| CO4 | Differentiate low power latches and flipflops | 2 | 2 |  | 2 |  |  |  |  |  |  |  |  | 2 | 1 |  |
| CO | Overall | 2 | 2 |  | 2 |  |  |  |  |  |  |  |  | 2 | 1 |  |

UNIT I

Introduction, Low-Power design an overview, Low-Voltage, Low-Power design limitations: Power

supply voltage, Threshold voltage, Scaling and Interconnect wires.

UNIT II

BiCMOS Processes: BiCMOS process using N-Well Process, BICMOS process using P-WellProcess and BICMOS process using Twin-Well Process.

BiCMOS manufacturing and Integration considerations: Process considerations for CMOS devicestructures, Process considerations for Bipolar Transistors.

UNIT III

Isolation in BiCMOS: Isolation in Bipolar transistors-Junction isolation in the SBC process,Collector diffusion isolation; Isolation in MOS transistors-Local oxidation of Silicon, Deep trenchisolation.

UNIT IV

Low-Voltage, Low-Power Logic Circuits-I: Conventional CMOS logic gates-Power dissipation inCMOS inverter, Basic NAND and NOR gates, Conventional BiCMOS logic gates-BiCMOSinverter, Basic driver configurations. Full swing with shunting devices.

UNIT V

Low-Voltage, Low-Power Logic Circuits-II: Full swing complementary MOS/Bipolar logiccircuit, Full swing complementary MOS/Bipolar logic circuit with feedback, Merged BiCMOSdigital circuit, Complementary BiCMOS circuits.

UNIT VI

Low-Power Latches and Flip-Flops: Introduction, Evolution of Latches and Flip-Flops.

TEXT BOOKS

1. CMOS/BiCMOS ULSI low voltage, low power by Yeo, Rofail,Goh(3 Authors)-Pearson

Education Asia 1st Indian reprint,2002

REFERENCES

1. Digital Integrated circuits ,J.Rabaey PH. N.J 1996

2. CMOS Digital ICs , Sung-moKang and Yusuf Leblebici 3 rd edition TMH 2003 (chapter 11)

3. VLSI DSP systems ,Parhi, John Wiley &amp; sons, 2003 (chapter 17)

4. IEEE Trans Electron Devices, IEEE J.Solid State Circuits, and other National andInternational Conferences and Symposia

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| **IV – I** | **9C731** | **Embedded Real Time Operating Systems (Professional Elective- IV)** | **3** | **0** | **0** | **3** |

***Course outcomes****:*

*1. Understand the Basic concepts of UNIX operating Systems and files, commands usage.*

*2.Understand the Real time Systems concepts and classification of Real time systems.*

*3. Design concepts of scheduling algorithms and its applications.*

*4. Understand the Interprocess communications and its applications in Real time systems.*

*5. Understand the Exceptional handling andInterrupts and Timers*

*6. Understand the case study of RTOS.*

***Mapping of Course Outcomes with Program Outcomes***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO | **Embedded Real Time operating system (8C736** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | *Understand the Basic concepts of UNIX operating Systems and files, commands usage*. |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO2 | *Understand the Real time Systems concepts and classification of Real time systems* |  | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO3 | *Design concepts of scheduling algorithms and its applications* |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO4 | *Understand the Interprocess communications and its applications in Real time systems* |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO5 | *Understand the Exceptional handling andInterrupts and Timers* |  | 2 |  |  |  |  |  |  |  |  |  | 2 | 2 |  | 2 |
| CO6 | *Understand the case study of RTOS* |  | 2 |  |  |  |  |  |  |  |  |  | 3 | 2 |  | 3 |
| CO | Overall |  | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  | 2 |

**UNIT – I**

**Introduction**: Introduction to UNIX/LINUX, Overview of Commands, File I/O,( open, create, close,

lseek, read, write), Process Control ( fork, vfork, exit, wait, waitpid, exec).

**UNIT - II**

**Real Time Operating Systems**: Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, Tasks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

**Unit III: Scheduling**

Commonly used Approaches to Real Time Scheduling Clock Driven, Weighted Round Robin, Priority Driven, Dynamic Vs State Systems, Effective release time and Dead lines, Offline Vs Online Scheduling.

**UNIT - IV**

**Inter-process Communication**

Inter-process Communication and Synchronization of Processes, Tasks and Threads- Multiple Process.

Problem of Sharing data by multiple tasks & routines, Inter-process communication

**UNIT - V**

**Exceptions, Interrupts and Timers**: Exceptions, Interrupts, Applications, Processing of Exceptions

and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines

(ISR), Soft Timers, Operations.

**UNIT - VI**

**Case Studies of RTOS**: RT Linux, Micro C/OS-II, Vx Works, Embedded Linux, and Tiny OS.

**TEXT BOOK:**

1. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2nd ed., 2008,TMH.  
2. Real Time Systems- Jane W. S. Liu- PHI.

3. Real Time Systems- C.M.Krishna, KANG G. Shin, 1996, TMH

4. Qing Li, “Real Time Concepts for Embedded Systems”, 2011, Elsevier.

**REFERENCE BOOKS:**

1. Rajkamal, “Embedded Systems- Architecture, Programming, and Design”, 2007, TMH.

2. W. Richard Stevens, Stephan A. Rago, “Advanced UNIX Programming”, 2006, 2nd Edition,

Pearson.

3. Dr. Craig Hollabaugh, “Embedded Linux: Hardware, Software and Interfacing”, 2008, 1st

Edition, Pearson.

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| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **IV – II** | **9C832** | **5G Communications**  **(Professional Elective- V)** | **3** | **0** | **0** | **3** |

**Pre-requisites:**

Probability & Stochastic process, Cellular mobile Communications

**Course Objectives**:

This course is intended to impart to the students the principlesof

* The fundamental concepts and design principles in “Multiple-Input Multiple-Output” (MIMO) wireless communications –channel capacity, antenna diversity, space-time coding.
* The fundamental concepts in “Orthogonal Frequency-Division Multiplexing” (OFDM) communications – transmission, synchronization, peak-to-average power ratio (PAPR) reduction.
* This fundamental concepts of massive MIMO will present a comprehensive analytical development of the various concepts in massive MIMO and mmWave MIMO technologies for 5G together with practical insights and problem solving.

**Course Outcome:** After Learning this course, the student will be able to gain knowledge and understanding of:-

|  |  |
| --- | --- |
| CO1 | Learn 5G Technology advances and their benefits |
| CO2 | Learn the key RF, PHY, MAC and air interface changes required to support 5G, OFDM’s transceiverarchitecture |
| CO3 | MIMO Capacity, space-timecoding |
| CO4 | The problem of PAPR and how to reduce thePAPR. To understand how the OFDM receiver performssynchronization |
| CO5 | Implementation options for 5G. Channel modeling and propagation |
| CO6 | Learn Device to device communication and millimeter wave  communication. Massive MIMO and mmWave MIMO technologies for 5G. |

***Mapping of Course Outcomes with Program Outcomes***

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| **CO** | 5G Communications (**8C844**) | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | OFDM’s transceiverarchitecture | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO2 | The problem of PAPR and how to reduce thePAPR | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO3 | To understand how the OFDM receiver performssynchronization | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO4 | Channel modeling andpropagation | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO5 | MIMO Capacity, space-timecoding | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO6 | Massive MIMO and mmWave MIMO technologies for 5G | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO | | 2 | 3 | 3 | 3 | 3 |  |  |  |  |  |  |  | 2 | 2 |  |

**UNIT 1:**

Overview of 5G Broadband Wireless Communications: Evaluation of mobile technologies   
1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for   
5G, Spectrum Analysis and Sharing for 5G. Introduction to Massive MIMO Wireless Systems, Generalized Spatial Modulation,mmWave MIMO Wireless Systems and Challenges.

**UNIT 2:**

Introduction to OFDM Effect- Multicarrier Modulation and Cyclic Prefix- Channel model and SNR performance- OFDM Issues of PAPR- Frequency and Timing Offset Issues. Fast Fading Wireless Channel Modeling, Rayleigh/Ricean Fading Channels, BER Performance in Fading Channels, Diversity modeling for Wireless Communications, BER Performance Improvement with diversity.

BER Analysis for Space Time Coding, Transmit Beam forming, Receiver Selection Combining, Receiver Equal Combining, Receiver Maximal Ratio Combining.

**UNIT 3:** Introduction to MIMO, Beam forming Antennas, Diversity: Receive- antenna diversity; Transmit-antenna diversity, MIMO Diversity and applications, MIMO Channel Capacity of ZF, LMMSE, MMSE. MIMO Channel Capacity-SVD and Eigen modes of the MIMO Channel-MIMO Spatial Multiplexing – BLAST-MIMO Diversity – Alamouti, OSTBC, MRT-MIMO ‐ OFDM.

**UNIT 4:**Millimeter-wave Communications – spectrum regulations, deployment scenarios, beam-  
forming, physical layer techniques, interference and mobility management, Massive MIMO   
propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with   
Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM)

**UNIT 5:**Transmission and Design Techniques for 5G: Basic requirements of transmission over 5G,   
Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized   
frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal   
filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency division   
multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-  
orthogonal multiple accesses (NOMA).

**UNIT 6:**The 5G wireless Propagation Channels: Channel modeling requirements, propagation   
scenarios and challenges in the 5G modeling, Channel Models for mmWave MIMO Systems.

Device-to-device (D2D) and machine-to-machine (M2M) type communications – Extension of   
4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multi-  
hop and multi-operator D2D communications.

Text Books:

1. Principles of Modern Wireless Communication Systems – Aditya K Jagannatham
2. MIMO-OFDM for LTE, WiFi and WiMAX Li Wang, Ming Jiang, Lajos L. Hanzo, YosefAkhtmanWeily2011
3. MIMO-OFDM Wireless Communications with MATLAB Yong SooCho,Jaekwon Kim, Won YoungYang, hung G. Kang John Wiley & Sons(2010)
4. Martin Sauter “From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband”, Wiley-Blackwell.
5. AfifOsseiran, Jose.F.Monserrat, Patrick Marsch, “Fundamentals of 5G Mobile Networks” , Cambridge University Press.
6. AthanasiosG.Kanatos, KonstantinaS.Nikita, PanagiotisMathiopoulos, “New Directions in Wireless Communication Systems from Mobile to 5G”, CRC Press.
7. Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock “Millimeter Wave Wireless Communications”, Prentice Hall Communications.

References**:**

1. OFDM for Wireless Communications Systems Ramjee Prasad, Artech House Publishers(2004).
2. MIMO Wireless Communications EzioBiglieri Robert Calderbank Anthony Constantinides Andrea Goldsmith ArogyaswamiPaulraj H. Vincent Cambridge University Press(2007).
3. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, John Wiley & Sons.
4. AmitabhaGhosh and RapeepatRatasuk “Essentials of LTE and LTE-A”, Cambridge   
   University Press.

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| Sreenidhi Institute of Science and Technology  (An Autonomous Institution approved by UGC and ‘A’ Grade Awarded by NAAC) | | | | | | |
| **Syllabus for B. Tech (E.C.E.) – A22 regulation** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **IV – II** | **9C833** | **Radar Signal Processing**  **(Professional Elective- V)** | **3** | **0** | **0** | **3** |

*Course Outcomes: After the completion of course, the student is able to*

CO1: *Recognise the basics of Radar systems and its applications and its frequencies, Recall the Doppler Effect, and draw backs of CW radars. (U – 1& 2)*

CO2: *Differentiate the Radar parameters, concept of scanning and tracking (U – 2& 5)*

CO3: analyze *how Radar affects the Range measurement and discuss the basic concepts of Moving target indicators and evaluate the draw backs of MTI Radars. (U - 3 & 4)*

*CO4: Illustrate various types of displays and different phased arrays (U - 6)*

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| **CO** | **Radar Signal Processing (8C843)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | *Recognise the basics of Radar systems and its applications and its frequencies, Recall the Doppler Effect, and draw backs of CW radars.* | 3 |  |  | 2 |  |  |  |  |  |  |  | 3 | 2 | 1 | 2 |
| CO2 | *Differentiate the Radar parameters, concept of scanning and tracking* | 2 | 3 | 3 | 3 |  |  |  |  |  |  |  | 3 | 2 | 2 | 2 |
| CO3 | analyze *how Radar affects the Range measurement* CO4: *Discuss the basic concepts of Moving target indicators and evaluate the draw backs of MTI Radars.* | 1 | 2 | 3 | 2 |  |  |  |  |  |  |  | 3 | 2 | 1 | 2 |
| CO4 | *Illustrate various types of displays and different phased arrays* | 2 | 2 | 3 | 2 |  |  | 3 |  |  |  |  | 3 | 2 | 1 | 2 |
| CO | *OVERALL* | 2 | 2 | 3 | 2 |  |  | 3 |  |  |  |  | 3 | 2 | 2 | 2 |

UNIT I

BASICS OF RADAR AND RADAR SIGNAL POCESSING

Nature of Radar, Maximum Range, Radar Equation. Block Diagram. RadarFrequencies and Applications. Prediction of Range Performance.. Rx Noise.Modified Range Equation.Basic Radar Signal Processing, , Signal Models, components of a RadarSignal, Amplitude Models, clutter, Noise Model and Signal -to –NoiseRatio, Jamming,Frequency Models

UNIT-II

CW AND FMCW RADAR

Doppler Effect. CW Radar, Block diagram, Applications of CW Radar. Rxbandwidth requirements. FM CW Radar, Block diagram and characteristics.FM- CW Altimeter. The Doppler Shift, Spatial Models, Spectral Model

UNIT-III

MTI and Tracking RADAR

Block diagram of MTI Radar with Power Amplifier and Power Oscillators. NonCoherent MTI Radar. Delay line Cancellers. Double Cancellation.BlindSpeeds. Filter Characteristics. MTI vs Pulse Doppler Radar. Staggered PRF,Range gated Doppler Filters.

TRACKING RADARS

Tracking Radars: Sequential lobing.Conical Scan.Mono Pulse trackingRadars.Phase Comparison Mono Pulse.

UNIT-V

Sampling and Quantization of Pulsed Radar Signals, Domains and Criteria for Sampling, Radar Signals, Sampling in the Fast Time Dimension, Sampling in Slow Time – Selecting the Pulse RepetitionInterval, Sampling the Doppler Spectrum, Sampling in the Spatial andAngle Dimensions, Quantization, I/Q Imbalance and Digital I/Q

UNIT-VI

Doppler Processing, Alternate Forms of the Doppler Spectrum, MovingTarget Indication (MTI), Pulse Doppler Processing, Pulse PairProcessing, Additional Doppler Processing Issues, Clutter Mapping andthe Moving Target Detector, MTI for moving plat forms

Text Books

1. Merrill I. Skolnik, Introduction to Radar Systems, McGraw-Hill, 2 nd Edition,1981.

2. Mark A. Richards, “Fundamentals of Radar Signal Processing”, McGraw Hill

3. Fred E. Nathanson, “Radar Design Principles: Signal Processing and TheEnvironment”,2ndEdition, 1999, PHI.

References

1. Merrill I.Skolnik,Introduction to Radar systems,McGraw-Hill,3 rd Edition,2001.

2. Byron Edde, Radar Principles,Technology,Applications. PearsonEdition,2004.

3. Peyton Z. Peebles, Jr., “Radar Principles”, 2004, John Wiley.

4. R. Nitzberg, “Radar Signal Processing and Adaptive Systems”, 1999, ArtechHouse.

5. F.E. Nathanson, “Radar Design Principles”, 1st Edition, 1969, McGraw Hill.

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| Sreenidhi Institute of Science and Technology  (An Autonomous Institution approved by UGC and ‘A’ Grade Awarded by NAAC) | | | | | | |
| **Syllabus for B. Tech (E.C.E.) – A22 regulation** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **IV – II** | **9C834** | **Design of Fault Tolerant System**  **(Professional Elective- V)** | **3** | **0** | **0** | **3** |

# Course Objectives:

1. To provide or broad understanding of fault diagnosis and tolerant design Approach.
2. To illustrate the framework of test pattern generation using semi and full automatic approach.

***Course outcomes****:*

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

1. Acquire the knowledge of fundamental concepts in fault tolerant design.
2. Explore the design requirements of self check-in circuits
3. Understand Test pattern generation using LFSR
4. Understand the basic architecture and concept of built-in-self test.
5. Explore the various BIST techniques
6. Demonstrate the boundary scan architectures.

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| CO |  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Acquire the knowledge of fundamental concepts in fault tolerant design. | 3 | 2 | 1 |  |  |  |  |  |  |  |  | 2 | 2 | 1 |  |
| C02 | Explore the design requirements of self check-in circuits | 3 | 2 | 2 | 1 |  |  |  |  |  |  |  | 2 | 2 | 2 |  |
| CO3 | Understand Test pattern generation using LFSR | 3 | 2 | 3 | 2 |  |  |  |  |  |  |  | 2 | 2 | 3 |  |
| CO4 | Understand the basic architecture and concept of built-in-self test. | 3 | 2 | 3 | 3 |  |  |  |  |  |  |  | 3 | 2 | 3 |  |
| CO5 | Explore the various BIST techniques | 3 | 2 | 2 | 2 |  |  |  |  |  |  |  | 3 | 2 | 2 |  |
| C06 | Demonstrate the boundary scan architectures. | 2 | 2 | 3 | 3 |  |  |  |  |  |  |  | 3 | 2 | 2 |  |
| CO | Overall | 3 | 2 | 2 | 2 |  |  |  |  |  |  |  | 3 | 2 | 2 |  |

# UNIT – I

**Fault Tolerant Design:** Basic concepts: Reliability concepts, Failures & faults, Reliability and Failure rate, Relation between reliability and mean time between failure, maintainability and availability, reliability of series, parallel and parallel-series combinational circuits.

Fault Tolerant Design: Basic concepts-static, dynamic, hybrid, triple modular redundant system (TMR).

# UNIT – II

**Self Checking circuits & Fail safe Design:** Self Checking Circuits: Basic concepts of self checking circuits, Design of Totally self checking checker, Checkers using m out of n codes.

Fail Safe Design: Strongly fault secure circuits, fail safe design of sequential circuits using Berger code.

# UNIT - III

**Design for Testability:** Design for testability for combinational circuits: Basic concepts of Testability, Controllability and observability, The Reed Muller’s expansion technique.

# Design for testability by means of scan:

Testability Insertion, Full scan DFT technique- Full scan insertion, flip-flop Structures, Full scan design and Test, Scan Architectures-full scan design, Partial scan methods, multiple scan design.

# UNIT - IV

**Built-in-self-test-I:** BIST Basics-Memory-based BIST,BIST effectiveness, BIST types, Designing a BIST, Test Pattern Generation- exhaustive counters, ring counters, twisted ring counter, Linear feedback shift register, Output Response Analysis- One’s counter, transition counter, parity checking.

# UNIT - V

**Built-in-self-test-II**

BIST architectures- A centralized and separate Board-level BIST architecture, Built-in evaluation and self test (BEST), LSSD On-chip self test, Self –testing using MISR and SRSG, Concurrent BIST, BILBO.

# UNIT – VI

**Standard IEEE Test Access Methods:** Boundary Scan Basics, Boundary scan architecture- Test access port, Boundary scan registers, TAP controller. Boundary scan Test Instructions, Board level scan chain structure-One serial scan chain, multiple-scan chain with one control test port, multiple-scan chains.

# TEXTBOOKS:

1. Fault Tolerant & Fault Testable Hardware Design- Parag K.Lala, 1984,PHI
2. Digital System Test and Testable Design using HDL models and Architectures - Zainalabedin Navabi, Springer International Edition.

# REFERENCES:

1. Digital Systems Testing and Testable Design-Miron Abramovici, Melvin A.Breuer and Arthur D. Friedman, Jaico Books
2. Essentials of Electronic Testing- Bushnell & Vishwani D.Agarwal, Springers.
3. Design for Test for Digital IC’s and Embedded Core Systems- Alfred L. Crouch, 2008, Pearson Education

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| **Syllabus for B. Tech (E.C.E.) – A22 regulation** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P** | **C** |
| **IV – II** | **9C835** | **System on Chip Architecture**  **(Professional Elective- V)** | **3** | **0** | **0** | **3** |

**OBJECTIVES**  
After going through this course the student will be able to

* Understand the System Architecture and Processor Architecture, approach for a SOC Design.
* Learn the, Basic concepts in Processor Micro Architecture, and Learn Different Types of Processors like VLIW Processors, Superscalar Processors etc.
* Learn about SOC external memory, Scratchpads and Cache memory and Multilevel Caches.
* Learn the SOC Design approach, Design and evaluation, Applications Like Image compression etc

**After studying this course, the students will be able to**

1. Know basics of System Architecture
2. Understand the various types of Processors like VLIW Processors, Superscalar Processors.
3. Distinguish Cache memory and Multilevel Caches, SOC external memory.
4. Know the Concept of Inter Connect Architectures, SOC Standard Buses and Reconfiguration Technologies.
5. Know the concepts and issues related to Interconnect Configuration.
6. Explore the SOC Design approach and develop its applications.

***Mapping of Course Outcomes with Program Outcomes***

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| CO | **System-on Chip Architecture (8C842)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Know basics of System Architecture |  | 2 |  |  |  |  |  |  |  |  |  | 3 | 3 |  |  |
| CO2 | Understand the various types of Processors like VLIW Processors, Superscalar Processors |  | 2 | 3 |  |  |  |  |  |  |  |  | 3 | 3 |  |  |
| CO3 | Distinguish Cache memory and Multilevel Caches, SOC external memory |  |  |  |  |  |  |  |  |  |  |  | 3 | 3 |  |  |
| CO4 | Know the Concept of Inter Connect Architectures, SOC Standard Buses and Reconfiguration Technologies*.* |  | 2 | 3 |  |  |  |  |  |  |  |  | 3 | 3 |  |  |
| CO5 | Know the concepts and issues related to Interconnect Configuration |  |  |  |  |  |  |  |  |  |  |  | 3 | 3 |  |  |
| CO6 | Explore the SOC Design approach and develop its applications |  |  | 3 |  |  |  |  |  |  |  |  | 3 | 3 |  |  |
| CO | overall |  | 2 | 3 |  |  |  |  |  |  |  |  | 3 | 3 |  |  |

**UNIT-I: Introduction**

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, an approach for SOC Design, System Architecture and Complexity.

**UNIT-II: Processors** :

Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

**UNIT-III: Memory Design for SOC:**

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

**UNIT-IV: Interconnect Customization and Configuration:**

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor.

**UNIT-V: Interconnect Configuration:**

Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

**UNIT-VI: Application Studies / Case Studies:**

SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

**Text Books**

* Computer System Design System-on-Chip – Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
* Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer

**Reference Books**

* ARM System on Chip Architecture – Steve Furber –2nd Ed., 2000, Addison Wesley Professional.
* System on Chip Verification – Methodologies and Techniques – PrakashRashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

Open Electives

offered by

ECE Department

(common to CSE, IT, EEE, ME, CIVIL)

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|  | **Syllabus for B. Tech (E.C.E.) III Year II semester** | |  |  |  |  |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P/D** | **C** |
| **III-II** | **9CC36** | **Fundamentals of digital circuits & Microprocessors (OE-I)** | **3** | **-** | **-** | **3** |

***Course objectives***: To develop the skills for understanding the design of digital circuits, learn programming skills for 8086 Microprocessor and interfacing peripherals to it.

***Course outcomes****:*

1. *To apply the rules of Boolean algebra to simplify Boolean expressions using theorems and K-maps and to understand number systems*
2. *To design combinational circuits such as full adders, multiplexers, decoders, encoders. Code converters etc.*
3. *To design basic memory units (latches and flip-flops) and sequential circuits*
4. *To understand Architecture, Instructions and I/O devices interfacing of 8086 and analyzing in single mode and in multi processor mode.*

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| CO | **Fundamentals of digital circuits & Microprocessors(7CC37)** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | *To apply the rules of Boolean algebra to simplify Boolean expressions using theorems and K-maps and to understand number systems* | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO2 | *To design combinational circuits such as full adders, multiplexers, decoders, encoders. Code converters etc.* | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO3 | *To design basic memory units (latches and flip-flops) and sequential circuits* | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO4 | *To understand Architecture, Instructions and I/O devices interfacing of 8086 and analyzing in single mode and in multi processor mode.* | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |
| CO | Overall | 3 | 2 | 2 | 2 | 2 |  |  |  |  |  |  |  | 2 | 2 |  |

**UNIT – I**

**Number System and Boolean Algebra:** Binary, decimal, octal, hexa decimal, weighted and un-weighted codes. Axiomatic definition of Boolean algebra, Binary operators, postulates of and theorems. Boolean addition, subtraction, 1’s complement, 2’s complement. Switching functions, Canonical forms and Standard forms, Simplification of switching functions using theorems. K-map representation, simplification of logic functions using K-map.

**UNIT - II**

**Combinational Logic Design:** Single output and multiple output combinational logic circuit design, Binary adders/subtractors, Encoder, Decoder, Multiplexer, Demultiplexer, Parity bit generator, Code-converters.

**UNIT - III**

**Sequential circuits:** Classification of sequential circuits, the clocked SR flip flop, J- K, T and D-types flip flops, triggering mechanism of flip-flops, flip-flop conversion, introduction to counters and registers

**UNIT - IV**

**Architecture of 8086 Microprocessor:** Memory segmentation, BIU and E.U General Purpose registers, 8086 flag register and function of 8086 Flags, Pin diagram of 8086-Minimum mode and maximum mode of operation.

**UNIT – V**

**Instruction set of 8086:** Addressing modes of 8086, Assembly directives, Simple programs. Assembly language programs: involving logical, Branch & Call instructions, sorting.

**UNIT - VI**

**Interfacing with 8086:** Interfacing with RAM, ROM, 8255 PPI – Interfacing with key board, ADC and DAC Stepper Motor.

**Text Books:**

1. Morris Mano-,Digital design –PHI, 2nd Edition.
2. ZviKohavi and Niraj K Jha -Switching & Finite Automata theory – Cambridge, 3rd Edition.
3. Microprocessors and interfacing – Douglas V. Hall, TMH, 2nd Edition, 1999.
4. Advanced microprocessor & Peripherals - A.K.Ray & K.M.Bhurchandi, TMH, 2000.

**References:**

1. Fletcher -An Engineering Approach to Digital Design – PHI.
2. Fundamentals of Logic Design, Roth, Kenny, Seventh Edition, Cengage Learning
3. R.P.Jain-Switching Theory and Logic Design- TMH Edition,2003.
4. CVS Rao -Switching Theory and Logic Design –Pearson Education, 2005
5. Micro computer systems, The 8086/8088 Family Architecture, Programming and Design – Y.Liu and G.A. Gibson, PHI, 2nd Edition.

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| **Syllabus for B. Tech (E.C.E.) IV Year I semester** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P/D** | **C** |
| **IV - I** | **9CC37** | **Fundamentals of Communication (OE-II)** | **3** | **0** | **0** | **3** |

**Course Objectives:**

The objective of this subject is to:

1.Introduce the students to communication systems, frequency spectrum ,need for modulation , antenna and measurable parameters.

2. Introduce to various analog and digital modulation schemes.

3. Introduce Radio system, Antenna and Wave propagation.

4. Knowledge in telecommunication systems and Networking

5. Knowledge of satellite communication and Optical communication

6. Cellular and mobile communication, knowledge in wireless technologies.

**Course Outcomes:** By completing this subject, the student can able to

CO1. Work on various types of modulations.

CO2. Use these communication modules in implementation.

CO3. Understanding basics of various wireless and cellular, mobile and telephone Communication

systems.

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| **CO** | **Fundamentals of Communication (8CC52)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | Work on various types of modulations. |  | 2 |  | 2 | 2 |  | 2 |  |  |  |  |  | 2 | 1 |  |
| CO2 | Use these communication modules in implementation | 2 | 3 | 3 | 3 | 3 |  | 2 |  |  |  |  |  | 3 | 2 |  |
| CO3 | Understanding basics of various wireless and cellular, mobile and telephone communication systems. | 2 | 3 | 3 | 3 | 3 |  | 2 |  |  |  |  |  | 3 | 2 |  |
| CO | |  | 2 | 3 | 2 | 2 | 2 |  | 2 |  |  |  |  | 3 | 2 |  |

**UNIT - I**

**Introduction:** Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain,

Attenuation and decibels. Fundamentals of antenna and wave propogation.

**UNIT - II**

**Simple description on Modulation:** Analog Modulation-AM, FM, Pulse Modulation-PAM,

PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and

demodulation schemes.

**UNIT - III**

**Radio System:**

Transmitter fundamentals, Power amplifier, and Typical transmitter circuit.

Super heterodyne receiver, Typical receiver circuit and Noise.

**Antenna and Wave Propagation :**

Antenna fundamentals, commonly usedantenna ,wave propagation and transmission line.

**UNIT - IV**

**Telecommunication Systems:** Telephones Telephone system, Paging systems, Internet

Telephony.

**Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet

LANs, Token Ring LAN.

**UNIT - V**

**Satellite Communication:** Satellite Orbits, satellite communication systems, satellite

subsystems, Ground Stations Satellite Applications, Global Positioning systems.

**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber –Optic

Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

**UNIT - VI**

**Cellular and Mobile Communications:** Cellular telephone systems, AMPS, GSM, CDMA,

and WCDMA.

**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless

networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

**Text Books:**

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill

publications,4th edition, 2016.

2. Electronic Communications systems, Kennedy, Davis 4e, MC GRAW HILL

EDUCATION, 1999

**Reference Books:**

1. Theodore Rapp port, Wireless Communications - Principles and practice, Prentice

Hall, 2002.

2. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.

3. Introduction to data communications and networking, Wayne Tomasi, Pearson

Education, 2005.

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| **Syllabus for B. Tech (E.C.E.) IV Year II semester** | | | | | | |
| **Year/Sem** | **Sub. Code** | **Subject Name** | **L** | **T** | **P/D** | **C** |
| **IV - II** | **9CC38** | **Embedded Systems (OE-III)** | **3** | **0** | **0** | **3** |

***Course Objectives -  The student will learn about***

1. *The constraints and challenges of an Embedded System design*
2. *The 8051 Architecture, Assembly Language Programming , Interfacing and Interrupt handling mechanism*
3. *Interfacing with various bus protocols*
4. *Concepts and constraints related to real-time systems*

***Course Outcomes – After completing this course, student shall be able to***

1. *Identify the design constraints and challanges of a modern embedded system.*
2. *Write ALP for 8051 architecture and Design hardware interface with 8051 to DC motor, keyboard, LCD.*
3. *Implement interfaces for Embedded System using various protocols and hardware modules.*
4. *Explain the concepts and design requirements related to a real time systems, getting embedded software into target system – Debugging.*

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| **CO** | **Embedded Systems Concepts (8CC53)** | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | *Identify the design constraints and challanges of a modern embedded system.* | 2 |  | 3 | 2 | 1 |  |  |  |  |  |  | 2 | 2 | 2 |  |
| CO2 | *Write ALP for 8051 architecture* | 2 | 2 | 3 | 2 | 1 |  |  |  |  |  |  | 2 | 2 | 2 |  |
| CO3 | *Write ALP for 8051 architecture and Design hardware interface with 8051 to DC motor, keyboard, LCD* | 2 | 2 | 3 | 2 | 1 |  |  |  |  |  |  | 2 | 2 | 2 |  |
| CO4 | *Explain the concepts and design requirements related to a real time systems, getting embedded software into target system – Debugging.* | 2 | 2 | 3 | 2 | 1 |  |  |  |  |  |  | 2 | 2 | 2 |  |
| CO | OVERALL | 2 | 2 | 3 | 2 | 1 |  |  |  |  |  |  | 2 | 2 | 2 |  |

**UNIT – I: Introduction to Embedded Systems**

Embedded Systems, Comparing Embedded and General Computing, Complex System Design and Processors, Classification of Embedded Systems, Embedded System Design Process, Formalization of System Design, Embedded SOC and VLSI Circuit Technology, Application examples of Embedded Systems.

**UNIT – II: 8051 Architecture, Memory Organization and Programming**

8051 Architecture, features, Addressing modes, Instruction set, Input/Output Ports and Circuits, External Memory, Counter and Timers, Serial data, Input/Output, Interrupts; The Assembly Language programming Process, Programming the 8051, Data Transfer and Logical Instructions. Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions, use of C programming for 8051.

**UNIT – III: 8051 Real World Interfacing**

Part A - Real World Interfacing, Performance metrics, Memory map, Processor and Memory selection,

Part B - IO Subsystem, Sensors and Actuators, LED and LCD Interfacing, Keyboard Interfacing, Stepper Motor Interfacing, DC motor Interfacing Using PWM

**UNIT – IV: Embedded Communication Interface**

Serial and Parallel Communication, Timer and Counting Devices, Watchdog Timer, Real Time Clock, I2C, SPI protocol, ISA , PCI, Internet Enabled Systems, Wireless and Mobile Systems Protocols

**UNIT – V: Introduction to Real - Time Operating Systems**

Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment. (Chapter 6 and 7 from Text Book 3, SImon).

**UNIT – VI: Basic Design Using a Real-Time Operating System** : Principles, Semaphores and Queues, HardReal-Tjme Scheduling Considerations, Saving Memory and Power, An example RTOS like uC-OS (Open Source);

**Embedded Software Development Tools**: Host and Target machines, Linker! Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging

**TEXT BOOKS:**

1. Embedded Systems- Architectuer, Programming and Design 2E, Raj Kamal, TMH
2. Introduction to Embedded Systems, K.Shibu, Tata McGraw-Hill
3. The 8051 Microcontroller And Embedded Systems Using Assembly And C – Mazidi, Pearson Education India, 2nd edition, 2008.
4. An Embedded Software Primer, David E. Simon, Pearson Education

**REFERENCES:**

1. Computers and Components: principles of embedded *computing* system design, Wayne Wolf, Elseveir.
2. 8051 Application Notes by Atmel.