IV Year - I Semester

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PC	UGEC7T0123	Cellular & Mobile Communications	3	0	0	3	30	70	100
2	Mang Course -II	UGMB7T0323	Management Science	2	0	0	2	30	70	100
3	PE	UGEC7T0223 UGEC7T0323 UGEC7T0423 UGEC7T0523	**Professional Elective – IV** 1. Low Power VLSI Design 2. Coding Theory and Applications 3. DSP Processors and Architectures 4. Soft Computing Techniques	3	0	0	3	30	70	100
4	PE	UGEC7T0623 UGEC7T0723 UGEC7T0823 UGEC7T0923	**Professional Elective – V** 1. Design for Testability 2. Radar Engineering 3. Digital Image Processing 4. Internet of Things	3	0	0	3	30	70	100
5	OE		OpenElective-III	3	0	0	3	30	70	100
6	OE		OpenElective-IV	3	0	0	3	30	70	100
7	Skill	UGEC7K1023	Digital Signal and Image Processing Lab	0	1	2	2	30	70	100
8	Audit	UGEC7A1123	Constitution of India	2	0	0	0	30	0	30
9	Internship	UGEC7I1223	Evaluation of Industry Internship	0	0	0	2	0	50	50
	Total			**19**	**01**	**02**	**21**	**240**	**540**	**780**

IV Year - II Semester

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	Internship & Project	UGEC8J0123	Full semester Internship & Project Work	0	0	24	12	60	140	200
	Total			**0**	**0**	**24**	**12**	**60**	**140**	**200**

CELLULAR & MOBILE COMMUNICATIONS

Subject Code: UGEC7T0123	**L**	**T**	**P**	**C**
IV Year/I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Basics of Communication Systems
- Fundamentals of Electromagnetic Waves and Antennas

Course Objectives

- To understand the principles and design of cellular communication systems, including frequency reuse, interference management, channel assignment, and signal propagation in wireless environments.
- To analyze modern cellular technologies and multiple access techniques, such as GSM, TDMA, FDMA, CDMA, MIMO, OFDM, and 4G/5G systems, for efficient wireless communication.

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

- **CO 1.** Explain the fundamentals of cellular communication systems, including system design principles, frequency reuse, and co-channel interference.
- **CO 2.** Analyze different types of interference and evaluate the role of antenna parameters and diversity techniques in improving system performance.
- **CO 3.** Apply frequency management and channel assignment strategies to enhance cell coverage and capacity under various propagation conditions.
- **CO 4.** Describe antenna systems and handoff mechanisms, and understand modern cellular technologies such as GSM, multiple access techniques, MIMO, OFDM, and 4G/5G networks.

Syllabus

UNIT I

CELLULAR SYSTEMS : Limitations of Conventional System, Basic Cellular Mobile System, Generations of Cellular Wireless Systems (1G to 4G), Operation of Cellular System, Mobile Radio Environment: Fading and Doppler Spread, Coherence Bandwidth, Fundamentals of Cellular Radio System Design: Frequency Reuse, Co-channel Interference and its Reduction Factor, Trunking and Grade of Service.

UNIT II

CO-CHANNEL & NON-CO-CHANNEL INTERFERENCE : Co-Channel Interference, Antenna Parameters and their Effects, Diversity Techniques: Space Diversity, Frequency Diversity, Polarization Diversity and Time Diversity, Non Co- Channel Interference, Adjacent Channel Interference, Near-End Far-End Interference.

UNIT III

FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT : Channel Assignment to Cell Sites and Mobile Units, Channel Sharing and Borrowing, Sectorization, Non-Fixed Channel Assignment.

CELL COVERAGE FOR SIGNAL AND TRAFFIC: Signal Propagation in Different Terrains, Effect of Structures, phase difference between direct and reflected paths, straight line path loss slope, general formula for mobile propagation over water and flat open area, form of a point to point model.

UNIT IV

CELLSITE AND MOBILE ANTENNAS & HANDOFFS : Omni Directional Antennas, Directional Antennas for Interference Reduction, Space Diversity Antennas, Minimum separation of Cell Site Antennas, High Gain Antennas.

HANDOFFS: Handoff Initiation, Types of Handoff, Soft and Hard Handoffs, Intersystem and Intrasystem Handoffs, Dropped Call Evaluation.

UNIT V

DIGITAL CELLULAR NETWORKS AND MULTIPLE ACCESS SCHEMES : GSM Architecture and Channels, Multiple Access Techniques: TDMA, FDMA, CDMA, Introduction to MIMO Systems, OFDM Basics, 4G LTE Basics, Introduction to 5G.

Mapping of CO's to PO's:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	-	-

TEXT BOOKS:

T1. Mobile Cellular Telecommunications W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006.

T2. Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.Pearson, 2010, ISBN 9788131731864

REFERENCES:

R1. Principles of Mobile Communications Gordon L. Stuber, Springer International 2nd Edition, 2001.

R2. Modern Wireless Communication Simon Haykin Michael Moher, Persons Eduction,2005.

MANAGEMENT SCIENCE

Subject Code : UGMB7T0323	**L**	**T**	**P**	**C**
IV Year / I Semester	**2**	**0**	**0**	**2**

Prerequisites:

- General awareness about Principles of Management.
- To have an insight about Production and Operations Management.
- To be able to acquire knowledge about Human Resource Management, Marketing, Strategic Management.

Course Objectives:

1. To create awareness about different Managerial concepts like Management, Production, Marketing, Human Resource and Strategic Management.
2. To make the students equip with knowledge on techniques of PERT and CPM in project management.

Course Outcomes: Upon completing the course, student will be able to

COs	Description	Blooms Level
CO 1	Understand the fundamentals of Management with specific insight as its function and role	Understanding
CO 2	Learn the concepts of production, Management of human Resources and Management of Marketing activities along with business environment	Understanding
CO 3	Apply the problem solving skills to demonstrate logical solution to real life problems	Applying
CO 4	Create the awareness of business strategies to deal with the dynamic business environment	Creating

SYLLABUS

UNIT-I **[8 Hrs]**

Introduction to Management : Concept and importance of Management, Functions of management, Evaluation of Management thought, Fayol's principles of Management, Maslow's need hierarchy & Herzberg's two factor theory of Motivation, Decision making process, Designing organizational structure, Principles of Organization, Types of organization structures.

UNIT-II **[8 Hrs]**

Operations Management : Plant Location Principles and types of plant Layout , Work study, Materials Management: Objectives - Need for inventory control- Inventory control techniques EOQ , ABC, HML, SDE, VED and FSN analysis.

UNIT-III **[12 Hrs]**

Human Resources Management (HRM): Concepts of HRM, Basic functions of HR manager, Job Evaluation and Merit Rating, Performance Appraisal, Methods of Performance appraisal Concepts Compensation.

Marketing Management: Functions of marketing, Marketing Mix, Marketing strategies based on Product life cycle, Channels of distribution (Place), Promotional Mix.

UNIT-IV **[10 Hrs]**

Project Management (PERT/CPM): Network analysis, Program Evaluation and Review Technique (PERT), Critical path method (CPM) - Identifying critical path, Difference between PERT & CPM (simple problems).

UNIT-V **[8 Hrs]**

Strategic Management: Mission, Goals, objectives, policy, strategy, Environmental scanning, SWOT analysis, Steps in strategy formulation and implementation Generic strategy alternatives.

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	2	-	-	-

Text Books:

T1. Dr. Arya Sri, "Management Science", TMH 2011.

T2. L.M. Prasad, "Principles & Practices of Management" Sultan chand & Sons, 2007.

Reference Books:

R1. K. Aswathappa and K. Sridhara Bhat, "Production and Operations Management", Himalaya Publishing House, 2010.

R2. Philip Kotler Philip Kotler, Kevin Keller, Mairead Brady, Malcolm Goodman, Torben Hansen, "Marketing Management" Pearson Education Limited, 2016.

LOW POWER VLSI DESIGN

(Professional Elective –IV)

Subject Code: UGEC7T0223	**L**	**T**	**P**	**C**
IV Year/I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Switching Theory And Logic Design
- VLSI Design

Course Objective:

- To expose the students to the low voltage device modeling.
- To design Low voltage, low power VLSI CMOS circuit design.

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

CO'S	Description Blooms Level	Blooms Level
CO1	Understand the need for low power circuit design and its importance in modern VLSI systems.	II - Understanding
CO2	Acquire the knowledge in various low power design approaches and techniques.	III-Applying
CO3	Analyze and design various types of low power adders.	IV-Analyzing
CO4	Apply the different low power techniques for designing multipliers and Low-Voltage Low-Power Memories.	III- Applying

Syllabus

UNIT –I **[10 Hrs]**

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT –II **[10 Hrs]**

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches.

Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, and Mask Level Measures.

UNIT –III **[12 Hrs]**

Low-Voltage Low-Power Adders: Introduction, StandardAdder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look- Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT –IV **[12 Hrs]**

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT –V **[10 Hrs]**

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Mapping of COs to POs:

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
CO1	3		3									2		3
CO2	3	3										2		3
CO3	3		3									2		3
CO4	3		3									2		3

TEXT BOOKS:

T1. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH,2011.

T2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

REFERENCE BOOKS:

R1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press,2011

R2. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.

R3. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.

CODING THEORY AND APPLICATIONS

(Professional Elective IV)

Subject Code: UGEC7T0323	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Pre requisites: To take this course the students should have the knowledge of

- Digital Communications

Course Objectives: This course provides a full understanding of

- Information theory concepts and their role in communication systems.
- Linear block and cyclic codes for error detection and correction.
- Convolutional coding techniques and decoding methods.
- Advanced error control techniques including burst and BCH codes.

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

COs	Description	Bloom's Level
CO1	Apply information theory concepts to evaluate communication system performance	III-Apply
CO2	Analyze linear block and cyclic codes for error detection and correction	IV-Analyze
CO3	Implement convolutional coding and decoding techniques for reliable communication	III-Apply
CO4	Examine burst and BCH coding techniques for error detection and correction	IV-Analyze

Syllabus

UNIT —I **[10 + 5 Hrs]**

Coding for Reliable Digital Transmission and Storage: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies

Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

UNIT —II **[10 + 5 Hrs]**

Cyclic Codes: Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT —III **[10 + 5 Hrs]**

Convolutional Codes: Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

UNIT —IV **[10 + 4 Hrs]**

Burst Error-Correcting Codes: Decoding of Single-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolutional Codes.

UNIT -V **[8 + 4 Hrs]**

BCH Codes: BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms.

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	-

TEXT BOOKS:

1. Error Control Coding- Fundamentals and Applications —Shu Lin, Daniel J.Costello, Jr, Prentice Hall, Inc.
2. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill Publishing.

REFERENCE BOOKS:

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
2. Digital Communications- John G. Proakis, 5th Ed., 2008, TMH.

DSP PROCESSORS AND ARCHITECTURES

(Professional Elective -IV)

Subject Code: UGEC7T0423	**L**	**T**	**P**	**C**
IV Year/I Semester	**3**	**0**	**0**	**3**

Prerequisite

- Digital Signal Processing

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

COs	Description	Bloom's Level
CO 1	Explain the fundamental concepts of Digital Signal Processing, including DSP systems, number formats, and sources of computational errors.	II- Understand
CO 2	Analyze the architectural features, computational building blocks, and memory organization of programmable DSP processors.	IV- Analyze
CO 3	Apply addressing modes, instruction sets, and programming techniques to develop assembly language programs for TMS320C54xx DSP Processor.	III- Apply
CO 4	Analyze the architecture of ADSP 2100 DSP Processor and interfacing techniques for memory and I/O peripherals, including interrupts and DMA.	IV- Analyze

Syllabus

Unit – I **[10+2 Hrs.]**

Introduction to Digital Signal Processing: Introduction, A Digital signal processing system. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Unit – II **[10+2 Hrs.]**

Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

Unit-III **[10+2 Hrs.]**

Programmable Digital Signal Processors: Commercial digital signal processing devices, Data Addressing modes of TMS320C54XX DSPs, data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX processors, program control, TMS320C54XX instructions and programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, pipeline Operation of TMS320C54XX Processors.

Unit – IV **[10+2 Hrs.]**

Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP2181 high performance processor.

Unit – V **[10+2 Hrs.]**

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

CO-PO Mapping

COs	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
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-	1	-	-
CO3	3	2	-	-	3	-	-	-	-	-	-	1	-	-
CO4	3	3	-	2	2	-	-	-	-	-	-	1	-	-

Text Books:

T1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

T2. A Practical Approach To Digital Signal Processing - K Padmanabhan, R. Vijaya rajeswaran, Ananthi. S, New Age International, 2006/2009.

Reference Books:

R1. Digital Signal Processors, Architecture, Programming and Applications–B. Venkataramani and M. Bhaskar, 2002, TMH.

R2. DSP Processor Fundamentals: Architectures & Features – Lapsley et al., S. Chand & Co. Digital Signal Processing Applications Using the ADSP-2100 Family, Prentice-Hall, Inc.

SOFT COMPUTING TECHNIQUES

(Professional Elective IV)

Subject Code : UGEC7T0523	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Pre requisites:

- Control Systems
- Machine Learning

Course Objectives:

- ✓ To provide fundamental knowledge of soft computing techniques including artificial neural networks, fuzzy logic, genetic algorithms, and swarm intelligence for solving complex engineering problems.
- ✓ To enable students to apply and analyze soft computing methods for real-world applications such as classification, optimization, and intelligent decision-making systems.

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

COs	**Description**	**Bloom's Level**
CO1	Understand and differentiate various soft computing techniques.	II- Understand
CO2	Apply artificial neural network models for solving classification and pattern recognition problems.	III-Apply
CO3	Apply fuzzy logic systems and genetic algorithms for solving control and optimization problems.	III-Apply
CO4	Analyze and evaluate swarm intelligence techniques for solving complex engineering applications.	IV-Analyze

Syllabus

UNIT —I **[8 + 5 Hrs]**

Introduction to soft computing: Introduction, Artificial Intelligence, Artificial Neural Networks, Fuzzy systems, Genetic Algorithm and Evolutionary programming, Swarm Intelligent systems, Expert systems, Comparison among Intelligent systems.

UNIT II **[10 + 5 Hrs]**

Artificial Neural Networks: Introduction to Artificial Neural Networks, Classification of ANNS, First generation neural networks, Perceptron network, Adaline, Madaline, Second generation neural networks, Back propagation neural networks, Hopfield Neural Network, Kohonen neural network, Hamming neural network, Radial basis function neural networks, spike neuron models.

UNIT III **[10 + 5 Hrs]**

Fuzzy Logic System: Introduction to fuzzy logic, classical sets and fuzzy sets, fuzzy set operations, fuzzy relations, fuzzy composition, natural language and fuzzy interpretations, fuzzy inference system, fuzzy controllers.

UNIT IV **[10 + 5 Hrs]**

Genetic Algorithm: Introduction to Genetic algorithms, Genetic algorithms, procedures of Gas, working of Gas, Travelling sales man problem, Evolutionary programming, working principle of GA Machine learning classifier system.

UNIT V **[10 + 5 Hrs]**

Swarm Intelligent system: Introduction to swarm intelligence, back ground, Ant colony system, working of ant colony optimization, Particle swarm intelligent systems, Artificial bee colony system, cuckoo search algorithm.

Mapping of COs to POs

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
CO1	3	3	2	3	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	3	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	2	-	-
CO4	3	3	2	3	-	-	-	-	-	-	-	2	-	-

TEXT BOOKS:

T1. Soft computing with MATLAB programming N.P.Padhy, S.P.Simon, Oxford university press, 2015.

T2. Neural Networks and Fuzzy Systems - Kosko, B., Prentice-Hall of India Pvt. Ltd., 1994.

REFERENCE BOOKS:

R1. Fuzzy Sets, Uncertainty and Information - Klir G.J. &Folger T.A., Prentice-Hall of India Pvt. Ltd., 1993.

R2. Fuzzy Set Theory and Its Applications - Zimmerman H.J. Kluwer Academic Publishers, 1994.

DESIGN FOR TESTABILITY

(Professional Elective V)

Subject Code : UGEC7T0623	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Switching theory and Logic Design
- VSLI Design

Course Objectives

1. To provide knowledge of fundamental concepts of VLSI testing, fault models, and various testing techniques used in digital systems.
2. To develop the ability to apply simulation, testability measures, and design-for-testability (DFT) techniques for efficient testing of VLSI circuits.

Course Outcomes: Students will be able to

COs	**Description**	**Bloom's Level**
CO1	Describe the fundamentals of VLSI testing, fault models, and various testing methodologies	II- Understand
CO2	Apply logic and fault simulation techniques along with ATPG algorithms for test generation and verification	III-Apply
CO3	Analyze testability measures and design-for-testability (DFT) techniques including scan and partial scan methods	IV-Analyze
CO4	Analyze BIST architectures and boundary scan standards for testing of digital systems	IV-Analyze

Syllabus

UNIT - I

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT - II

Logic and Fault Simulation: Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation, ATPG.

UNIT - III

Testability Measures: SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

UNIT - IV

Built-In Self-Test: The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per-Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

UNIT - V

Boundary Scan Standard: Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

Mapping of Cos to POs:

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

TEXT BOOK:

T1. M.L. Bushnell, V. D. Agrawal, "Essential of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Publishers

REFERENCE BOOKS:

R1. M. Abramovici, M. A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House

RADAR ENGINEERING

(Professional Elective -V)

Subject Code : UGEC7T0723	**L**	**T**	**P**	**C**
IV Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites: Students should have prior knowledge of

- Antennas & Wave Propagation

Course Outcomes : After Completion of the course, the student can be able to

COs	Course Outcome Statement	Bloom's Level
CO1	Interpret the basic principles of radar, radar range equation, and radar performance parameters.	Understand (L2)
CO2	Apply Doppler effect, CW and FM-CW radar principles to determine target range and velocity.	Apply (L3)
CO3	Analyze the performance of MTI, Pulse Doppler and Tracking radar systems.	Analyze (L4)
CO4	Analyze radar signal detection in noise, matched filter receiver, radar transmitters, receivers and phased array antennas.	Analyze (L4)

Syllabus

UNIT–I

Basics of Radar: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Illustrative Problems

RADAR EQUATION: Modified Radar Range Equation, SNR, Probability of Detection, Probability of False Alarm, Integration of Radar Pulses, Radar Cross-section of Targets (simple targets-sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, Illustrative Problems.

UNIT–II

CW and Frequency Modulated Radar:

The Doppler Effect, CW Radar–Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. Illustrative Problems

FM-CW Radar - Range and Doppler Measurement, Block Diagram and characteristics. FM-CW Altimeter, Multiple Frequency CW Radar.

UNIT-III

MTI AND PULSE DOPPLER RADAR: Introduction, Principle, MTI Radar with power amplifier transmitter and Power Oscillator transmitter, Delay line Cancellers–Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs, Range gated Doppler filters. MTI radar Parameters, Limitation to MTI performance, MTI versus Pulse Doppler Radar.

UNIT–IV

TRACKING RADAR: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar-amplitude comparison monopulse (one – and Two- coordinates), Phase comparison monopulse. Tracking in range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT–V

Detection of Radar Signals in Noise : Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Detection and Cross-correlation Receiver, , Matched Filter with Non-white Noise, Noise Figure and Noise Temperature.

Radar Transmitters & Receivers: Displays – Types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width Changes, Series versus Parallel Feeds.

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	–	–	2	2	2	–
CO2	3	3	2	2	-	–	–	–	–	–	2	2	2	-
CO3	3	3	–	3	-	–	–	–	–	–	2	2	3	–
CO4	3	3	2	3	2	–	–	–	–	–	3	2	3	-

Text Book

T1. Merrill I skolnik, "Introduction to Radar Systems', McGraw Hill, 2nd Edition,2007.

T2. G S N Raju, "Radar Engineering and Fundamentals of Navigational Aids", IK international Publishers, 2008

Reference Books

R1. Peyton Z Peebles Jr. (2004), "Radar Principles", John Wiley Inc.

DIGITAL IMAGE PROCESSING
(Professional Elective -V)

Subject Code : UGEC7T0823	**L**	**T**	**P**	**C**
IV Year I Semester	**3**	**0**	**0**	**3**

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

COs	**Description**	**Blooms Level**
CO1	Understand the fundamental concepts of digital image processing, including image acquisition, sampling, quantization, pixel relationships, and basic image transforms.	II – Understand
CO2	Apply image transformation techniques along with spatial and frequency domain methods for image enhancement, filtering, and representation.	III – Apply
CO3	Apply image restoration techniques to remove noise and degradation using spatial and frequency domain approaches.	III – Apply
CO4	Analyze advanced image processing techniques such as segmentation, wavelets, compression, and color image processing for practical applications.	IV – Analyze

Syllabus

Unit I **[10+4 Hours]**

Introduction: Introduction to Image Processing, Examples of fields that use Digital Image Processing, Fundamental steps in digital image processing, components of an image processing system, Elements of Visual Perception, Light and the Electromagnetic Spectrum, Examples of the fields that use Digital Image Processing. Image sensing and acquisition, image sampling and quantization, Some basic relationships between pixels, An introduction to the mathematical tools used in digital image processing.

Image Transforms: Need for image transforms, Image transforms, Fourier Transform, 2D Discrete Fourier Transform and its properties, Walsh Transform, Hadamard transform, Haar Transform, Discrete Cosine transform, KL Transform, Singular Value Decomposition.

Unit II **[10+4 Hours]**

Intensity Transformations and Spatial Filtering: Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, and sharpening spatial filters.

Filtering in the Frequency Domain: The Basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering

Unit III **[8+4 Hours]**

Image Restoration and Reconstruction: A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering.

Unit IV **[10+4 Hours]**

Wavelets and Multi resolution Processing: Image pyramids, sub band coding, Multi resolution expansions, wavelet transforms in one dimensions& two dimensions, Wavelet packets.

Image compression: Fundamentals, Basic compression methods: Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-Length coding, Block Transform coding, Predictive coding

Unit V **[10+4 Hours]**

Image segmentation: Fundamentals, point, line, edge detection, thresholding, and Region based segmentation.

Color image processing: Color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression.

CO-PO Mapping

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	3	2	1	2	-	-	-	-	-	-	1	-	-
CO3	3	3	2	2	3	-	-	-	-	-	-	1	-	-
CO4	3	3	3	2	2	-	-	-	-	-	-	2	-	-

Textbooks:

T1. R.C. Gonzalez and R.E. Woods, "Digital Image Processing" 3rd edition, Pearson, 2008.

Reference Books:

R1. Anil K, Jain "Fundamentals of Digital Image Processing" Prentice Hall of India, 9th Edition, Indian Reprint, 2002.

R2. Jayaraman, S. Esakkirajan, and T. Veera Kumar," Digital Image Processing" Tata McGraw-Hill Education, 2009.

INTERNET OF THINGS
(Professional Elective-V)

Subject Code: UGEC7T0923	**L**	**T**	**P**	**C**
IV Year /I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Electronic Devices and Circuits
- Switching Theory and Logic Design

Course Objectives

1. To introduce the fundamental concepts, architecture, networking principles, and security aspects of the Internet of Things (IoT) and their role in modern connected systems**.**
2. To develop an understanding of IoT hardware platforms and embedded devices such as Arduino, Raspberry Pi, and ARM Cortex processors for building IoT-based systems**.**
3. To enable students to design and analyze IoT applications using communication protocols, cloud integration, and solution frameworks for real-world domains such as healthcare, agriculture, and smart homes.

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

COs	**Description**	**Bloom's Level**
CO1	Discuss the fundamental concepts of IoT including architecture, design principles, networking basics, M2M communication, and the role of cloud computing and security in IoT systems.	II- Understanding
CO2	Implement and apply knowledge of IoT hardware components such as Arduino, Raspberry Pi, and ARM Cortex processors, including their architecture and instruction sets in embedded system design.	III- Applying
CO3	Develop IoT-based applications using appropriate communication protocols (MQTT, CoAP, TCP/UDP, Bluetooth) and analyze the performance of sensing, actuation, and software components.	IV- Analyzing
CO4	Analyze and evaluate IoT solution frameworks, including device integration, data management, cloud storage, and security mechanisms, and assess real-world IoT case studies across domains like healthcare, agriculture, and smart homes.	IV- Analyzing

SYLLABUS

UNIT I **[10 Hrs]**

Introduction to IoT Introduction to IoT, Architectural Overview, Design principles and needed capabilities, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.

UNIT II **[12 Hrs]**

Elements of IoT Hardware Components- Computing- Arduino, Raspberry Pi, ARM Cortex-A class processor, Embedded Devices ARM Cortex-M class processor, Arm Cortex-M0 Processor Architecture, Block Diagram, Cortex-M0 Processor Instruction Set, ARM and Thumb Instruction Set.

UNIT III **[12 Hrs]**

IoT Application Development Communication, IoT Applications, Sensing, Actuation, I/O interfaces. Software Components- programming API" s(using python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, CoAP, UDP, TCP, Bluetooth. Bluetooth Smart Connectivity Bluetooth overview, Bluetooth Key Versions, Bluetooth Low Energy (BLE) Protocol, Bluetooth, Low Energy Architecture, PSoC4 BLE architecture and Component Overview.

UNIT IV **[12 Hrs]**

Solution framework for IoT applications Implementation of Device integration, Data acquisition and integration, Device data storage Unstructured data storage on cloud/local server, Authentication, authorization of devices.

UNIT V **[10 Hrs]**

IoT Case Studies IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

Cloud Analysis for IOT Application: Introduction to cloud computing, Difference between cloud computing and Fog computing: The Next Evolution of Cloud Computing, Role of Cloud computing in IOT, Connection IOT to cloud, Cloud Storage for IOT Challenges in M.

Mapping of COs to Pos

POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	3	-	1	2	-	-	-	-	-	-	1	-	-
CO3	3	2	1	2	2	-	-	-	-	-	-	1	-	-
CO4	2	2	1	2	3	-	-	-	-	1	-	1	-	-

Text Books:

T1. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017.

T2. The Definitive Guide to the ARM Cortex-M0 by Joseph Yiu, 2011.

Reference Books:

R1. Cypress Semiconductor/PSoC4 BLE (Bluetooth Low Energy) Product Training Modules.

R2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

DIGITAL SIGNAL AND IMAGE PROCESSING LAB

Subject Code: UGEC7K1023	**L**	**T**	**P**	**C**
IV Year /I Semester	**0**	**1**	**2**	**2**

Prerequisite

- Signals and Systems Lab

Laboratory Objectives

- To verify various DSP algorithms using Simulation Software.
- To implement the DSP algorithms on a DSP processor

COURSE OUTCOMES: Upon completion of the Laboratory, students will be able to

COs	Description	Blooms Level
CO 1	Understand and explain the fundamental concepts of digital signal processing and image processing, including DFT, convolution, filtering, and basic image operations	II - Understand
CO 2	Apply and implement DSP algorithms (DFT, convolution, FIR/IIR filters, multirate processing) and image processing techniques (enhancement, filtering, edge detection, transformations) using software tools and hardware platforms.	III – Apply
CO 3	Analyze and evaluate the performance of DSP systems and image processing techniques by interpreting frequency responses, filter characteristics, and image quality metrics.	IV – Analyze
CO 4	Develop signal and image processing solutions, including filter design, compression, segmentation, and real-time implementation using platforms like CCS and TMS320C6713 processor.	IV – Analyze

EXPERIMENTS (At least 10 Experiments)

PART – A

1. N-point DFT of a given sequence
2. Linear convolution and Circular convolution
3. Analog filters design and analysis
4. IIR filters design and analysis
5. FIR filters design and analysis
6. Decimation and Interpolation
7. Linear Convolution using Code Composer Studio (CCS) and Implement the same on TMS320C6713 Processor
8. Circular Convolution using CCS and Implement the same on TMS320C6713 Processor

PART – B

1. Study of Basic Image Operations
2. Image Enhancement in Spatial Domain
3. Implementation of Spatial Filtering Techniques
4. Edge Detection Techniques
5. Point Processing Transformations
6. Frequency Domain Processing
7. Image Compression Techniques
8. Image Segmentation Methods

CO-PO Mapping

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	–	2	2	–	–	–	3	–	2	–	2	-
CO2	3	3	2	2	3	–	–	–	3	–	3	2	2	-
CO3	2	3	2	2	3	–	–	–	3	–	3	2	2	-
CO4	2	2	3	2	3	–	-	–	3	-	3	3	2	-

CONSTITUTION OF INDIA

Subject Code: UGEC7A1123	**L**	**T**	**P**	**C**
IV Year /I Semester	**2**	**0**	**0**	**0**

Course Objectives:

- Understand the concept of Indian constitution directive principle of state policy Analyze the History, features Evaluate Preamble Fundamental Rights and Duties
- Understand the structure of Indian government
- Understand the structure of state government role of Governor and Chief Minister Secretariat Differentiate between structure and functions of state secretariat
- Understand the local Administration district administration Mayer and elected representatives of Municipalities Zilla panchayat block level organization
- Know the role of Election Commission role of Chief Election commissioner and Commissionerate state election commission SC/ST/OBC and women

Course Outcomes

COs	Description	Blooms Level
CO 1	Understand historical background of the constitution making and its importance for building a democratic India.	II - Understand
CO 2	Understand the functioning of three wings of the government ie., executive, legislative and judiciary	II - Understand
CO 3	Understand the value of the fundamental rights and duties for becoming good citizen of India.	II - Understand
CO 4	Analyze the decentralization of power between central, state and local self-government	IV – Analyze
CO 5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy	III – Apply

Syllabus

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT-IV

A Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women

Mapping of COs to Pos

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	–	–	–	–	–	3	–	3	–	1	–	1
CO2	–	–	–	–	–	3	–	2	–	1	–	1
CO3	–	–	–	–	–	3	–	3	–	2	–	1
CO4	–	–	–	–	–	3	–	2	–	1	–	2
CO5	–	–	–	–	–	3	–	3	–	2	–	2

TEXT BOOKS:

T1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi

T2. SubashKashyap, Indian Constitution, National Book Trust

T3. J.A. Siwach, Dynamics of Indian Government & Politics

T4. D.C. Gupta, Indian Government and Politics

T5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)

References

R1. J. Raj Indian Government and Politics

R2. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi

R3. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right),

R4. Challenges to Civil Rights Guarantees in India, Oxford University Press 2012 resources: