B.Tech IV Year I Semester

S.No.	Category	Title	Subject Code	L	T	P	Credits
1	Professional Core	Cellular & Mobile Communications	V231410431	3	0	0	3
2	Management Course– II	Management Science	V2314104M1	2	0	0	2
3	Professional Elective–IV	Low Power VLSI Design	V2314104441	3	0	0	3
		Coding Theory and Applications	V2314104442				
		DSP Processors and Architectures	V2314104443				
		Soft Computing Techniques	V2314104444				
		12 WEEKS MOOCS/swayam/NPTEL Course Recommended by BOS	V2314104445				
4	Professional Elective–V	1. Design for Testability	V231410446	3	0	0	3
		2. Radar Engineering	V231410447				
		3. Digital Image Processing	V231410448				
		4. Internet of Things	V231410449				
5	Open Elective – III	Fundamentals of VLSI Design	V231410451	3	0	0	3
		Digital Electronics	V231410452				
		Electronic Measurements and Instrumentations	V231410453				
		Optical communications	V231410454				
6	Open Elective– IV	Principles of Cellular & Mobile communications	V231410455	3	0	0	3
		Fundamentals of Satellite Communication	V231410456				
		Embedded Systems	V231410457				
		Transducers and Signal Conditioning	V231410458				
		Quantum Science and Technology	V231410459				
7	Skill Enhancement Course	Digital Signal and Image Processing Lab	V231410461	0	1	2	2
8	Audit Course	Constitution of India	V2314104C1	2	0	0	-
9	Internship	Evaluation of Industry Internship	V231410481	-	-	-	2
Total				**19**	**1**	**02**	**21**

B.Tech.– IV Year II Semester

S. No.	Category	Title	Subject Code	L	T	P	Credits
1	Project	Internship and Project	V2314204A1	0	0	24	12

IV Year I Semester	CELLULAR & MOBILE COMMUNICATIONS (V231410431)	L	T	P	C
		3	0	0	3

Course Outcomes: The student will be able to

CO1 To identify the limitations of conventional mobile Telephone systems and to Understand the concepts of cellular systems.

CO2 To understand the different types of interferences influencing cellular and mobile communications.

CO3 To understand the frequency management, channel assignment and types of handoff

CO4 To Understand the concept of handoff in cellular systems

CO5 To understand the Multiple access schemes in mobile and to develop the ability to search, select, organize and present information on new technologies in mobile and cellular communications.

UNIT I

CELLULAR SYSTEMS: Limitations of Conventional System, Basic Cellular Mobile System, Operation of Cellular System. Uniqueness of Mobile Radio Environment –Fading, coherence bandwidth, Doppler Spread. Fundamentals of cellular Radio System Design: concept of frequency reuse channels, Co-channel Interference, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system. Trunking and grade of service

UNIT II

CO-CHANNEL & NON-CO-CHANNEL INTERFERENCE: Measurement of Real Time Co-Channel Interference, design of Antenna system. Non-co channel interference-adjacent channel interference, Near End far end interference, effect on coverage and interference by power decrease, antenna height decrease

UNIT III

FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT : Numbering and grouping, setup access and paging channels ,channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non fixed channel assignment.

CELL COVERAGE FOR SIGNAL AND TRAFFIC: Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long distance propagation.

UNIT IV

CELLSITE AND MOBILE ANTENNAS: Sum and difference patterns and their synthesis, directional antennas for interference reduction, space diversity antennas, umbrella pattern

antennas, minimum separation of cell site antennas.

HANDOFFS: Handoff Initiation, types of handoff, delaying handoff, advantages of Handoff, power difference handoff, forced handoff, mobile assisted and soft and Hard handoffs. Intersystem and Intrasystem handoffs, dropped call rates and their evaluation.

UNIT V

DIGITAL CELLULAR NETWORKS AND MULTIPLE ACCESS SCHEMES: Introduction to MIMO systems Principles of CDMA cellular systems, Principles of OFDM based broadband wireless systems, 4G LTE basics – OFDM, and OFDMA, Generalized framework for Filtered OFDM and FBMC, Introduction of 5G.

TEXT BOOKS:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006. Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.
2. T. S. Rappaport, "Wireless Communications – Principles and Practice" (2nd edition) Pearson, 2010, ISBN 9788131731864

REFERENCES:

1. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2001.
2. Modern Wireless Communication –Simon Haykin Michael Moher, Persons Eduction,2005. 3. Wireless Communication theory and Techniques, Asrar U.H .Sheikh ,Springer,2004.
3. A. Goldsmith, "Wireless Communications," Cambridge Univ Press, 2005
4. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005

IV Year I Semester	MANAGEMENT SCIENCE (V2314104M1)	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

CO1 To impart knowledge of source and function of values.

CO2 Demonstrate an understanding of the importance of values, ethics, and social responsibility for the self and for contemporary society.

CO3 Reflect on how values shape personal and community ethics and decision-making. An Ability to function effectively on multi-disciplinary teams (team work).

CO4 Inculcate professional, ethical, legal, security and social issues and responsibilities.

CO5 Gain personal and professional insight into organizational behavior, diversity, Personalities, goal setting, motivation, empowerment, and leadership style.

UNIT - I

CONCEPTS OF MANAGEMENT AND ORGANISATION: Functions of management, evolution of management thought, Taylor's scientific management, fayol's principles of management, Hertzberg's Maslow's hierarchy of human needs, theory x and y, Hawthorne experiment, morale, motivation, working environmental conditions, systems approach to management.

DESIGNING ORGANISATIONAL STRUCTURES: Basic concepts related to organization - depart mentation and decentralization, types of organization structures.

UNIT - II

PLANT LOCATION: Definition, factors affecting the plant location, comparison of rural and urban sites, methods for selection of plant- matrix approach. Plant layout - definition, objectives, types of plant layout, various data analyzing forms travel chart.

WORK STUDY: Definition, objectives, method study - definition, objectives, steps involved- various types of associated charts, difference between micro motion and memo motion studies. Work measurement- definition, time study, steps involved, equipment, different methods of performance rating, allowances, standard time calculation. Work Sampling - definition, steps involved, standard time calculations, and differences with time study.

UNIT - III

INTRODUCTION TO PERT / CPM : Project management, network modelling-probabilistic model, various types of activity times estimation, programme evaluation review techniques, critical path, probability of completing the project, deterministic model, critical path method (CPM), critical path calculation, crashing of simple of networks.

INSPECTION AND QUALITY CONTROL: Types of inspections, statistical quality control, techniques, variables and attributes, assignable and non assignable causes, variable control charts, and R charts, attributes control charts, p charts and c charts. Acceptance sampling plan, single sampling and double sampling plans, OC curves. Introduction to TQM - quality circles, ISO 9000 series procedures.

UNIT – IV

MATERIALS MANAGEMENT: Objectives, inventory functions, types, associated costs, inventory classification techniques-ABC and VED analysis. Inventory control systems, continuous review system, periodical review system. Stores management and stores records. Purchase management, duties of purchase of manager, associated forms.

UNIT – V

INTRODUCTION TO HUMAN RESOURCE MANAGEMENT: Functions of HRM, job evaluation, different types of evaluation methods. Job description, merit rating, different methods of merit ratings, wage incentives, different types of wage incentive schemes. Marketing, selling, marketing mix, product life cycle.

TEXT BOOKS: 1. O. P. Khanna (2004), Industrial Engineering and Management, Dhanpat Rai, New Delhi.

REFERENCE BOOKS: 1. Stoner, Freeman (2005), Gilbert, Management, 6th edition, Pearson Education, New Delhi. 2. Panner Selvam (2004), Production and Operations Management, Prentice Hall of India, New Delhi. 3. Ralph M. Barnes (2004), Motion and Time Studies, John Wiley and Sons.

IV Year I Semester	LOW POWER VLSI DESIGN (PE-IV) (V231410441)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Understand the need of Low power circuit design.

CO2 Attain the knowledge of architectural approaches.

CO3 Analyze and design Low-Voltage Low-Power combinational circuits.

CO4 Known the design of Low-Voltage Low-Power Memories

CO5 Estimation metrics to analyze RTL/circuit-level power consumption during the design cycle.

UNIT –I:

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:

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:

Low-Voltage Low-Power Adders: Introduction, Standard Adder 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:

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:

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.

TEXT BOOKS:

1. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH,2011.
2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

REFERENCE BOOKS:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press,2011
2. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
3. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.

IV Year I Semester	CODING THEORY AND APPLICATIONS (PE-IV) (V231410442)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Perform the measurement of information and compute errors.
CO2 Design Linear Block Codes and Cyclic codes.
CO3 Construct tree and trellies diagrams for convolution codes
CO4 Design the Turbo codes and Space time codes and also carry out their applications
CO5 Apply error-control schemes to solve practical engineering problems in wireless networks, cloud storage, and hardware data protection.

UNIT –I:

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:

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:

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:

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, Phased-Burst –Error-Correcting Cyclic and Convolutional codes.

UNIT -V:

BCH – Codes: BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

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.
3. Introduction to Error Control Codes-Salvatore Gravano-oxford
4. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon,2006, Wiley India.
5. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Ed, 2009, TMH.

IV Year I Semester	DSP PROCESSORS AND ARCHITECTURES (PE-IV) (V231410443)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Understand the basics of Digital Signal Processing and transforms.
CO2 Able to distinguish between the architectural features of general purpose processors and DSP processors.
CO3 Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices.
CO4 Able to write simple assembly language programs using instruction set of TMS320C54xx.
CO5 Can interface various devices to DSP Processors.

Unit – I: Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. 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: 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: 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: 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. Introduction to Blackfin Processor- The Blackfin Processor, Introduction to Micro signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

Unit – V: 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).

Text Books:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach To Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009.
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-SengGan, Sen M. Kuo, Wiley-IEEE Press, 2007.

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications–B. Venkataramani and M. Bhaskar, 2002, TMH.
2. DSP Processor Fundamentals: Architectures & Features – Lapsley et al., S. Chand & Co. Digital Signal Processing Applications Using the ADSP-2100 Family, Prentice-Hall, Inc.
3. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Digital Signal Processing, California Technical Publishing, San, Diego, CA.
4. Embedded Media Processing, David J. Katz and Rick Gentile, Elsevier, 2005.

IV Year I Semester	SOFT COMPUTING TECHNIQUES (PE-IV) (V231410444)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Identify and describe soft computing techniques and their roles in building intelligent systems.

CO2 Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.

CO3 Integrate and Develop learning mechanism using neural network for intelligent applications.

CO4 Solved optimization problem using genetic algorithms.

CO5 Judge the role played by engineers to automate the process by integrating the knowledge of soft computing techniques.

UNIT –I:

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:

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:

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:

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:

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..

TEXT BOOKS:

1. 1.Soft computing with MATLAB programming—N.P.Padhy, S.P.Simon, Oxford university press,2015
2. Neural Networks and Fuzzy Systems - Kosko, B., Prentice-Hall of India Pvt. Ltd., 1994.
3. Introduction to Artificial Neural Systems-Jacek.M.Zurada, Jaico Publishing House,1999

REFERENCE BOOKS:

1. Fuzzy Sets, Uncertainty and Information - Klir G.J. &Folger T.A., Prentice-Hall of IndiaPvt. Ltd., 1993.
2. Fuzzy Set Theory and Its Applications - Zimmerman H.J. Kluwer Academic Publishers,1994.
3. Introduction to Fuzzy Control - Driankov, Hellendroon, Narosa Publishers.
4. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.

IV Year I Semester	DESIGN FOR TESTABILITY (PE-V) (V231410446)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Acquire verification knowledge and test evaluation

CO2 Design for testability rules and techniques.

CO3 Utilize the scan architectures for different digital circuits.

CO4 Acquire the knowledge of design of built-in-self test.

CO5 Assess how DFT structures impact overall chip area, performance overhead, power consumption, and production yield

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.

TEXT BOOK:

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

REFERENCE BOOKS:

1. M. Abramovici, M. A. Breuer and A.D Friedman, Digital Systems and Testable Design”, JaicoPublishing House
2. P. K. Lala, “Digital Circuits Testing and Testability”, Academic Press

IV Year I Semester	RADAR ENGINEERING (PE-V) (V231410447)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Derive the radar range equation and to solve some analytical problems.

CO2 Understand the different types of radars and its applications.

CO3 Understand the concept of tracking and different tracking techniques.

CO4 Understand the various components of radar receiver and its performance

CO5 Apply matched filter concepts and analyze receiver performance in noisy environments.

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), Creeping Wave, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

UNIT–II:

CW and Frequency Modulated Radar : 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, Nth Cancellation Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

UNIT –IV:

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, 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, Efficiency of Non-matched Filters, 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, Applications, Advantages and Limitations. Radomes Modulators, solid state

TEXT BOOKS:

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Ed., 2007.

REFERENCE BOOKS:

1. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004.
2. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.
3. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm, Yesdee, 2013
4. Radar Engineering – GSN Raju, IK International

IV Year I Semester	DIGITAL IMAGE PROCESSING (PE-V) (V231410448)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Describe the Image Processing system, scope of digital image processing and Compare various image transforms.

CO2 Apply filtering operations on images both in spatial and frequency domain.

CO3 Describe Image degradation model and Explain the restoration techniques on images.

CO4 Analyze the digital Images using wavelets and multi resolution processing and use various coding techniques for various image compression methods.

CO5 Explain various segmentation techniques on digital images; Explain various colour models and colour Image Processing.

Unit I:

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:

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:

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:

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:

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.

Text Books

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

Reference Books

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-Hill Education, 2009.

IV Year I Semester	INTERNET OF THINGS (PE-V) (V231410449)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Understand internet of Things and its hardware and software components.

CO2 Interface I/O devices, sensors & communication modules.

CO3 Remotely monitor data and control devices.

CO4 Design real time IoT based applications

CO5 Identify privacy risks and security needs in connected networks.

UNIT I:

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:

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:

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:

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:

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

Cloud Analytics 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, Connecting IoT to cloud, Cloud Storage for IoT Challenge in integration of IoT with Cloud.

Text Books:

1. Raj Kamal, “Internet of Things: Architecture and Design Principles”, 1st Edition, McGraw Hill Education, 2017.
2. The Definitive Guide to the ARM Cortex-M0 by Joseph Yiu,2011.
3. Vijay Madisetti, ArshdeepBahga, Internet of Things, “A Hands on Approach”, University Press, 2015.

References:

1. Cypress Semiconductor/PSoC4 BLE (Bluetooth Low Energy) Product Training Modules.
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

IV Year I Semester	FUNDAMENTALS OF VLSI DESIGN (OE-III) (V231410451)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1: Understand the physical structure, operation, and electrical characteristics of MOS transistors, including threshold voltage, transconductance, and body effects.

CO2: Describe the MOS fabrication technology process steps, including wafer fabrication, oxidation, photolithography, diffusion, and CMOS/NMOS fabrication techniques, and analyze common fabrication issues like latch-up and short-channel effects.

CO3: Apply layout design rules to CMOS circuits, including scalable CMOS design rules, micron design rules, and circuit elements, ensuring compliance with fabrication constraints.

CO4: Design and analyze MOS combinational logic circuits, including pass-transistor logic, CMOS gate logic, dynamic logic circuits, and advanced logic families such as domino and NORA logic.

CO5: Understand and design sequential MOS logic circuits, including bistable elements, SR latches, clocked latches, and CMOS flip-flops, to implement memory and timing functions.

UNIT 1: MOS Transistors

Introduction, The Structure of MOS Transistors, The Fluid Model, The MOS Capacitor, The MOS Transistor, Modes of Operation of MOS Transistors, Electrical Characteristics of MOS Transistors, Threshold Voltage, Transistor Transconductance g_m, Figure of Merit, Body Effect, Channel-Length Modulation, MOS Transistors as a Switch, Transmission Gate

UNIT 2: MOS Fabrication Technology

Introduction, Basic Fabrication Processes, Wafer Fabrication, Oxidation, Mask Generation, Photolithography, Diffusion, Deposition. N-MOS Fabrication Steps, CMOS Fabrication Steps,n-Well Process,p-Well Process, Twin-Tub Process, Latch-Up Problem and Its Prevention, Use of Guard Rings, Use of Trenches, Short-Channel Effects-Channel Length Modulation Effect. Drain-Induced Barrier Lowering, Channel Punch Through, Hot carrier effect, Velocity Saturation Effect.

UNIT 3: Layout Design Rules

Design Rule Background, Scribe Line and Other Structures MOSIS Scalable CMOS Design Rules, Micron Design Rules, CMOS Process Enhancements, Transistors, Interconnect, Circuit Elements, Beyond Conventional CMOS.

UNIT4: MOS Combinational Circuits

Pass-Transistor Logic, Realizing Pass-Transistor Logic, Advantages and Disadvantages, Pass-Transistor Logic Families, Gate Logic, Fan-In and Fan-Out, n-MOS NAND and NOR Gates, CMOS Realization, Switching Characteristics, CMOS NOR Gate, CMOS Complex Logic Gates,

MOS Dynamic Circuits, Single-Phase Dynamic Circuits, Two-Phase Dynamic Circuits, CMOS Dynamic Circuits, Advantages and Disadvantages Domino CMOS Circuits, NORA Logic.

UNIT 5: Sequential MOS Logic Circuits

Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

TEXT BOOKS

1. 1.Principals of CMOS VLSI Design-N.H.EWeste, K. Eshraghian, 2nd Edition, Addison Wesley.
2. 2.CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.
3. 3.Low-Power VLSI Circuits and Systems,Ajit Pal, SPRINGER PUBLISHERS

REFERENCE BOOKS:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, BorivojeNikolic, 2nd Ed., PHI.

IV Year I Semester	DIGITAL ELECTRONICS (OE-III) (V231410452)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1	Classify different number systems and apply to generate various codes.
CO2	Use the concept of Boolean algebra in minimization of switching functions
CO3	Design different types of combinational logic circuits.
CO4	Apply knowledge of flip-flops in designing of Registers and counters
CO5	The operation and design methodology for synchronous sequential circuits and algorithmic state machines.

UNIT – I

REVIEW OF NUMBER SYSTEMS & CODES:

Representation of numbers of different radix, conversation from one radix to another radix, r-1's compliments and r's compliments of signed members. Gray code ,4 bit codes; BCD, Excess-3, 2421, 84-2-1 code etc., Error detection & correction codes: parity checking, even parity, odd parity, Hamming code

Boolean theorems and logic operations

Boolean theorems, principle of complementation & duality, De-morgan theorems. Logic operations ; Basic logic operations -NOT, OR, AND, Universal Logic operations, EX-OR, EX-NOR operations. Standard SOP and POS Forms, NAND-NAND and NOR-NOR realizations.

UNIT – II

MINIMIZATION TECHNIQUES:

Minimization and realization of switching functions using Boolean theorems, K-Map (up to 6 variables) and tabular method

COMBINATIONAL LOGIC CIRCUITS DESIGN

Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4-bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit

UNIT – III

COMBINATIONAL LOGIC CIRCUITS DESIGN USING MSI &LSI :

Design of encoder ,decoder, multiplexer and demultiplexers, Implementation of higher order circuits using lower order circuits . Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and seven segment decoder

UNIT – IV

INTRODUCTION OF PLD's :

PLDs: PROM, PAL, PLA -Basics structures, realization of Boolean functions. Architectures of CPLD,FPGA, flash memories(NAND,NOR)

UNIT – V

SEQUENTIAL CIRCUITS :

Classification of sequential circuits (synchronous and asynchronous) , operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals. Design of ripple counters, design of synchronous counters, Johnson counter, ring counter.

TEXT BOOKS:

1. Switching and finite automata theory Zvi.KOHAVI 3RD EDITION
2. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers
3. Digital Design by Mano PHI.

REFERENCES:

1. Switching Theory and Logic Design by A. Anand Kumar
2. Switching Theory and Logic Design by Hill and Peterson Mc-Graw Hill TMH edition

IV Year I Semester	ELECTRONIC MEASUREMENTS AND INSTRUMENTATIONS (OE-III) (V231410453)	L	T	P	C
		3	0	0	3

Course outcomes:

CO1 Understand the various Analog and Digital measuring Instruments
CO2 Aware of the principles and operations of various oscilloscopes
CO3 Learn measurements using various bridges
CO4 Familiarize different Signal Generators and function generators
CO5 Learn various transducers

UNIT I

Measuring Instruments: Introduction, Errors in Measurement, Accuracy, Precision, Resolution and Significant figures, Basic PMMC Meter- construction and working, DC and AC Voltmeters- Multirange, Range extension, DC Ammeter, Multimeter for Voltage, Current and resistance measurements.

Digital Instruments: Digital Voltmeters – Introduction, DVM's based on V–T, V–F and Successive approximation principles, Resolution and sensitivity, General specifications, Digital Multimeters, Digital frequency meters, Digital measurement of time.

UNIT II

Oscilloscopes: Introduction, Block diagram of CRO, Basic principle of CRT, CRT Construction and features, vertical amplifiers, horizontal deflection system- sweep, trigger pulse, delay line, sync selector circuits. Dual beam and dual trace CROs, Sampling and Digital storage oscilloscopes.

UNIT III

Bridges: DC Bridges for Measurement of resistance - Wheat stone bridge, Kelvin's Bridge, AC Bridges for Measurement of inductance- Maxwell's bridge, Hay's Bridge, Anderson bridge, Measurement of capacitance - Schearing Bridge, Wien Bridge, Errors and precautions in using bridges.

UNIT IV

Signal Generators: Introduction, Fixed and variable AF oscillator, Standard signal generator, Laboratory type signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator, Sweep frequency generator.

UNIT V

Transducers: Introduction, Types of Transducers, Electrical transducers, Selecting a transducer, Resistive transducer, Strain gauges, Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Temperature transducers-RTD, LVDT.

TEXT BOOKS

1. H. S. Kalsi, "Electronic Instrumentation", Third edition, Tata McGraw Hill, 2010.
2. A. D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 6th Edition, 2010.

REFERENCE BOOKS

1. A.K. Sawhney, DhanpatRai& Co., "A course in Electrical and Electronic Measurements and Instrumentation", 9th Edition, 2010.
2. David A. Bell, "Electronic Instrumentation & Measurements", PHI, 2nd Edition, 2006.

IV Year I Semester	OPTICAL COMMUNICATIONS (OE-III) (V231410454)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Choose necessary components required in modern optical communications systems.
CO2 Design and build optical fiber experiments in the laboratory, and learn how to calculate electromagnetic modes in waveguides, the amount of light lost going through an optical system, dispersion of optical fibers.
CO3 Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
CO4 Choose the optical cables for better communication with minimum losses
CO5 Design, build, and demonstrate optical fiber experiments in the laboratory.

UNIT I

Overview of optical fiber communication - Historical development, The general system, advantages of optical fiber communications. Optical fiber waveguides-Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers-Cutoff wave length, Mode Field Diameter, Effective Refractive Index, Related problems.

UNIT II

Fiber materials:- Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. Signal distortion in optical fibers-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay, Types of Dispersion:- Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening in Graded index fiber, Related problems.

UNIT III

Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing-Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss-Multimode fiber joints, single mode fiber joints.

UNIT IV

Optical sources-LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED&ILD, Optical detectors- Physical principles of PIN and APD, Detector response time, Comparison of Photo detectors, Related problems.

UNIT V

Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation-

Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers. Optical system design - Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.

TEXT BOOKS:

1. Optical Fiber Communications–Gerd Keiser, McGraw Hill International edition, 3rd Edition,2000.
2. Fiber Optic Communications– Joseph C.Palais, 4thEdition, Pearson Education, 2004.

RERFERENCES:

1. Fiber Optic Communications–D.K.Mynbaev, S.C.Gupta and Lowell L.Scheiner,PearsonEducation,2005.
2. Text Book on Optical Fiber Communication and its Applications–S.C.Gupta, PHI,2005.
3. Fiber Optic Communication Systems–Govind P.Agarwal ,JohnWiley,3rdEdiition,2004.

IV Year I Semester	PRINCIPLES OF CELLULAR & MOBILE COMMUNICATIONS (OE-IV) (V231410455)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 The student will be able to understand impairments due to multipath fading channel.
CO2 The student will be able to understand the fundamental techniques to overcome The different fading effects.
CO3 The student will be able to understand co-channel and non co-channel interferences.
CO4 The student will be able to understand the frequency management, channel assignment and types of handoff.
CO5 The student will be able to understand the Multiple access schemes in mobile communications

UNIT I

CELLULAR SYSTEMS: Limitations of Conventional System, Basic Cellular Mobile System, First, second, third and fourth and Generation cellular wireless systems. Operation of Cellular System. Uniqueness of Mobile Radio Environment –Fading, coherence bandwidth, Doppler Spread. Fundamentals of cellular Radio System Design: concept of frequency reuse channels, Co-channel Interference, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system. Trunking and grade of service

UNIT II

CO-CHANNEL & NON-CO-CHANNEL INTERFERENCE: Measurement of Real Time Co-Channel Interference, design of Antenna system, Antenna parameters and their effects, diversity techniques: Space Diversity, Polarization diversity, frequency diversity and time diversity. Non-co channel interference-adjacent channel interference.

UNIT III

Frequency Management And Channel Assignment : Numbering and grouping, setup access and paging channels ,channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non fixed channel assignment

UNIT IV

HANDOFFS: Handoff Initiation, types of handoff, delaying handoff, advantages of Handoff, power difference handoff, forced handoff, mobile assisted and soft and Hard handoffs. Intersystem and Intrasystem handoffs, Concept of Call drop rates.

UNIT V

Multiple access schemes in mobile communications: TDMA, FDMA, CDMA. Introduction to MIMO systems Principles of CDMA cellular systems, Principles of OFDM based broadband wireless systems , 4G LTE basics – OFDM, and OFDMA ,Generalised framework for Filtered OFDM and FBMC .Introduction of 5G

TEXT BOOKS:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006. 2. Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.
2. T. S. Rappaport, "Wireless Communications – Principles and Practice" (2nd edition) Pearson, 2010, ISBN 9788131731864

REFERENCES:

1. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2001.
2. Modern Wireless Communication –Simon Haykin Michael Moher, Persons Eduction,2005.
3. Wireless Communication theory and Techniques, Asrar U.H .Sheikh ,Springer,2004.
4. A. Goldsmith, "Wireless Communications," Cambridge Univ Press, 2005
5. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005

IV Year I Semester	FUNDAMENTALS OF SATELLITE COMMUNICATIONS (OE-IV) (V231410456)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

CO1 Introduce the architecture and fundamentals of satellite communication systems, their history, applications, and frequency usage.

CO2 Develop an understanding of orbital mechanics, satellite motion, and calculations related to orbital parameters.

CO3 Explore the various sub-systems in satellite communication, including TTC&M, AOCS, communication, power, and antenna systems.

CO4 Analyse natural phenomena affecting satellite communication, such as solar eclipses, sun transit outages, and Doppler effects.

CO5 Provide knowledge of satellite link budgets, noise calculations, modulation, access techniques, and real-world case studies like VSAT, GPS, and LEO-based systems.

UNIT I

INTRODUCTION: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications. Orbital Mechanics, launches and launch vehicles, Orbital effects in communication systems performance

UNIT II

SATELLITE SUBSYSTEMS: Attitude and orbit control system, telemetry, tracking, Command and monitoring system, power systems, communication subsystems, Satellite antennas, Equipment reliability and Space qualification

UNIT III

SATELLITE LINK DESIGN: Basic transmission theory, link equation, C/N ratio, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

UNIT IV

MULTIPLE ACCESS: Frequency division multiple access (FDMA): Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA); Frame structure, Examples. Code Division Multiple access (CDMA): Spread spectrum transmission and reception.

UNIT V

GLOBAL NAVIGATION SATELLITE SYSTEM(GNSS):

Introduction, various GNSS: GPS, GLONASS, GALILEO, BeiDou, QZSS, IRNSS. GPS-location principle, GPS navigation message, GPS receiver operation, differential GPS;IRNSS-introduction, IRNSS satellites, IRNSS constellation, IRNSS configuration, IRNSS services, navigation data, applications of IRNSS; multi GNSS.

TEXT BOOKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 3RD Edition, 2020.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, 2nd Edition, Pearson Publications, 2003.

REFERENCES:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communication - D.C Agarwal, Khanna Publications, 5th Ed.
3. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition

IV Year I Semester	EMBEDDED SYSTEMS (OE-IV) (V231410457)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand the basic concepts of an embedded system and able to know an embedded system design approach to perform a specific function.

CO2 The hardware components required for an embedded system and the design approach of an embedded hardware.

CO3 The various embedded firmware design approaches on embedded environment.

CO4 Understand how to integrate hardware and firmware of an embedded system using real time operating system.

CO5 Use development tools, emulators, and debugging techniques to verify hardware-software integration

UNIT-I

INTRODUCTION: Embedded system-Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT-II

EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

UNIT-III

EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT-IV

REAL TIME OPERATING SYSTEM: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

HARDWARE SOFTWARE CO-DESIGN: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

UNIT-V:

EMBEDDED SYSTEM DEVELOPMENT, IMPLEMENTATION AND TESTING: The integrated development environment, Types of files generated on cross-compilation, Deassembler/ De-compiler, Simulators, Emulators and Debugging, Target hardware debugging,
Embedded Software development process and tools, Interpreters, Compilers and Linkers, debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

Text Books:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.

References:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2. Embedded Systems-Lyla B.Das-Pearson Publications,2013.

IV Year I Semester	TRANSDUCERS AND SIGNAL CONDITIONING (OE-IV) (V231410458)	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Choose Suitable sensor/transducer for a given physical variable and understand its principle, characteristics and determine order of the sensor.

CO2 Measure displacement, pressure, flow, temperature variables.

CO3 Design suitable signal conditioning circuit for sensor/transducers.

CO4 Analyze the bridge circuits for calculating L, C, R.

CO5 Understand noise reduction using grounding and shielding techniques and design high input impedance instrumentation amplifiers

UNIT – I

Generalized Performance characteristics of Instruments:

Functional elements of an instrument, generalized performance characteristics of instruments-static characteristics, dynamic characteristics, Experimental determination of measurement system parameters, loading effects under dynamic conditions.

UNIT – II

Signal Conditioning Circuits:

Signal Generator- fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, sweep, Arbitrary waveform. Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

Signal Conditioning Circuits:

INTRODUCTION: Need for pre-processing, identification of signal conditioning blocks and their characteristics. BRIDGE CIRCUITS: Analysis of DC and AC bridges with applications

UNIT – III

Transducers: Motion and Dimensional Measurements: Relative displacement, translation and rotational resistive potentiometers, resistance strain gauges, LVDT, capacitance pickups. Piezo-electric transducers. Force Measurement: Bonded strain gauge transducers, variable reluctance pickup, torque measurement dynamometers. Pressure Measurement: Manometers, elastic transducers, very high-pressure transducers, thermal conductivity gauges. Temperature Measurement: Thermal expansion methods, thermometers (liquid in glass), Thermocouples materials, Thermistors, Junction semiconductors and Sensors. Smart sensors, MEMS and Nano Sensors.

UNIT – IV

Intelligent Sensors: definition of intelligent instrumentation, types of instruments, Static Characteristics: Accuracy and Precision, Error, Correction, and Uncertainty, Repeatability, Reproducibility, and Hysteresis, Sensitivity, Offset, and Dead Band, Resolution and Linearity, Statistical Characteristics, Error Modeling, Dynamic Characteristics, Dynamic Error and

Dynamic Sensitivity, Input-Output Impedances., Historical Perspective, Current status, software based instruments. Classification, Smart sensors , Cogent Sensors, Soft or Virtual sensors, Self-Adaptive Sensors, Self-Validating Sensors, Temperature Compensating Intelligent Sensors, Pressure Sensor, Indirect Sensing.

UNIT – V

Instrumentation Amplifiers & Isolation Amplifiers: Specifications and use of instrumentation amplifiers for signal conditioning circuits using commercial ICs. Necessity for isolation amplifiers, industrial and medical applications of isolation amplifiers, Grounding and Shielding.

Text Books:

1. Measurement Systems -Application and Design, DOEBELIN, E.O., McGraw Hill, 4th Ed.1990
2. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2nd Edition, 2003.
3. Manabendra Bhuyan, —Intelligent Instrumentation: Principles and Applications‖ CRC Press,2011.

Reference Books:

1. Instrumentation Systems and Devices, Rangan, Mani, Sarma., Tata McGraw Hill. 2nd ed
2. Transducers and Instrumentation, Murthy, D.V.S.,PHI, New Delhi.

IV Year I Semester	QUANTUM SCIENCE AND TECHNOLOGY (OE-IV) (V231410459)	L	T	P	C
		3	0	0	3

Prerequisites: Basic Physics, Linear Algebra, and Introduction to Modern Physics

Course Objectives:

CO1 To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
CO2. To explore quantum computing and communication principles and technologies.
CO3 To understand the physical implementation and limitations of quantum systems.
CO4 To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
CO5 To familiarize students with the emerging trends in quantum technologies.

Course Outcomes:

After completing this course, students will be able to:
CO1. Explain core principles of quantum mechanics and their technological implications.
CO2. Analyze quantum phenomena like superposition and entanglement.
CO3. Apply mathematical tools to model and solve quantum systems.
CO4. Demonstrate understanding of quantum algorithms and quantum circuits.
CO5. Evaluate potential applications and challenges in quantum communication and sensing.

Unit 1: Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, Eigen functions.

Unit 2: Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)

Unit 3: Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, and Shor's 9-qubit code; Introduction to quantum programming: Qiskit, Cirq, IBM Quantum Experience (overview)

Unit 4: Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise)

Unit 5: Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era; Global initiatives: IBM, Google, D-Wave, IonQ, India's NQM; Ethical concerns and future prospects

Text Books:

1. **"Quantum Computation and Quantum Information"** by Michael A. Nielsen and Isaac L. Chuang
2. **"Quantum Mechanics: Concepts and Applications"** by Nouredine Zettili

Online Learning Resources:

1. https://nptel.ac.in/courses/104104082
2. https://nptel.ac.in/courses/115104096
   https://nptel.ac.in/courses/122106034

IV Year I Semester	DIGITAL SIGNAL AND IMAGE PROCESSING LAB (V231410461)	L	T	P	C
		0	1	2	2

COURSE OUTCOMES

CO1 Experiment concepts of DSP and its applications using MATLAB Software.

CO2 Understand about the basic signal generation.

CO3 Learned Fourier Transform Concepts.

CO4 Design FIR filters & IIR filters.

CO5 Demonstrate their abilities towards DSP processor based implementation of DSP systems.

PART-A

List of the Experiments

1. Generation of DT signals.
2. Verify the Linear Convolution of two DT signals
   a) Using MATLAB
   b) Using Code Composer Studio(CCS)
3. Verify the Circular Convolution of two DT signals
   a) Using MATLAB
   b) Using Code Composer Studio (CCS)
4. Find the sum of DT sinusoidal signals.
5. Computation of Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform(IDFT)
   a) Using MATLAB
   b) Using Code Composer Studio (CCS)
6. Compute N-point DFT of a given DT sequence using Decimation in Time. (Without Using Library Function)
7. Compute N-point DFT of a given DT sequence using Decimation in Frequency. (Without Using Library Function)

PART-B

Following Experiments are to be done using a TI DSP Starter Kit.

7. Generation of a sinusoidal signal.
8. Linear and circular convolution of DT sequences.
9. Compute N-point DFT of a given DT sequence.
10. Design and implementation of FIR filters.
11. Design and implementation of IIR filters.

PART-C

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Filtering in Spatial Domain
4. Computation of 2D-DFT
5. Filtering in Frequency Domain
6. Implementation of Image Restoration methods
7. Implementation of JPEG compression Algorithm (Without using Library function)
8. Comparison of coding Techniques for image compression (Bitplane, Predictive, Arithmetic, Huffman coding).
9. Detections of edges in an image (Prewitt, Sobel, Krisch and Laplacian of Gaussian

operators).

10. Image Segmentation based on thresholding.

(Note: Students have to perform at least FOUR experiments from each part.)

IV Year I Semester	CONSTITUTION OF INDIA (V2314104C1)	L	T	P	C
		2	0	0	-

Course Outcomes

CO1 Understand historical background of the constitution making and its importance for building a democratic India.

CO2 Understand the functioning of three wings of the government ie., executive, legislative and judiciary.

CO3 Understand the value of the fundamental rights and duties for becoming good citizen of India.

CO4 Analyze the decentralization of power between central,state and local self-government.

CO5 Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

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

Text Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans

References:

1. J. Raj Indian Government and Politics
2. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
3. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right),
4. Challenges to Civil Rights Guarantees in India, Oxford University Press 2012 resources:
5. nptel.ac.in/courses/109104074/8
6. nptel.ac.in/courses/109104045/
7. nptel.ac.in/courses/101104065/
8. www.hss.iitb.ac.in/en/lecture-details
9. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

B.Tech IV Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Internship	Full semester Internship **(V231410481)**	-	-	-	2
2	Project Work	Full semester Project work **(V2314204A1)**	0	0	24	12

Honor Course	ADVANCED COMMUNICATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1	Learned 5G Technology advances and their benefits
CO2	Learned the key MIMO, SDR changes required to support 5G
CO3	Learned Device to device communication with Wireless Networks
CO4	Implementation options for 5G

UNIT I:

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES: Introduction, Pseudo noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques wireless communication, TDMA and CDMA in wireless communication systems, source coding of speech for wireless communications.

UNIT II:

Wireless channel modeling (microwave, mmWave, and teraHertz): Propagation mechanism, reflection, refraction, diffraction and scattering. Fading channels- Multipath and small-scale fading Doppler shift, statistical multipath channel models, narrowband and wideband fading models, coherence bandwidth, and coherence time.

UNIT III:

Multiple-Input, Multiple-Output (MIMO) wireless communication: Basic MIMO model, MIMO capacity in fading channels, Diversity multiplexing trade off, Space-time code for MIMO wireless communication.

Software Define Radio (SDR): Characteristics and benefits of a software radio, design principles of software radio, enhanced flexibility with software radios, receiver design challenges.

UNIT IV:

Wireless Networks Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, HiperLan, WLL

UNIT V:

5G Communication: 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies. 5G CHANNEL MODEL: The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling. 5G USE CASES AND SYSTEM CONCEPT: Use cases and requirements, 5G

system concept.5G waveforms, OFDM, OTFS, OFDMA, carrier aggregation, dual connectivity. Beyond 5G key enablers: Intelligent reflecting surfaces (IRS), wireless energy harvesting, SWIPT, integrated sensing and communication

Text Books:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. S. Haykin and M. Moher, Modern Wireless Communication, Pearson Education, 2005.
3. Jeffrey H. Reed, Software Radio: A Modern Approach to Radio Engineering, Prentice Hall, May 2002

References Books:

1. C. Oestges and B. Clerckx, MMIO Wireless Communications, 1st Ed, 2007.
2. Paul Burns, Software Defined Radio for 3G, Artech House Inc., 2003.
3. AfifOsseiran, Jose F Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016
4. Wireless Sensor Networks: An Information Processing Approach, 1st edition, Feng Zhao, Leonidas Guibas, Elsevier Science imprint, Morgan Kauffman Publishers, 2005, rp2009

Honor Course	EMI/EMC	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Effects of EMI and counter measures by EMC-techniques.

CO2 Kknowledge gained in selecting proper gadget/device/appliance/system, as per EMC- norms specified by regulating authorities.

CO3 Choose career in the fields of EMI/EMC as an engineer / Researcher Entrepreneur in India/abroad.

CO4 Understand the various aspects of shielding & PCB Tracing, termination & Implementation.

CO5 Identifying of EMI Hotspot and various techniques like grounding filtering soldering etc.

UNIT – I:

Natural and Nuclear sources of EMI / EMC: Introduction, Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations. An overview of EMI/ EMC, Natural and Nuclear sources of EMI

UNIT – II:

EMI from apparatus, circuits and open area test sites: Electromagnetic emissions, noise from relays and switches, non-linearity in circuits, passive inter-modulation, cross talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI). Open area test sites and measurements.

UNIT – III:

Radiated and conducted interference measurements: Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents / voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI detectors and measurements.

UNIT – IV:

ESD, Grounding, shielding, bonding and EMI filters: Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design. ESD, Electrical fast transients / bursts, electrical surges.

UNIT – V:

Cables, connectors, components: Introduction, EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators, Transient and Surge Suppression Devices.

EMC standards- National / International: Introduction, Standards for EMI and EMC, MIL-Standards, IEEE/ANSI standards, CISPR/IEC standards, FCC regulations, EMI/EMC standards in JAPAN, Conclusions.

Text Books:

1. Engineering Electromagnetic Compatibility by Dr. V.P. Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.

References Books:

1. Introduction to Electromagnetic Compatibility, NY, John Wiley, 1992, by C.R. Pal.
2. Electromagnetic Interference and Compatibility IMPACT series, IIT – Delhi.

Honor Course	VLSI SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand Pipelining and parallel processing.

CO2 Use VLSI design for digital filters

CO3 Optimize VLSI architectures for basic DSP algorithms

CO4 Analyze various parallel processing algorithms

CO5 Familiar with VLSI algorithms and architectures for DSP.

CO6 implement basic architectures for DSP using CAD tools

UNIT-I:

Introduction to DSP: Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms. **Pipelining and Parallel Processing:** Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power. **Retiming:** Introduction – Definitions and Properties – Solving System of Inequalities – Retiming Techniques

UNIT-II:

Folding: Introduction -Folding Transform - Register minimization Techniques – Register minimization in folded architectures – folding of multirate systems

Unfolding: Introduction – An Algorithm for Unfolding – Properties of Unfolding – critical Path, Unfolding and Retiming – Applications of Unfolding

UNIT-III:

Systolic Architecture Design

Introduction – Systolic Array Design Methodology – FIR Systolic Arrays – Selection of Scheduling Vector – Matrix Multiplication and 2D Systolic Array Design – Systolic Design for Space Representations contain Delays

UNIT-IV:

Fast Convolution

Introduction – Cook-Toom Algorithm – Winograd algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

UNIT-V:

Low Power Design

Scaling Vs Power Consumption –Power Analysis, Power Reduction techniques – Power Estimation Approaches Programmable DSP: Evaluation of Programmable Digital Signal Processors, DSP Processors for Mobile and Wireless Communications, Processors for Multimedia Signal Processing.

TEXT BOOKS:

1. VLSI Digital Signal Processing- System Design and Implementation – Keshab K. Parhi, 1998, Wiley Inter Science.
2. VLSI and Modern Signal Processing – Kung S. Y, H. J. While House, T. Kailath, 1985, Prentice Hall.

REFERENCE BOOKS:

1. Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing – Jose E. France, YannisTsividis, 1994, Prentice Hall.
2. VLSI Digital Signal Processing – Medisetti V. K, 1995, IEEE Press (NY), USA.

Honor Course	CMOS MIXED SIGNAL DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Fundamentals of data converters and also optimized their performances.
CO2 Understand the design methodology for mixed signal IC design
CO3 Analyze the design of PLL and operational amplifiers
CO4 Design the CMOS digital circuits and implement its layout.
CO5 Design the Switched Capacitor Circuits for different applications.

UNIT-I: Switched Capacitor Circuits

Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, biquad filters.

UNIT-II: Phased Lock Loop (PLL)

Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.

UNIT-III: Data Converter Fundamentals

DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT-IV: Nyquist Rate A/D Converters

Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.

UNIT-V: Oversampling Converters

Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multibit quantizers, Delta sigma D/A

TEXT BOOKS:

1. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition, 2016
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition, 2002

REFERENCE BOOKS:

1. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters-Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2. Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Interscience, 2005.
3. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009.

Honor Course	ADAPTIVE SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand the Adaptive Systems and Understand the various measures to be opted for developing adaptive systems
CO2 Understand different algorithms to develop the adaptive filtering
CO3 Apply adaptive filter theory for different problems
CO4 Perform RLS & Kalman Filtering

Unit -I

Introduction to Adaptive Systems: Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response, Performance function - Gradient & Mean Square Error.

Unit-II

Development of Adaptive Filter Theory & Searching the Performance surface: Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance surface Searching the performance surface – Methods & Ideas of Gradient Search methods, Gradient Searching Algorithm & its Solution, Stability& Rate of convergence , Learning Curve.

Unit-III

Steepest Descent Algorithms: Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

Unit-IV

LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability &Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms -Convergence of LMS algorithm. Applications: Noise cancellation – Cancellation of Echoes inlong distance telephone circuits, Adaptive Beam forming.

Unit-V

RLS &Kalman Filtering: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Examples using Kalman filtering.

Text Books

1. Adaptive Signal Processing - Bernard Widrow, Samuel D. Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4th Ed., 2002, PE Asia.

Reference Books

1. Optimum signal processing: An introduction – Sophocles .J. Orfamadis, 2nd Ed., 1988,McGraw-Hill, New York
2. Adaptive signal processing-Theory and Applications - S.Thomas Alexander, 1986,Springer – Verlag.
3. Signal analysis – Candy, McGraw Hill Int. Student Edition
4. James V. Candy - Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988

Honor Course	RTOS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand the mathematical model of the system and to develop real time algorithm for task scheduling.

CO2 Categorize capabilities Handling Resource Sharing and dependencies among Real-time Tasks generate a high-level analysis for Scheduling Real-time tasks in multiprocessor and distributed systems

CO3 Analyze the working of real time operating systems and real time database.

CO4 Apply the fault tolerance techniques, evaluation of reliability.

UNIT-I: Introduction

OS Services, Process Management, Timer Functions, Event Functions, Memory Management, Device, File and IO Systems Management, Interrupt Routines in RTOS Environment and Handling of Interrupt Source Calls, Real-Time Operating Systems, Basic Design Using an RTOS, RTOS Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security Issues.

UNIT-II: RTOS Programming

Basic Functions and Types of RTOS for Embedded Systems, RTOS mCOS-II, RTOS Vx Works, Programming concepts of above RTOS with relevant Examples, Programming concepts of RTOS Windows CE, RTOS Linux 2.6.x and RTOS RT Linux.

UNIT-III: Program Modeling – Case Studies

case study of digital camera hardware and software architecture, Case Study of Embedded System for an Adaptive Cruise Control (ACC) System in Car, Case Study of Embedded System for a Smart Card, Case Study of Embedded System of Mobile Phone Software for Key Inputs.

UNIT-IV: Target Image Creation & Programming in Linux

Operating System Software, Target Image Creation for Window XP Embedded, Porting RTOS on a Micro Controller based Development Board. Overview and programming concepts of Unix/Linux Programming, Shell Programming, System Programming

UNIT-V: Programming in RT Linux

Overview of RT Linux, Core RT Linux API, Program to display a message periodically, semaphore management, Mutex, Management, Case Study of Appliance Control by RT Linux System

TEXT BOOKS:

1. Rajkamal: "Embedded Systems-Architecture, Programming and Design", Tata McGraw Hill Publications, Second Edition, 2008.
2. Dr. K.V.K.K. Prasad: "Embedded/Real-Time Systems" Dream Tech Publications, 2005 Edition, Black pad book.

REFERENCES:

1. Labrosse, "Embedding system building blocks ", CMP publishers.
2. Rob Williams," Real time Systems Development", Butterworth Heinemann Publications.

Honor Course	PC BASED DATA ACQUISITION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Be able to identify a data acquisition system, objectives and different configurations

CO2 Be familiar with different methods of linear/Nonlinear Analog-to-Digital conversion and their role in real time applications

CO3 Be familiar with different methods of linear/Nonlinear Digital to Analog Conversion. and their role in real time applications

CO4 Be able to identify the type of interface used to get a digital signal/Analog signal into a microprocessor and familiar with Monolithic Converters.

CO5 Be familiar with different noise reduction techniques in DAS and case studies of Data Converter

UNIT-I

INTRODUCTION: Objective of a DAS, single channel DAS, Multi-channel DAS, Components used in DAS– Converter Characteristics-Resolution-Non-linearity, settling time, Monotonicity.

UNIT-II

ANALOG TO DIGITAL CONVERTERS (ADCS): Classification of A/D converters. Parallel feed back – Successive approximation – Ramp comparison – Dual slope integration – Voltage to frequency – Voltage to Time – Logarithmic types of ADCS.

NON-LINEAR DATA CONVERTERS (NDC): Basic NDC configurations – Some Common NDACS and NADCS – Programmable non-linear ADCS – NADC using optimal sized ROM –High speed hybrid NADC – PLS based NADC – Switched capacitor NDCS.

ADC APPLICATIONS: Data Acquisition systems – Digital signal processing systems –PCM voice communication systems – Test and measurement instruments – Electronic Weighing machines.

UNIT-III

DIGITAL TO ANALOG CONVERTERS (DACS): Principles and design of – Parallel R–2R, Weighted resistor, inverted ladder, D/A decoding – Codes other than ordinary binary.

DATA CONVERTER APPLICATIONS: DAC applications – Digitally programmable V/I sources – Arbitrary waveform generators – Digitally programmable gain amplifiers – Analog multipliers/ dividers – Analog delay lines.

UNIT-IV

Monolithic data converters: typical study of monolithic DACS and ADCS. Interfacing of DACS and ADCS to a μP.

UNIT-V

Error budget of DACS and ADCS: Error sources, error reduction and noise Reduction techniques in DAS. Error budget analysis of DAS, case study of a DAC and an ADC.

TEXT BOOKS:

1. Electronic data converters fundamentals and applications – Dinesh K. Anvekar, B.S. Sonde –Tata McGraw Hill.

REFERENCES:

1. Electronic Analog/ Digital conversions – Hermann Schmid – Tata McGraw Hill.
2. E.R. Hanateck, User's Handbook of D/A and A/D converters - Wiley
3. Electronic instrumentation by HS Kalsi- TMH 2 ndEdition, 2004.
4. Data converters by G.B. Clayton

Honor Course	DIGITAL CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1	Have the awareness of Discrete Time Control Systems
CO2	Calculate the Z-transforms and use its concepts of Discrete control systems
CO3	Get familiarize with design of Discrete control systems using various Approaches
CO4	Understand the State Space approach to analyze the discrete system
CO5	Have the concepts of Controllability and Observability of discrete control system

UNIT –I: Introduction to Discrete Time Control Systems:

Introduction, Digital Control Systems, Quantizing and Quantization Error, Data Acquisition, Conversion, and Distribution Systems

UNIT-II:

The Z – Transforms:

Introduction, The Z Transform, Z-Transform of elementary functions, properties and theorems of Z-Transform, Inverse Z-Transform, Z-Transform method for solving difference equations

Z-Plane Analysis of Discrete-Time Control System:

Introduction, Impulse Sampling and Data Hold, Obtaining the Z-Transform by the convolutional integral method, Reconstruction of original signals from sampled signals, Pulse transfer function, Realization of digital controllers and digital filters

UNIT –III: Design of Discrete Time Control Systems by Conventional Methods:

Introduction, Mapping between the s plane and the z plane, stability analysis of closed loop systems in the z plane, transient and steady response analysis, design based on the Root-Locus method, design based on the frequency response method, Analytical design method.

UNIT-IV: State Space Analysis:

Introduction, State Space Representation of discrete time systems, solving discrete time state space equations, Pulse Transfer function matrix, Discretization of continuous time state – space equations, Liapunov stability analysis

UNIT –V: Controllability and Observability:

Introduction, Controllability, Observability, Useful Transformations in State Space Analysis and Desig.

TEXT BOOKS:

1. K. Ogata - “Discrete-Time Control systems” - Pearson Education/PHI, 2nd Edition.

REFERENCE BOOKS:

1. Kuo - “Digital Control Systems”- Oxford University Press, 2nd Edition, 2003.
2. M. Gopal - “Digital Control and State Variable Methods”- TMH

Honor Course	MICROSTRIP ANTENNAS	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1	Remember the antenna basics and planar antennas.
CO2	Describe and discuss characteristics and principles of microstrip antennas.
CO3	Demonstrate and implement the CP patch antennas and microstrip antenna arrays.
CO4	Analyze planar slot antennas and planar monopole antennas.
CO5	Evaluate characteristics and design aspects of electrically small antennas.
CO6	Investigate planar antennas for special applications for wireless access.

UNIT –I:

Planar Radiators: Introduction to antennas (radiation pattern, directivity, efficiency, gain, impedance, axial ratio etc.), different types of planar antennas, applications of planar antennas, Brief description of fabrication process of planar antennas.

UNIT –II:

Microstrip Patch Antennas-I: Characteristics of microstrip patch antennas, radiation from microstrip antenna, field configurations, different types of feeding techniques. Design equations for rectangular and circular microstrip patches, analysis of microstrip antennas using transmission line model and cavity method. Broadband techniques using stacked patch antennas, proximity-coupled and aperture-coupled microstrip antennas, slot-loaded and slit-loaded microstrip antennas, microstrip antennas with shorted pin, effect of finite ground plane on the performance of microstrip antennas, principle of planar fractal antennas.

UNIT –III:

Microstrip Patch Antennas-II: Methods of generating circular polarization in microstrip antennas using single feed and double feed, methods of generating multiple frequencies using microstrip antennas, miniaturization techniques for mcirostrip antennas. Design techniques of microstrip antenna arrays with feed network, effect of mutual coupling, microstrip phased array antenna design.

UNIT –IV:

Planar Slot Antennas: Geometry and design of microstrip slot antenna, radiation pattern, CPW-fed slot antennas, design of folded slot antenna, annular slot antenna.

Planar Monopole Antennas: Feeding methods and characteristics of planar triangle monopole, Sierpinski monopole, planar bi-conical monopole antenna and roll monopole antenna.

UNIT –V:

Planar Antennas for Special Applications: Planar mobile handset antennas, planar laptop computer antennas, planar antennas for USB modem, planar antennas for WLAN and UWB communication.

Honor Course	IMAGE & VIDEO PROCESSING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Describe the Image Processing system, scope of digital image processing and compare various image transforms.

CO2 Apply filtering operations on images both in spatial and frequency domain; describe image restoration in presence of noise and degradation.

CO3 Analyze various segmentation techniques and compression methods on digital images.

CO4 Describe the fundamental of digital video, sampling and filtering of video signals.

CO5 Explain various methods for two dimensional motion estimation and their applications in video processing

Unit – I

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, Examples of the fields that use Digital Image Processing. Image sensing and acquisition, image sampling and quantization, Some basic relationships between pixels.

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

Unit – II

Image Enhancement:

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Filtering in frequency domain: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Image Restoration:

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 – III

Image segmentation: Fundamentals, point, line, edge detection, thresholding, and Region –based segmentation. Image compression: Fundamentals, Basic compression methods: Huffman coding, Golom bcoding, Arithmetic coding, LZW coding, Run-Length coding, Block Transform coding, Predictive coding.

Unit – IV

Basic Steps of Video Processing:

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

Unit – V

2-D Motion Estimation:

Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation

TEXT BOOKS:

1. Digital Image Processing – Gonzaleze and Woods, 3rd Ed., Pearson.
2. Digital Video Processing – M. Tekalp, Prentice Hall International.
3. Video Processing and Communication – Yao Wang, JoemOstermann and Ya–quin Zhang. 1st Ed., PH Int.

REFRENCE BOOKS:

1. Fundamentals of Digital Image Processing – Anil K. Jain, Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. Digital Image Processing –S. Jayaraman, S. Esakkirajan, and T. Veerakumar, McGraw-Hill Education, 2018.

Honor Course	ADVANCED COMMUNICATIONS LAB	L	T	P	C
		0	0	3	1.5

COURSE OUTCOMES:

CO1 Investigate the characteristics of optical source and detectors.

CO2 Examine the Eye Pattern, Pulse broadening of optical fiber and the impact on BER.

CO3 Estimate the Wireless Channel Characteristics and analyse the performance of satellite Communication System.

CO4 Understand the intricacies in Microwave System design.

List of Experiments :(Minimum of Twelve Experiments has to be performed)

1. Implementation of Linear Block Code Encoder and Decoder
2. Implementation of Binary Cyclic Codes Encoder and Decoder
3. Implementation of Convolution Encoder- Decoder
4. Determination of Losses in Optical Fiber
5. Characteristics of LASER Diode.
6. Study of Satellite Communication System, uplink transmitter, down link receiver and transponder
7. Signal to noise ratio and Link Failure operations in satellite communication
8. Carrier to Noise Ratio in Satellite Communication
9. Study of Direct Sequence Spread Spectrum Modulation & Demodulation using CDMA-DSS BER Trainer
10. Efficiency of DS Spread- Spectrum Technique
11. Simulation of Frequency Hopping (FH) system
12. Generation of PN sequence and Gold Sequence
13. Outdoor propagation model - Okumura model and Hata model
14. Free space propagation – path loss model
15. Study of WLAN / network topologies

Honor Course	CMOS Mixed Signal Design Lab	L	T	P	C
		0	0	3	1.5

COURSE OUTCOMES

CO1 Ability to design and simulate basic and advanced CMOS-based analog and mixed-signal building Blocks
CO2 Capability to implement and analyze data conversion systems like Analog-to-Digital Converters (ADCs) and Digital-to-Analog Converters (DACs)
CO3 Understanding and practical implementation of switched-capacitor techniques for realizing active filters and signal processing functions.
CO4 Design of PLL,VCO

List of Experiments:

Cycle 1:

1) Fully compensated op-amp with resistor and miller compensation
2) High speed comparator design
   i. Two stage cross coupled clamped comparator ii. Strobed Flip-flop
3) Data converter

Cycle 2:

1) Switched capacitor circuits i. Parasitic sensitive integrator ii. Parasitic insensitive integrator
2) Design of PLL
3) Design of VCO
4) Band gap reference circuit
5) Layouts of All the circuits Designed and Simulated

Lab Requirements:

Software: Mentor Graphics/ Cadence/ Tanner/Industry Equivalent Standard Software Tools

Hardware: Personal Computer with necessary peripherals, configuration and operating System.

Honor Course	RTOS Lab	L	T	P	C
		0	0	3	1.5

COURSE OUTCOMES

CO1 Understand RTOS Principles.

CO2 Implement Task Scheduling

CO3 Analyze System Performance

CO4 Apply inter-task communication and synchronization mechanisms

CO5 Install and configure real-time kernels on physical microcontroller boards like ARM Cortex or similar hardware

List of Experiments:

Part-I:Experiments using ARM-926 with PERFECT RTOS

1. Register a new command in CLI.
2. Create a new Task.
3. Interrupt handling.
4. Allocate resource using semaphores.
5. Share resource using MUTEX.
6. Avoid deadlock using BANKER'S algorithm.
7. Synchronize two identical threads using MONITOR.
8. Reader's Writer's Problem for concurrent Tasks.

Part-II: Experiments on ARM-CORTEX processor using any open source RTOS.
(Coo-Cox-Software-Platform)

1. Implement the interfacing of display with the ARM- CORTEX processor.
2. Interface ADC and DAC ports with the Input and Output sensitive devices.
3. Simulate the temperature DATA Logger with the SERIAL communication with PC.
4. Implement the developer board as a modem for data communication using serial port communication between two PC's.

Lab Requirements:

Software:

- Eclipse IDE for C and C++ (YAGARTO Eclipse IDE), Perfect RTOS Library, COO-COX Software Platform, YAGARTO TOOLS, and TFTP SERVER.
- LINUX Environment for the compilation using Eclipse IDE & Java with latest version.

Hardware:

- The development kits of ARM-926 Developer Kits and ARM-Cortex Boards.
- Serial Cables, Network Cables and recommended power supply for the board.

Honor Course	DIGITAL CONTROL SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

COURSE OUTCOMES

CO1 Represent discrete-time systems under the form of z-domain transfer functions and state-space models.

CO2 Analyze stability, transient response, and steady-state behavior of linear discrete-time systems, analytically and numerically using tools such as Matlab and Simulink.

CO3 Design digital control systems using transform techniques and state-space methods.

CO4 Describe and test the controllability and observability of linear systems.

CO5 Communicate effectively in oral and written forms.

To study

a. Conversion of a transfer function from continuous domain to discrete domain.
b. Conversion of a transfer function from the continuous domain to the digital domain.
c. Pole Zero Map of a discrete transfer function
2. To determine

a. Z transform of a discrete-time signal
b. Inverse Z transform of a discrete-time signal
c. Factored form and partial fraction form of a rational z function d. Pole zero map of a digital system
3. To study

a. Closed loop response of a discrete-time system
b. Comparison of time responses of continuous time and discrete time systems
c. Effect of sampling time on system response and system parameters
4. To design a lead compensator to obtain system response with the desired accuracy, and less overshoot.

5. To design a lag compensator to meet performance specification parameters

6. To study a. The effect of variation in controller parameters on system response

7. To obtain

a. Transfer function model from a state model
b. State model from transfer function model
c. Step response of a system represented by its state model
8. To determine

a. Eigenvalues from state model
b. Eigenvalues from transfer function model
c. Stability of a system

9. To study the effect of common nonlinearities such as relay, dead zone, and saturation on the response of a 2nd order control system

Softwares Required

1. Matlab Software
2. Simulink Tool

Honor Course	ANTENNAS and MICROWAVE LAB	L	T	P	C
		0	0	3	1.5

COURSE OUTCOMES:

CO1 Analyze Microwave Components

CO2 Understand Microwave Sources

CO3 Examine Antenna Parameters & Theorems

CO4 Design and simulate wire and aperture antennas or microstrip patch configurations Using specialized high-frequency software like HFSS or MATLAB.

CO5 Handle specialized RF and microwave test equipment safely to evaluate unknown loads, reflection coefficients, and scattering (S) parameters

LIST OF EXPERIMENTS : (Minimum of Ten Experiments has to be performed)

1. Calculation of transmission line parameters (R, L, G and C) for two wire line, coaxial line and Strip line.
2. Study on the standing wave pattern along a transmission line when the line is open-circuited, Short circuited and terminated by a resistive load at the load end.
3. Investigate the effect of length of transmission line on the input impedance at the sending end.
4. Familiarization of Smith chart on MATLAB platform.
5. Radiation resistance of electric and magnetic dipoles as a function of electrical size.
6. Feed (input terminal) impedance of an electric dipole as a function of antenna length.
7. 3D radiation pattern of a half-wavelength dipole antenna in both horizontal and vertical Orientations
8. Radiation patterns for electric dipoles of various electrical lengths.
9. Characteristics and radiation patterns of Linear array, Planar and Circular arrays.
10. Variation of normalized input impedance with Feeding position in Inset-Fed Microstrip patch Antenna
11. Design of Rectangular Microstrip Patch antenna.

Honor Course	IMAGE & VIDEO PROCESSING LAB	L	T	P	C
		0	0	3	1.5

COURSE OUTCOMES:

CO1: Understand Fundamentals

CO2: Perform Image Enhancement

CO3: Apply Restoration and Segmentation

CO4: Analyze Morphological and Compression Techniques

CO5: Process and Analyze Video Sequences

List of Experiments:

Note: In the first 10 experiments, atleast 8 experiments; In the last three experiments, atleast 2 experiments must be executed.

1. Perform basic operations on images like addition, subtraction etc.
2. Perform Pixel based operations (Point based operations) for Image enhancement
3. Plot the histogram of an image and perform histogram equalization
4. Filtering in Spatial Domain
5. Computation of 2D-DFT and Perform filtering in Frequency domain
6. Implementation of Image Restoration methods
7. Implementation of JPEG compression Algorithm (Without using Library function)
8. Comparison of coding Techniques for image compression (Bit plane, Predictive, Arithmetic, Huffman coding).
9. Detections of edges in an image (Prewitt, Sobel, Krisch and Laplacian of Gaussian Operators, Canny operators) and compare
10. Image Segmentation based on thresholding.
11. Basic operations on Video, and identification of key frame
12. Computation of optical flow velocities for a moving object in a Video
13. Implementation of two dimensional motion estimation

Minor Course	ELECTRONICS DEVICES AND BASIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand the semiconductor physics, their concepts and characteristics of p-n junction diode.

CO2 Understand V-I characteristics of various semiconductor devices.

CO3 Learn the operation of transistor and its characteristics in various configurations, Biasing of transistor

CO4 Analyze the transistor using h-parameters and its equivalent model.

CO5 Describe the operation of FET and MOSFET, their application as an amplifier.

UNIT I:

Review of Semiconductor Physics: Mobility and Conductivity, Intrinsic and extrinsic semiconductors**,** Hall effect

Junction Diode Characteristics : Energy band diagram of PN junction Diode, Open circuited p-n junction, Biased p-n junction, p-n junction diode, current components in p-n junction Diode, Qualitative explanation of Diode equation (Derivation not required) , V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance

UNIT II:

Special Semiconductor Devices: Zener Diode, Breakdown mechanisms, Zener diode applications, Varactor Diode, LED, Photodiode, Tunnel Diode and its characteristics with the help of energy band diagram, UJT and its application, PNPN Diode, SCR, Construction, operation and V-I characteristics.

Diode Circuits: Clipping (limiting) circuits, Peak Detector, Clamping circuits, Comparators, Basic Rectifier setup**,** half wave rectifier, full wave rectifier, bridge rectifier, Inductor filter, Capacitor filter

UNIT III:

Transistor Characteristics: Junction transistor, transistor current components, transistor equation in CB configuration, transistor as an amplifier, characteristics of transistor in Common Base and Common Emitter configurations, punch through/ reach through, typical transistor junction voltage values.

Transistor Biasing and Thermal Stabilization : Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in V_{BE}, Ic, and β, Stability factors, (S, S', S''), Bias compensation, Thermal runaway, Thermal stability.

UNIT IV:

Small Signal Low Frequency Transistor Amplifier Models

BJT: Two port network, Transistor hybrid model, determination of h-parameters, Millers theorem and Dual of Millers theorem, Analysis of CB, CE and CC amplifiers using exact analysis, Comparison of transistor amplifiers.

UNIT V:

FET: FET types, JFET operation and characteristics (qualitative explanation only), small signal model of JFET.

MOSFET: MOSFET Structure, Operation of MOSFET, MOSFET as a variable resistor, derivation of V-I characteristics of MOSFET, Comparison of Bipolar and MOS devices.

CMOS amplifiers: General Considerations, Common Source Stage, Common Gate Stage, Source Follower, comparison of FET amplifiers.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C. C. Halkias, Mc-Graw Hill Education.
2. Integrated Electronics-J. Millman, C. Halkias, Mc-Graw Hill Education.
3. Fundamentals of Microelectronics-Behzad Razavi, Wiley, 3rd edition, 2021.

References:

1. Electronics devices & circuit theory- Robert L.Boylestad and LouiNashelsky, Pearson, 11th edition, 2015.
2. Electronic Devices and Circuits - David A. Bell, Oxford University Press, 5th edition, 2008.
3. Electronic Devices and Circuits- S. Salivahanan, N. Suresh Kumar, Mc-Graw Hill, 5th edition, 2022.

Minor Course	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1	Classify different number systems and apply to generate various codes.
CO2	Use the concept of Boolean algebra in minimization of switching functions
CO3	Design different types of combinational logic circuits.
CO4	Apply knowledge of flip-flops in designing of Registers and counters
CO5	The operation and design methodology for synchronous sequential circuits and algorithmic state machines.
CO6	Produce innovative designs by modifying the traditional design techniques.

UNIT – I

REVIEW OF NUMBER SYSTEMS & CODES:

Representation of numbers of different radix, conversation from one radix to another radix, r 1's compliments and r's compliments of signed members. Gray code ,4 bit codes; BCD, Excess-3, 2421, 84-2-1 code etc. Error detection & correction codes: parity checking, even parity, odd parity, Hamming code.

UNIT – II

BOOLEAN THEOREMS AND LOGIC OPERATIONS:

Boolean theorems, principle of complementation & duality, De-Morgan theorems. Logic operations ; Basic logic operations -NOT, OR, AND, Universal Logic operations, EX-OR, EX-NOR operations. Standard SOP and POS Forms, NAND-NAND and NOR-NOR realizations, Realization of three level logic circuits. Study the pin diagram and obtain truth table for the following relevant ICs 7400,7402,7404,7408,7432,7486.

MINIMIZATION TECHNIQUES: Minimization and realization of switching functions using Boolean theorems, K-Map (up to 6 variables)and tabular method(Quine-mcCluskey method) with only four variables and single function.

UNIT – III

COMBINATIONAL LOGIC CIRCUITS DESIGN: Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4 bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit, Design code converts using Karnaugh method and draw the complete circuit diagrams.

COMBINATIONAL LOGIC CIRCUITS DESIGN USING MSI &LSI :

Design of encoder ,decoder, multiplexer and de-multiplexers, Implementation of higher order circuits using lower order circuits .Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and seven segment decoder. Study the relevant ICs pin diagrams and their functions 7442,7447,7485,74154.

UNIT – IV SEQUENTIAL CIRCUITS : Classification of sequential circuits (synchronous and asynchronous) , operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals. Conversion from one flip-flop to another flip-flop. Design of 5ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - Buffer register, control buffer register, shift register, bi directional shift register, universal shift, register.

UNIT-V INTRODUCTION OF PLD's : PLDs: PROM, PAL, PLA -Basics structures, realization of Boolean functions, Programming table. ROM: Internal structure, Static RAM: Internal structure, Dynamic RAM: Internal structure.

TEXT BOOKS:

1. Switching and finite automata theory Zvi.KOHAVI, Niraj.K.Jha 3rd Edition, Cambridge University Press,2009
2. Digital Design by M.Morris Mano, Michael D Ciletti,4th edition publication,2008 PHI
3. Switching theory and logic design by Hill and Peterson, Mc-Graw Hill TMH edition, 2012.

REFERENCES:

1. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers,2006

2. Digital electronics by R S Sedha.S.Chand& company limited,2010

3. Switching Theory and Logic Design by A. Anand Kumar, PHI Learning pvt ltd,2016.

4. Digital logic applications and design by John M Yarbough, Cengage learning, 2006.

Minor Course	PRINCIPLES OF COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1	Analyze the performance of analog modulation schemes in time and frequency domains.
CO2	Analyze the performance of angle modulated signals.
CO3	Characterize analog signals in time domain as random processes and noise
CO4	Characterize the influence of channel on analog modulated signals
CO5	Determine the performance of analog communication systems in terms of SNR

UNIT I : Basic tools for communication, Fourier Series/Transform, Properties, Autocorrelation, Energy Spectral Density, Parsevals Relation, Amplitude Modulation (AM), Spectrum of AM, Envelope Detection, Power Efficiency, Modulation Index

UNIT II : Double Sideband Suppressed Carrier (DSB-SC) Modulation, Demodulation, Costas Receiver, Single Sideband Modulation (SSB), Hilbert Transform, Complex Pre-envelope/ Envelope, Demodulation of SSB, Vestigial Sideband Modulation (VSB)

UNIT III : Angle Modulation, Frequency Modulation (FM), Phase Modulation (PM), Modulation Index, Instantaneous Frequency, Spectrum of FM Signals, Carsons Rule for FM Bandwidth, Narrowband FM Generation, Wideband FM Generation via Indirect Method, FM Demodulation

UNIT IV : Introduction to Sampling, Spectrum of Sampled Signal, Aliasing, Nyquist Criterion, Signal Reconstruction from Sampled Signal, Pulse Amplitude Modulation**,** Quantization, Uniform Quantizers – Midrise and Midtread, Quantization noise, , Non uniform Quantizers, Delta Modulation, Differential Pulse Code Modulation (DPCM)

UNIT V: : Basics of Probability, Conditional Probability, MAP Principle, Random Variables, Probability Density Functions, Applications in Wireless Channels, Basics of Random Processes ,Gaussian Random Process, Noise.

TEXT BOOKS:

1. Simon Haykin, Communications Systems, 4th Edition. John Wiley and Sons, Inc
2. Fundamentals of Wireless Communication by David Tse

References:

1. Principles of Communication Systems – Simon Haykin, John Wiley, 2nd Edition.
2. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.

Minor Course	SIGNAL ANALYSYS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 To be able to determine if a given system is linear/causal/stable
CO2 Capable of determining the frequency components present in a deterministic signal
CO3 Capable of characterizing LTI systems in the time domain and frequency domain
CO4 To be able to compute the output of an LTI system in the time and frequency domains

UNIT I: CLASSIFICATION OF SIGNALS AND SYSTEMS

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II: ANALYSIS OF CONTINUOUS TIME SIGNALS Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties

UNIT III: LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV: ANALYSIS OF DISCRETE TIME SIGNALS

Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties

UNIT V: LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

Impulse response – Difference equations - Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, —Signals and Systems‖, Pearson, 2015

REFERENCES BOOKS

1. B. P. Lathi, —Principles of Linear Systems and Signals‖, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, —Signals & Systems - Continuous and Discrete‖, Pearson,
3. John Alan Stuller, —An Introduction to Signals and Systems‖, Thomson, 2007.

Minor Course	MICROCONTROLLERS AND APPLICATIONS	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Understand the architecture and operation of common microcontrollers.
CO2 Write and debug assembly/C programs for microcontrollers.
CO3 Interface microcontrollers with input/output devices.
CO4 Interface microcontrollers with various advanced peripherals.
CO5 Design and implement microcontroller-based applications.

Unit 1: Introduction to Microcontrollers

Evolution of microcontrollers and comparison with microprocessors, Microcontroller families (8051, PIC, AVR, ARM), Architecture of 8051 microcontroller, Memory organization, registers, and flags, Overview of development tools (IDE, simulators, programmers)

Unit 2: Programming of Microcontrollers

Instruction set of 8051, Assembly language programming, Introduction to Embedded C programming, Debugging and simulation tools

Unit 3: Interfacing with Input/Output Devices

Basics of interfacing and role of GPIO, Interfacing LEDs, switches, and push buttons, Interfacing 7-segment displays and buzzers, Interfacing LCDs (16x2 and 20x4, Keypad interfacing for user inputs

Unit 4: Interfacing with Advanced Peripherals and Communication Devices

Interfacing sensors (temperature, light, and proximity sensors),
Interfacing actuators (motors: DC, stepper, and servo).
Communication interfaces:UART (serial communication with PC), SPI and I2C (interfacing EEPROM and sensors), ADC/DAC interfacing (e.g., analog sensors and audio signals).
Interfacing wireless modules (Bluetooth, ZigBee, ESP8266/ESP32 for IoT applications)

Unit 5: Advanced Microcontrollers

Introduction to ARM Cortex-M series, Comparison of ARM with 8051 and PIC, Overview of Arduino and Raspberry Pi platforms, Embedded IoT basics

Real-Time Applications and Case Studies: Microcontroller applications in robotics, automation, and consumer electronics, Designing energy-efficient systems with microcontrollers; Case studies:Home automation, Smart agriculture systems, Healthcare monitoring.

Textbook:

1. Mazidi and Mazidi, The 8051 Microcontroller and Embedded Systems, 4th Impression, PHI, 2000.
2. Raj Kamal, Microcontrollers Architecture, Programming, Interfacing and System Design, 2nd Edition, Pearson Education, 2005.

Reference Books:

1. Kenneth J. Ayala, *The 8051 Microcontroller: Architecture, Programming, and Applications*, Cengage Learning.
2. John Boxall, *Arduino Workshop: A Hands-On Introduction with 65 Projects*, No Starch Press.

Minor Course	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand the basic concepts of an embedded system and able to know an embedded system design approach to perform a specific function.

CO2 The hardware components required for an embedded system and the design approach of an embedded hardware.

CO3 The various embedded firmware design approaches on embedded environment.

CO4 Understand how to integrate hardware and firmware of an embedded system using real time operating system.

UNIT-I

INTRODUCTION: Embedded system-Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT-II

EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

UNIT-III

EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT-IV

REAL TIME OPERATING SYSTEM: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

HARDWARE SOFTWARE CO-DESIGN: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

UNIT-V:

EMBEDDED SYSTEM DEVELOPMENT, IMPLEMENTATION AND TESTING: The integrated development environment, Types of files generated on cross-compilation, Deassembler/ De-compiler, Simulators, Emulators and Debugging, Target hardware debugging,

Embedded Software development process and tools, Interpreters, Compilers and Linkers, debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

Text Books:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.

References:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2. Embedded Systems-Lyla B.Das-Pearson Publications,2013.

Minor Course	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand the new computing technologies

CO2 Able to apply the latest computing technologies like cloud computing technology and Big Data

CO3 Ability to introduce the concept of M2M (machine to machine) with necessary protocols

CO4 Get the skill to program using python scripting language which is used in many IoT devices

Unit I

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT Communication Models, Iot Communication APIs IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle(Chap 1 and 2)

Unit II

IoT and M2M – Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANGNETCONF, YANG, SNMP NETOPEER(Chapter 3 and 4)

Unit III

IOT Platform design Methodology, Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib (Chapter 5 and 6)

Unit IV

IoT Physical Devices and Endpoints - Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins., other IOT Devices (Chapter 7)

Unit V

IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API, Amazon web services for IOT, Skynet IOT messaging platform (Chapter 8)

Text Books:

1. Internet of Things - A Hands-on Approach, ArshdeepBahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD),2014, ISBN: 9789350239759

Reference Books:

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
2. From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence, Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media, 2011.

Minor Course	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1 Understand the concepts of discrete signals and discrete systems with its characteristics

CO2 Calculate z-Transform, Fourier Transform, Discrete Fourier Transform of discrete signals.

CO3 Understand the algorithms for the efficient computation of DFT coefficients of signals

CO4 Know the various filter structures for FIR and IIR filters.

CO5 Design the FIR and IIR filters.

Unit -I

Introduction: Signals, Systems, and Signal Processing, Classification of Signals, The Concept of Frequency in Continuous Time and Discrete Time Signals

Discrete Time Signals and Systems: Discrete Time Signals, Discrete Time Systems, Analysis of Discrete Time Linear Time Invariant Systems, Discrete Time Systems Described by Difference Equations, Implementation of Discrete Time Systems, Correlation of Discrete Time Signals

Frequency Analysis of Signals: Frequency Analysis of Continuous Time Signals, Frequency Analysis of Discrete Time Signals, Frequency Domain and Time Domain Signal Properties, Properties of the Fourier Transform for Discrete Time Signals.

Unit –II

Frequency Domain Analysis of LTI Systems: Frequency domain characteristics of LTI systems, Frequency response of LTI systems.

The z-Transform and Its Applications to the Analysis of LTI Systems: The z-Transform, Properties, Rational z Transforms, Inversion of the z-Transform, Analysis of Linear Time Invariant Systems in the z-Domain, The One sided z-Transform.

Unit –III

The Discrete Fourier Transform: Its Properties and Applications: Frequency Domain Sampling: The Discrete Fourier Transform, Properties of the DFT, Linear Filtering Methods Based on the DFT, Frequency Analysis of Signals Using DFT

Efficient Computation of the DFT: Fast Fourier Transform Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms.

Unit –IV

Implementation of Discrete Time Systems: Structures for the Realization of Discrete Time Systems. **Structures for FIR Systems**: Direct Form Structure, Cascade Form Structures.

Structures for IIR Systems: Discrete Form Structures, Signal Flow Graphs and Transposed Structures, Cascade Form Structures, Parallel Form Structures.

Unit –V

Design of Analog Filters: Butterworth filters… Low Pass Filter, High Pass filter, Band Pass Filter, Band Reject Filter. **Design of Digital Filters**: General Considerations: Causality and Its Implications, Characteristics of Practical Frequency Selective Filters.

Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear Phase FIR Filters Using Windows, Design of Linear Phase FIR Filters by the Frequency Sampling Method.

Design of IIR Filters From Analog Filters: IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Frequency Transformations: Frequency Transformations in the Analog Domain, Frequency Transformations in the Digital Domain.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G.Manolakis, 4th Edition, Pearson Education, 2007.

Reference Books:

1. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, 3rd Edition, Pearson, 2014.
2. Digital Signal Processing-P. Ramesh Babu, 5th Edition, SCITECH Publishers.

Minor Course	ELECTRONICS DEVICES AND BASIC CIRCUITS LAB	L	T	P	C
		0	0	3	1.5

COURSE OUTCOMES

CO1 Component Identification
CO2 Measure electrical parameters and analyze wave signals safely using laboratory tools like multimeters,
CO3 Plot and examine the volt-ampere characteristics of semiconductor devices such as PN junction
diodes, Zener diodes, Bipolar Junction Transistors (BJT), and Field Effect Transistors (FET).
CO4 Build and test basic functional setups like rectifiers, Zener voltage regulators, and transistor biasing Configurations
CO5 Construct, analyze, and measure the performance parameters of single-stage or multi-stage transistor and FET amplifiers

List of Experiments:(Minimum of Ten Experiments has to be performed)

1. P-N Junction Diode Characteristics
   Part A: Germanium Diode (Forward bias& Reverse bias)
   Part B: Silicon Diode (Forward Bias only)
2. Zener Diode Characteristics
3. Part A: V-I Characteristics
   Part B: Zener Diode as Voltage Regulator
4. Rectifiers (without)
   Part A: Half-wave Rectifier
   Part B: Full-wave Rectifier
5. BJT Characteristics (CE Configuration)
6. FET Characteristics (CS Configuration)
7. Transistor Biasing
8. CRO Operation and its Measurements
9. BJT-CE Amplifier
10. Emitter Follower-CC Amplifier
11. FET-CS Amplifier

Equipment required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscillo scopes
3. Analog/Digital Function Generators
4. Digital Multi-meters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analogor Digital)
8. Voltmeters (Analogor Digital)
9. Active & Passive Electronic Components

Minor Course	DIGITAL ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

COURSE OUTCOME

CO1 Identify different logic gates ICs and verify their truth table.

CO2 Illustrate realization of Boolean expression in SOP and POS form.

CO3 Examine various arithmetic and logical combinational circuit.

CO4 Implement synchronous and asynchronous sequential circuits.

CO5 Implement applications of combinational & sequential logic circuits.

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. Verification of truth tables of Logic gates
   Two input (i) OR (ii) AND (iii) NOR (iv) NAND (v) Exclusive OR (vi) Exclusive NOR
2. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit
3. Verification of functional table of 3 to 8 line Decoder/De-multiplexer
4. four variable logic function verification using 8 to1 multiplexer.
5. Design full adder circuit and verify its functional table.
6. Verification of functional tables of
   (i) JK Edge triggered Flip–Flop (ii) JK Master Slav Flip–Flop (iii) DFlip-Flop
7. Design a four bit ring counter using D Flip–Flops/JK Flip Flop and verify output
8. Design a four bit Johnson's counter using D Flip-Flops/JK Flip Flops and verify output
9. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.
10. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T- Flip-Flops and Test it with a low frequency clock and Sketch the output wave forms.
11. Design MOD–8 synchronous counter using T Flip- Flop and verify the result and Sketch the output wave forms.
12. (a) Draw the circuit diagram of a single bit comparator and test the output
    (b) Construct 7 Segment Display Circuit Using Decoder and 7 Segment LED and test it.

Minor Course	INTERNET OF THINGS LAB

COURSE OUTCOME

CO1 Implement interfacing of various sensors with Arduino/Raspberry Pi.

CO2 Demonstrate the ability to transmit data wirelessly between different devices

CO3 Show an ability to upload/download sensor data on cloud and server.

CO4 Examine various SQL queries from MySQL database.

List of Experiments: (Minimum of Twelve Experiments has to be performed)

1. Getting started with Raspberry Pi, Install Raspian on your SD card.
2. Python-based IDE(integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device.
3. Display a word on LCD, Interfacing with Raspberry Pi.
4. Using Raspberry Pi, Display Seven Segment.
5. Servo Motor Controlling with Interfacing using Raspberry Pi.
6. Soil Moisture detecting with soil moisture sensor using Raspberry Pi.
7. Calculate the distance using distance sensor Using Node MCU.
8. Basic LED functionality Using Node MCU
9. Familiarization with ARM keil MDK for programming and debugging an application on the PSoC 4 BLE chip and perform necessary software installation.
10. To interface Push button/Digital sensor (IR/LDR) with ARM keil MDKonPSoC4BLEchipandwriteaprogramtoturnONLED when push button is pressed or at sensor detection.
11. Setup a Bluetooth Low Energy (namely Bluetooth Smart)connection between the PSoC BLE kit and a smart phone and use an app to send and receive data to and from the BLE Pioneer kit.
12. To interface capacitor sensor (touch sensor) with smart phone and write a program to turn RGBLEDON/OFFwhen„1“/“0“ is received from smart phone using Bluetooth.
13. Automatic street light control to control the street light (Turn on and off based on the light)using Arduino/Node MCU/Raspberry Pi
14. SmokeDetectionusingMQ-2GasSensor
15. Detecting obstacle with IR Sensor and Arduino/NodeMCU/Raspberry Pi

Equipment required for Laboratories:

- Arduino/NodeMCU/Raspberry Pi+PSoC4 BLE Bluetooth Low Energy Pioneer Kit + Hardware, MQ-2 Gas Sensor, Ultrasonic sound sensor.

Minor Course	DIGITAL SIGNAL PROCESSING LAB	L	T	P	C
		0	0	3	1.5

COURSE OUTCOME:

CO1 Formulate programs for performing time & frequency operation on signals and systems.

CO2 . Design and implement impulse response filters and Multirate system for a given sequence

CO3 . Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital IIR-Butterworth, Chebyshev filters

CO4. Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filters using window techniques

CO5. Develop various DSP Algorithms using MATLAB Software package

(Note: Students have to perform at least FIVE experiments from each part.)

PART-A

List of the Experiments

1. Generation of DT signals.
2. Verify the Linear Convolution of two DT signals
   a) Using MATLAB
   b) Using Code Composer Studio(CCS)
3. Verify the Circular Convolution of two DT signals
   a) Using MATLAB
   b) Using Code Composer Studio (CCS)
4. Find the sum of DT sinusoidal signals.
5. Computation of Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT)
   a) Using MATLAB
   b) Using Code Composer Studio (CCS)
6. Compute N-point DFT of a given DT sequence using Decimation in Time. (Without Using Library Function)
7. Compute N-point DFT of a given DT sequence using Decimation in Frequency. (Without Using Library Function)

PART-B : Following Experiments are to be done using a TI DSP Starter Kit.

1. Generation of a sinusoidal signal.
2. Linear and circular convolution of DT sequences.
3. Compute N-point DFT of a given DT sequence
4. Design and implementation of FIR filters.
5. Design and implementation of IIR filters.