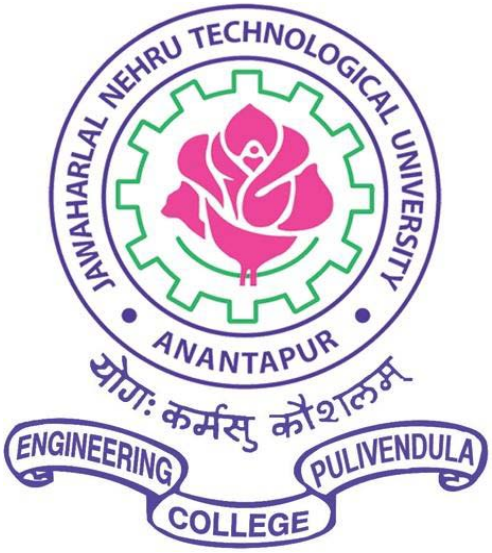
TWO YEAR COURSE STRUCTURE

FOR

M.TECH – DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)

w.e.f.

2013-2014 ADMITTED BATCH



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COLLEGE OF ENGINEERING (AUTONOMOUS) :: PULIVENDULA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

PULIVENDULA – 516390, Y.S.R. (DIST), ANDHRA PRADESH, INDIA

M.Tech I Semester

S.NO	Course code	Subject Name	Theory/Tutorial	Drawing/Lab	Credits
1.	13D38101	Structural Digital System Design	4		4
2.	13D38102	Advanced Computer Networks.	4		4
3.	13D38104	Digital Communication Techniques	4		4
4.	**13D38105** 13D38103 13D38106	**Elective-I** a. Advanced operating Systems b. Mobile Networks c. Transform Techniques	4		4
5.	**13D38110** **13D38111** 13D38107	**Elective-II** a. Nano Electronics b. Secured Communications c. Adaptive Signal Processing	4		4
6.	13D38108	Structural Digital System Design Lab		3	2
7.	13D38109	Networking Lab		3	2
		Contact periods/week	20	6	
			Total/week	26	
		Total Credits (5 Theory + 2 Labs)			24

M.Tech II Semester

S.NO	Course code	Subject Name	Theory/Tutorial	Drawing/Lab	Credits
1.	13D38201	Image & Video Processing	4		4
2.	13D38202	Detection and Estimation Theory	4		4
3.	13D38203	Wireless Communications	4		4
4.	13D38204	**Elective-III** a. Embedded System Design b. Fuzzy Systems and Neural Networks c. Wireless Sensor Networks	4		4
5.	13D38207	**Elective-IV** a. Speech Processing b. Software Define Radio c. Multimedia Communications	4		4
6.	13D38210	Advanced Communications Lab		3	2
7.	13D38211	Image & Video Processing Lab		3	2
	Contact periods/week		20	6	
	Total/week		26		
	Total Credits (5 Theory + 2 Lab)		24		

M.Tech III & IV SEMESTERS

Name of the Subject	**No. of credits**
SEMINAR	
PROJECT REVIEW SEMINAR	
PROJECT WORK	

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DECS I-I SEMESTER

STRUCTURAL DIGITAL SYSTEM DESIGN

Course Objectives:

- To study about structural functionality of different Digital blocks (Both combinational and Sequential)
- To provide an exposure to ASM charts, their notations and their realizations.
- To provide an exposure to VHDL and different styles of modelling using VHDL.
- To introduce concept of micro programming and study issues related to micro programming

Learning Outcomes:

After Completion of this course students will be able to

- Understand structural functionality of different digital blocks
- Represent and Realize their designs in ASM charts
- Represent their designs in different modelling styles by using VHDL
- Understand concept of Micro program and issues related to micro programming

UNIT-I

COMBINATIONAL CIRCUIT BUILDING BLOCKS: Multiplexers, Demultiplexers, Encoders, Decoders, Comparators, Adders, ALU, Carry lookAhed adder.

SEQUENTIAL CIRCUIT BUILDING BLOCKS: Flipflops, registers, Memory elements, Shift Registers, Sequence Generators, Timing Generators.

UNIT-II

MODELLING WITH HDL:

Introduction to VHDL/Verilog, Modelling Styles in VHDL/Verilog (Data Flow, Behavioral, Structural and Mixed style modelling using HDL).

SYSTEM DESIGN METHODOLOGY:

Finite State Machine, RTL Design, Realization and implementation of Dice Game, Micro Programming, Linked State machines, RTL Implementation Options.

UNIT-III

DESIGN OF COMBINATIONAL LOGIC:

BCD to 7-Segment Display decoder, BCD Adder, Arithmetic and Logic Unit (ALU), State graphs for control circuits, score board and controller, Synchronization and debouncing,A Shift and Add Multiplier, Array Multiplier, Booth Multiplier.

UNIT-IV

DESIGN OF SEQUENTIAL LOGIC:
Design Procedure for sequential circuits, Design Example- code Converter, Design of Iterative circuits, Design of sequential circuits using ROMs and PLAs, sequential circuit design using CPLD, FPGAs, Reduction of state and Flow Tables, Race-Free State Assignment Hazards.
Design Examples: UART, Traffic Light Controller

UNIT-V

HARDWARE TESTING AND DESIGN FOR TESTABILITY: Testing combinational Logic, Testing sequential Logic, Scan Testing, Boundary Scan, Built in Self Test.

Text Books:
1. Charles H.Roth jr, Lizy Kurian John, "Digital System Design Using VHDL", CENGAGE Learning, 2013.
2. Ming-Bio Lin, "Digital System Design and Pratices using Verilog HDL and FPGAs" , Willey India Edition, 2012.

References:
1. Charles H. Roth,Jr., "Fundamentals of Logic Design", 5th edition, CENGAGE Learning, 2012.
2. Z. Kohavi , "Switching & finite Automata Theory" ,TMH.

3.Michael D. Cilleti, "Advanced Digital Design with Verilog HDL", PHI, 2013.

4. William Fletcher, An Engineering Approach to Digital Design, 1st Edition, Prentice-Hall India, 1997.
5. William J Dally and John W Poulton, Digital Systems Engineering, Cambridge University Press, 2008.

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DECS I-I SEMESTER

ADVANCED COMPUTER NETWORKS

Course Objectives:

- To study about different protocols related to advanced computer networks such as wireless Lans, Wimax and so on.
- To study about security features associated with different advanced computer networks.

Learning Outcomes:

After completion of this course students will be able to

- Know the functioning different protocols associated with modern computer network system
- Know the security features associated with modern computer network system.

UNIT-I

Review of data communication standards, topologies, OSI, TCP/IP models, Transmission media, circuit switched networks, packet switched networks, Point to Point Protocol (PPP), Asymmetric Digital Subscriber Line (ADSL)

UNIT-II

Fast Ethernet, Gigabit Ethernet, Wireless LANs, Bluetooth, WiMax, Virtual LANs,

UNIT-III

Advanced Network Architectures - SONET/SDH, Frame Relay and ATM architectures and services, VPN architectures, IP over ATM, MPLS, RSVP

UNIT-IV

IPv6 protocol, Socket interface, Domain Name System, Simple Mail Transfer Protocol, WWW and HTTP, Simple Network Management Protocol

UNIT-V

Voice Over IP, Cryptography, Network security, Digital Signatures, IPSec, Firewalls,

Text Books :

1. BEHROUZ A. FOROUZAN, “Data Communications and Networking”, 4th Ed, Tata McGraw-Hill, New Delhi, 2006
2. LEON-GARCIA, INDRA WIDJAJA, “Communication Networks – Fundamental concepts and Key architectures”, TMH, 2000

Reference:

1. Jim Kurose, Keith Ross, “Addison *Computer Networking: A Top Down Approach”,* 4th edition, Wesley, July 2007.
2. Andrew S. Tanenbaum “Computer Networks”, 4th Edition, Pearson Education, 2008
3. William Stallings, “Data and Computer Communication”, 9th edition, Prentice hall, 2010

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DECS I-I SEMESTER

DIGITAL COMMUNICATION TECHNIQUES

Course Objectives:

- To study about base band signal concepts and different equalizers.
- To study in detail about coherent detection schemes such as ASK, FSK, PSK
- To study in detail about M'ary signalling schemes like QPSK, QAM, MSK.

Learning Outcomes:

- Students will be aware of base band signal concepts and different equalizers.
- Students will be able to get complete knowledge regarding coherent detection schemes like ASK, FSK, PSK.
- Students will be able to design M'ary signalling schemes like QPSK, QAM, MSK

UNIT I

Review of Random Variables and Random Processes:
Random variable, Moment generating function, Markov's inequality, Chebyshev's inequality, Central limit theorem, Different distributions – Gaussian, Poisson, Chi square, Rayleigh, Rician; Correlation - Auto-correlation, Cross correlation, Correlation matrix; Stationary processes, Wide sense stationary processes, Gaussian & Ergodic processes, Problem solving.

UNIT II

Baseband Signal Concepts:
Baseband data transmission, Nyquist criterion for zero ISI, Correlative level coding, Data Detection, Optimum design of transmit and receive filters, Equalization - Linear, adaptive, fractionally spaced and decision feedback equalizers.

UNIT III

Digital Modulation Schemes:
Detection using matched filter – Optimum receivers for arbitrary binary signals and M'ary Orthogonal signals, Analysis of coherent detection schemes for ASK, PSK and DPSK, M'ary signalling schemes – QPSK, QAM, MSK, Performance of the data transmission schemes under AWGN. Trellis coded Modulation.

UNIT IV

Synchronization:

Receiver synchronization, costas loop, symbol synchronization, synchronization with CPM – data aided and Non aided synchronization- synchronization methods based on properties of wide sense cyclo-stationary random process – Carrier recovery circuits – Symbol clock estimation schemes.

UNIT V

Spread Spectrum Systems:

PN sequences, Generation of PN sequences, DS spread spectrum systems, FH spread spectrum systems and performance of DSSS & FHSS in AWGN – Synchronization – Jamming considerations – Commercial Applications, Cellular subsystems.

Text Books:

1. J.G.Proakis, Digital Communication (4/e), McGraw- Hill, 2001

2. Bernard Sklar, "Digital Communications – Fundamentals &Applications,"Prentice Hall, 2001.

Reference Books:

1. S.Haykin, Communication Systems (4/e), Wiley,2001.

2. R.E.Zimer & R.L.Peterson : Introduction to Digital Communication, PHI, 2001.

3. G. R. Cooper & C. D. Mc Gillem, "Modern Communications & Spread Spectrum,"McGraw Hill, 1986.

4. L.Hanzo etal, Turbo Coding, Turbo Equalization & Space-Time Coding Wiley,2002.

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DECS I-I SEMESTER

ADVANCED OPERATING SYSTEMS
(ELECTIVE I)

Course Objectives:

- To Study in detail about kernel structures associated with various Operating systems
- To Study in detail about various systems calls, statements and their arguments associated with Unix .
- To Study in detail about various systems calls, statements and their arguments associated with Linux .

Learning Outcomes:

After completion of the course students will be able to

- Get complete knowledge regarding different types of operating systems and their Kernel structures.
- To work effectively on Unix Platform
- To work effectively on Linux Platform

UNIT I

INTRODUCTION

General Overview of the System : History – System structure – User perspective – Operating system services – Assumptions about hardware. Introduction to the Kernel : Architecture of the UNIX operating system – Introduction to system concepts. The Buffer Cache: Buffer headers – Structure of the buffer pool – Scenarios for retrieval of a buffer – Reading and writing disk blocks – Advantages and disadvantages of the buffer cache.

UNIT II

UNIX I*:* Overview of UNIX system, Structure, files systems, type of file, ordinary & Special files, file permissions, Introduction to shell.UNIX basic commands & command arguments, Standard input / output Input / output redirection, filters and editors, System calls related file structures, input / output process creation & termination.

UNIT III

INTERPROCESS COMMUNICATION IN UNIX: Introduction, file and record locking, Client – Server example, pipes, FIFOs, Streams & Messages, Name Speces, Systems V IPC, Message queues, Semaphores, Shared Memory, Sockets & TLI.

UNIT IV

INTRODUCTION TO NETWORKS AND NETWORK PROGRAMMING IN UNIX: Network Primer, TCP/IP, Internet Protocols, Socket Programming, Introduction & overview, UNIX domain protocols, Socket Addresses, Elementary Socket system calls, Simple examples.

UNIT V

LINUX: Introduction to LINUX System, Editors and Utilities, Type of Shells, Shell Operations, File structure, File Management, Operations. Memory Management Policies: Swapping – Demand paging. The I/O Subsystem: Driver Interface – Disk Drivers – Terminal Drivers– Streams – Inter process communication.

TEXT BOOKS:

1. Maurice J.Bach, “The design of the UNIX Operating Systems”, PHI
2. Kernighan & Pike, “The UNIX Programming Environment”, PHI

REFERENCES:

1. W.Richard Stevens, “UNIX Network Programming”, PHI, 1998.
2. Richard Peterson, “The Complete reference LINUX”, TMH
3. Ritchie & Yates, “UNIX User Guide”.

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DECS I-I SEMESTER

MOBILE NETWORKS
(ELECTIVE I)

Course Objectives:

- To study different wireless communication systems
- To study in detail about different multiples accessing schemes
- To study about different architectures in mobile networks such as wireless LAN, Hyper LAN and so on
- To study about dynamic routing and different routing protocols employed in mobile networks

Learning Outcomes:

After completion of the course the student will be able to

- Gain complete knowledge regarding different wireless communication systems.
- Gain complete knowledge regarding different multiples accessing schemes.
- Know the architectures of different mobile networks such as wireless LAN , Hyper LAN and so on
- Know about different routing mechanisms by employing different routing protocols.

UNIT-I

Wireless communication standards, Cellular communications, GSM protocol architecture,, 3G mobile wireless systems, Beyond 3G

UNIT - II

Multiple Access Techniques - GDMA, TDMA, CDMA, Mobile Data Networks - CDPD, GPRS

UNIT-III

Wireless LAN architecture, physical & MAC layers, Wireless ATM architecture, HIPERLAN, Wireless Personal Area (WPAN) networks - Home RF, Bluetooth.

UNIT-IV

Mobility management in Wireless Networks, Handoff management, Location management , Mobile IP, TCP Wireless Application Protocol

UNIT - V

Mobile Adhoc Networks, Dynamic routing, Route discovery, Routing protocols, Mobile Multimedia Adhoc Networks, MPLS

Text Books:

1. JW Mark **,** W Zhuang, "Wireless communications & Networking", PHI, 2005
2. Kaveh Pahlavan, Prashant Krishnamurthy, "Principles of Wireless Networks", PHI, 2010
3. George Aggelou, "Mobile Adhoc Networks", TMH, 2009.

References:

1. William Stallings, "Wireless Communications and Networks", Prentice Hall, 2004.
2. Siva Ram Murthy C. and Manoj B. S., "Ad Hoc Wireless Networks: Architectures and Protocols", 2nd Edn. Pearson Education 2005.
3. Toh C. K., "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR, 2001.
4. Yi-Bing and Imrich Chlamtac, "Wireless and Mobile Networks Architectures", John Wiley & Sons, 2001.

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DECS I-I SEMESTER

TRANSFORM TECHNIQUES
(ELECTIVE I)

Course Objectives:

- Study of different types of transforms which can be applicable for different types of signals.
- To study the application of wavelets for different types of signals.
- To study the applications of Multi rate systems and filter banks.

Learning Outcomes:

After completion of the course the student will be able to

- Use different 1-d and 2-d transforms for different signals.
- Apply wavelet transforms for different signals and will be able to appreciate its differences with other transformations.
- Use different advanced transforms such as DCT, DWT and KLT for different applications like signal de noisy, sub band coding of speech and music and signal compression.

UNIT I:

REVIEW OF TRANSFORMS: Signal spaces, concept of convergence, Hilbert spaces for energy signals, Orthogonality, Ortho normality, Fourier basis, FT-failure of FT-need for time-frequency analysis, spectrogram plot-phase space plot in time-frequency plane, Continuous FT, DTFT, Discrete Fourier Series and Transforms, Z-Transform.

ADVANCE TRANSFORMS

Relation between CFT-DTFT, DTFT-DFS, DFS-DFT, DCT (1D&2D), Walsh, Hadamard, Haar, Slant, KLT, Hilbert Transforms – definition, properties and applications.

UNIT II:

CWT & MRA: Time-frequency limitations, tiling of time-frequency plane for STFT, Heisenberg uncertainty principle, Short time Fourier Transform (STFT) analysis, short comings of STFT.

NEED FOR WAVELETS: Wavelet Basis- Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT.

UNIT III:

NEED FOR SCALING FUNCTION: Multi resolution analysis, Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat Meyer, Shannon, Daubechies.

SPECIAL TOPICS: Wavelet Packet Transform, Bi-orthogonal basis- B-splines, Lifting Scheme of Wavelet Generation-implementation.

UNIT IV:

MULTIRATE SYSTEMS, FILTER BANKS AND DWT: Basics of Decimation and Interpolation in time & frequency domains, Two-channel Filter bank, Perfect Reconstruction Condition, Relationship between Filter Banks and Wavelet basis, DWT Filter Banks for Daubechies Wavelet Function.

UNIT V:

APPLICATIONS OF TRANSFORMS: Signal De-noising, Sub-band Coding of Speech and Music, Signal Compression - Use of DCT, DWT, KLT.

TEXT BOOKS:

1. Jaideva C Goswami, Andrew K Chan, "Fundamentals of Wavelets- Theory, Algorithms and Applications", John Wiley & Sons, Inc, Singapore, 1999.
2. Raghuveer M.Rao and Ajit S. Bopardikar, "Wavelet Transforms-Introduction theory and applications" Pearson edu, Asia, New Delhi, 2003.
3. Soman.K.P, Ramachandran K.I, "Insight into Wavelets from Theory to practice", Printice Hall India, First Edition, 2004.

REFERENCES:

1. Vetterli M. Kovacevic, "Wavelets and sub-band coding", PJI, 1995.
2. C. Sydney Burrus, "Introduction to Wavelets and Wavelet Transforms", PHI, First Edition, 1997.
3. Stephen G. Mallat, "A Wavelet Tour of Signal Processing", Academic Press, Second Edition,
4. Jayaraman, "Digital Image Processing", TMH,2009
5. S.Jayaraman, S.Esakkirajan, T.Veera Kumar, "Digital Image Processing", TMH,2009

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DECS I-I SEMESTER

NANO ELECTRONICS
(ELECTIVE II)

Course Objectives:

- To study about different quantum devices
- To study in detail about nano devices and nano architectures and their computations
- To study about Molecular nano Electronics

Learning Outcomes:

After completion of the course the student will be able to

- Gain complete knowledge regarding different Quantum Devices.
- Know about nano devices and nano architectures and their computations.
- Know about Molecular Nano Electronics

UNIT – I: Quantum Devices:
Charge and spin in single quantum dots- Coulomb blockade – Electrons in mesoscopic structures - single electron transfer devices (SETs) – Electron spin transistor – resonant tunnel diodes, tunnel FETs - quantum interference transistors (QUITs) - quantum dot cellular automata (QCAs) - quantum bits (qubits).

UNIT – II: Nano Electronic Devices:
Electronic transport in 1,2 and 3 dimensions- Quantum confinement - energy subbands - Effective mass - Drude conduction - mean free path in 3D - ballistic conduction - phase coherence length - quantized conductance - Buttiker-Landauer formula- electron transport in pn junctions - short channel NanoTransistor –MOSFETs - Advanced MOSFETs - Trigate FETs, FinFETs - CMOS.

UNIT – III: Molecular NanoElectronics:
Electronic and optoelectronic properties of molecular materials - Electrodes & contacts – functions – molecular electronic devices - elementary circuits using organic molecules- Organic materials based rectifying diode switches – TFTs- OLEDs- OTFTs – logic switches.

UNIT – IV: Spintronics:
Spin tunneling devices - Magnetic tunnel junctions- Tunneling spin polarization - Giant tunneling using MgO tunnel barriers - Tunnel-based spin injectors - Spin injection and spin transport in hybrid nanostructures - spin filters -spin diodes - Magnetic tunnel transistor - Memory devices and sensors - ferroelectric random access memory- MRAMS -Field Sensors - Multiferro electric sensors- Spintronic Biosensors.

UNIT – V: NanoElectronic Architectures & Computations:

Architecture Principles: Mono and Multi processor systems – Parallel data processing – Power Dissipation and Parallelism – Classic systolic arrays - Molecular devices-properties - Self-organization – Size dependent -limitations. Computation: Monte Carlo Simulations-Computational methods and Simulations from ab initio to multiscale Modeling- Modeling of Nanodevices.

Text Books:

1. V. Mitin, V. Kochelap, M. Stroscio, "Introduction to Nanoelectronics," Cambridge University Press, 2008.
2. Rainer Waser, "Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices," Wiley-VCH, 2003.

References:

1. Karl Goser, Peter Glosekotter, Jan Dienstuhl, "Nanoelectronics and Nanosystems," Springer, 2004.
2. Sadamichi Maekawa, "Concepts in Spin Electronics," Oxford University Press, 2006.
3. L. Banyai and S.W.Koch, "Semiconductor Quantum Dots," World Scientific, 1993.
4. Edward L. Wolf, "Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience," Wiley-VCH, 2006.

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DECS I-I SEMESTER

SECURED COMMUNICATIONS
(ELECTIVE II)

Course Objectives:

- To study security and different types of attacks.
- To study about different techniques associated with encryption.
- To study about different algorithms associated with security.
- To study about IP security architecture and designing issues related to fire walls.

Learning Outcomes:

After completion of this course students will be able to know

- The need and role of security.
- Gain knowledge about different techniques associated with encryption.
- Functioning of different algorithms associated with security.
- Gain knowledge regarding IP security architecture and designing issues related to fire walls.

UNIT-I

Information security, Types of attacks, Info security services - Confidentiality, Integrity, Availability, security process - assessment, Implement security, training

UNIT - II

Security technologies - Firewalls, VPNs ; Encryption - Private Key Encryption, Public key encryption, Key management; Concepts of intrusion detection.

UNIT-III

Message authentications and Hash functions, Digital signatures, e-mail security, IP security architecture, Web security

UNIT-IV

Authentication and authorization in WLANs -802.1X authentication, RADIUS protocol; Extensible Authentication protocol, Transport Layer Security and certificates

UNIT - V

Data protection in WLANs - WEP, 802.11i security, RSNA, CCMP, TKIP, wireless roaming security, WMAN security.

Text Books:

1. Eric Maiwald**, "**Fundamental of Network Security", Dreamtech press Osborne MGH, 2004
2. W. Stallings, "Cryptography & Network Security", 3/e, PHI 2003
3. Thomas Hardjono , RD Lakshminath**, "**Security in Wireless LAN & MAN", Artech House, 2005

References:

1. Roger J. Sutton, "Secure Communications: Applications and Management", WILEY,2002.
2. Don J. Torrieri, "Principles of secure communication systems", 2nd Eedition, ArtechHouse Publishers, 1992.
3.Cryptography and secure Communications by M.Y. Rhee, Mc Graw Hill

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DECS I-I SEMESTER

ADAPTIVE SIGNAL PROCESSING
(ELECTIVE II)

Course Objectives:

- To study in detail about adaptive Systems.
- To study about various Linear optimum filtering techniques.
- To study about various techniques related Linear and Non Linear adaptive filtering.

Learning outcomes:

After the course students is expected to be able to:

- Get complete knowledge regarding adaptive systems
- Design various Linear optimum filters by employing different techniques associated with them
- Understand various techniques related to with Linear and Non linear adaptive filtering and their design considerations

Unit I:

Introduction to Adaptive Systems: *Eigen Analysis* - Eigen Value problem, Properties of eigen values and eigen vectors, Eigen filters, Eigen value computations, *Adaptive Systems* - Definitions, Characteristics, Applications and Examples of Adaptive systems, The adaptive linear combiner – Description, weight vectors, Desired response performance function, Gradient and Mean square error(MSE).

Unit II:

Linear Optimum Filtering: *Wiener Filters* – Linear optimum filtering, Principle of Orthogonality, Wiener-Hopf equations, Error performance surface, Channel Equalization, Linearly constrained minimum variance filter, *Linear Prediction* – Forward and Backward linear prediction, Levinson-Durbin Algorithm, Properties of prediction error filters, AR modeling of stationary stochastic process, Lattice predictors, Joint process estimation, *Kalman Filters* - Recursive mean square estimation for scalar random variables, Kalman filtering problem, The innovations process, Estimation of the state using innovations process, Filtering, Initial conditions, Variants of the Kalman filter, Extended Kalman filter, Problem Solving.

Unit III:

Linear Adaptive Filtering-I: Method of Steepest descent algorithm and its stability, *Least Means Square (LMS) algorithm* – Structure & operation of LMS algorithm, Examples, Stability & performance analysis of the LMS algorithm, Simulations of Adaptive equalization using LMS algorithm, Convergence aspects, *Method of Least Squares (LS)* - Statement, Data windowing, Minimum sum of error squares, Normal equations and linear least squares filters, Properties.

Unit IV

Linear Adaptive Filtering-II *Recursive Least Squares (RLS) Algorithm* – Matrix inversion lemma, The exponentially weighted RLS algorithm, Update recursion for the sum of weighted error squares, Example, Convergence Analysis, Simulation of adaptive equalization using RLS algorithm, *Order Recursive Adaptive Filters* – Adaptive forward and backward linear prediction, Least squares Lattice predictor, QR-Decomposition based Least squares Lattice filters & their properties, Simulation of Adaptive equalization using Lattice Filter.

Unit V:

Non linear Adaptive Filtering: *Blind deconvolution* – Theoretical and practical considerations, Bussgang algorithm for blind equalization for real base band channels, Special cases of Bussgang algorithm, Simulation studies of Bussgang algorithms, Problem solving.

Text Books:

1. Simon Haykin, "Adaptive Filter Theory," Prentice Hall, 4th Edition, 2002.
2. Bernard Widrow, Samuel D. Strearns, "Adaptive Signal Processing," Prentice Hall, 2005.

References:

1. Paulo S.R. Diniz, Adaptive Filtering Algorithms and Practical Implementation, Third Edition,Springer, Kluwer Academic Publishers.
2. Alexander D Poularikas, Zayed M Ramadan, Adaptive Filtering Primer with MATLAB, CRC Press Taylor & Francis Group, 2008 Indian Edition.
3. Ali H. Sayed, Adaptive filters, IEEE Press, Wiley-Interscience, A john Wiley & Sons, INC.,Publication.
4. S. Thomas Alexander, "Adaptive Signal Processing-Theory & Applications," Springer – Verlag, 1986

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DECS I-I SEMESTER

STRUCTURAL DIGITAL SYSTEM DESIGN LAB

Objectives:

- To understand about VHDL and Verilog Programming in all available styles.
- To understand differences between Verilog and VHDL.
- To represent the different digital blocks in verilog and VHDL in all available styles of modelling

Learning Out Comes:

After completion of this course the students will be able to understand

- Different modelling styles available in VHDL and Verilog and difference between them
- Difference between verilog and VHDL
- Representation of different digital modules in different modelling styles available in VHDL and Verilog

Using VHDL and Verilog do the following experiments

1. Design of 4-bit adder / subtractor
2. Design of Booth Multiplier
3. Design of 4-bit ALU
4. Design 32-bit ALU using ripple carry and carry look-ahead logic
5. Design of counters and shift registers
6. Design of MIPS processor
7. Design of Washing machine controller
8. Design of Traffic Light Controller
9. Mini project

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DECS I-II SEMESTER

IMAGE AND VIDEO PROCESSING (13D38201)

Course Objectives:

- To understand different transforms related to gray scale and color images.
- To get complete knowledge regarding different techniques associated with Image Enhancement, Image Restoration, Image Segmentation and Image Compression.
- To get clear knowledge regarding motion estimation, video filtering and video standards

Learning Outcomes:

After completion of this course the students will be able to

- Different transforms related to gray scale and color images.
- Complete knowledge regarding different techniques associated with Image Enhancement, Image Restoration, Image Segmentation and Image Compression.
- Understand basic concepts regarding to motion estimation, video filtering and video standards.

UNIT I

IMAGE FUNDAMENTALS & TRANSFORMS: Gray scale and colour Images, image sampling and quantization. Two dimensional orthogonal transforms: DFT, WHT, Haar transform, KLT, DCT.

UNIT II

IMAGE ENHANCEMENT: Filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Edge detection, non parametric and model based approaches, LOG filters, localization problem.

IMAGE RESTORATION: Degradation Models, PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.

UNIT III

IMAGE SEGMENTATION: Pixel classification, Bi-level Thresholding, Multi-level Thresholding, P-tile method, Adaptive Thresholding, Spectral & spatial classification, Edge detection, Hough transform, Region growing.

UNIT IV

IMAGE COMPRESSION: Compression models, Information theoretic perspective, Fundamental coding theorem. Huffman Coding, Arithmetic coding, Bit plane coding, Run length coding, Lossy compression: Transform coding, Image compression standards.

UNIT V

VIDEO PROCESSING: Representation of Digital Video, Spatio-temporal sampling, Motion Estimation. Video Filtering, Video Compression, Video coding standards.

References:

1. R. C. Gonzalez, R. E. Woods,"Digital Image Processing", Pearson Education. 2nd edition,2002
2. W. K. Pratt, "Digital image processing", Prentice Hall, 1989
3. Rosenfold and A. C. Kak, "Digital image processing", Vols. 1 and 2, Prentice Hall, 1986.
4. H. C. Andrew and B. R. Hunt, "Digital image restoration", Prentice Hall, 1977
5. R. Jain, R. Kasturi and B.G. Schunck, "Machine Vision", McGraw-Hill International Edition, 1995
6. M. Tekalp, "Digital Video Processing", Prentice-Hall, 1995
7. Bovik, "Handbook of Image & Video Processing", Academic Press, 2000

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DECS I-IISEMESTER

DETECTION AND ESTIMATION THEORY (13D38202)

Course Objectives:

1. To provide knowledge about various estimation, and detection techniques.
2. To analyze different methods & to detect and estimate the signal from noisy signal.
3. Estimate and detect the signals in the presence of noise.

Learning Outcomes:

1. The students will be able to apply various methods of signal estimation knowing the significance of each method.
2. The students will be able to know Cramer-Rao Lower bound in estimating a signal.
3. By applying suitable criterion the students will be able to detect the signals with minimum errors in the presence of noise.

UNIT - I

Introduction to Estimation and Detection:

Introduction, Detection and Estimation in Signal Processing, the Mathematical Detection& Estimation problem, Assessing Estimator Performance, Hierarchy of detection problems, Role of asymptotics.

Estimation

UNIT - II

Minimum Variance Unbiased Estimation:

Unbiased Estimators, Minimum Variance Criterion, Existence of the minimum Variance Unbiased Estimator, Finding the Minimum Variance Unbiased Estimator,

Cramer-Rao Lower Bound - Estimator of Accuracy Considerations, Cramer-Rao Lower Bound (CRLB), General CRLB for Signals in White Gaussian Noise, Transformation of Parameters, Extension to a Vector Paramter, Vector Parameter CRLB for Transformations, CRLB for the general Gaussian case,

Linear Models -Definition and Properties, Linear Model Examples, Extension to the Linear Model,

General Minimum Variance Unbiased Estimation: Introduction, Sufficient Statistics, Finding Sufficient Statistics.

UNIT - III

Best Linear Unbiased Estimators:

Definition of BLUE, Finding the BLUE, Extension to Vector Parameter,

Estimation Methods - Maximum Likelihood Estimation (MLE), Finding MLE, Properties of MLE, MLE for Transformed Parameters, Numerical Determination of the MLE, Extension to a Vector Parameter, The Least Squares Approach, Linear Least Squares, Method of Moments, Extension to a Vector Parameter, Statistical Evaluation of Estimators.

The Basian Philosophy - Prior Knowledge and Estimation, Choosing a Prior PDF, Properties of Gaussian PDF, Basian Linear Model, Minimum Mean Square Error (MMSE) Estimators, Maximum A Posteriori Estimators, Performance Description, Linear Basian Estimators – Introduction, Linear MMSE Estimation, Geometrical Interpretations, The Vector LMMSE Estimator.

Detection

UNIT - IV

Statistical Decision Theory I:

Introduction, Neyman-Pearson Theorem, Receiver Operating Characteristics, Minimum Probability of Error, Bayes Risk, Multiple Hypothesis Testing,

Deterministic Signals - Matched Filters, Development of Detector, Performance of Matched Filter, Performance of Generalized Matched Filters, Multiple Signals – Binary Case and its performance, M-ary Case, Linear Model, **Random Signals**– EstimatorCorrelator, Linear Model.

UNIT - V

Statistical Decision Theory II:

Introduction, Summary of Composite Hypothesis, Composite Hypothesis Testing (CHT),

CHT approaches – Bayesian Approach, Generalized Likelihood Approach, Performance of GLRT for Large Data Records, Equivalent Large Data Records Tests.

References:

1. Steven M. Kay, "Fundamentals of Statistical Signal Processing – Estimation Theory," Pearson, 2010.
2. Steven M. Kay, "Fundamentals of Statistical Signal Processing – Detection Theory," Pearson, 2010.
3. Shanmugam and Breipohl, "*Detection of Signals in Noise and Estimation*,"John Wiley& Sons, 2004.
4. Mischa Schwartz, L.Shaw, "Signal Processing: Discrete Sprectral Analysis, Detection, and Estimation," McGraw Hill.

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

WIRELESS COMMUNICATIONS (13D38203)

Course Objectives:

- To understand basics of Wireless Communications and its evolution process.
- To learn about the mechanism of radio mobile propagation and its effects.
- To understand various types of diversity and equalization techniques to counter balance the effects of Wireless Channel.
- To Study about importance of Wireless Networking and multiple access techniques in the present day mobile communications
- To design and analyze mobile systems using OFDM technology for mitigating the ISI effects at higher data rates.

Learning Outcomes*:*

After completion of this course the students will be able to

- Understand basics of Wireless Communications and its evolution process.
- Know about the mechanism of radio mobile propagation and its effects.
- Apply various types of diversity and equalization techniques to counter balance the effects of Wireless Channel.
- Recognize the importance of Wireless Networking and multiple access techniques in the present day mobile communications
- Analyze and design mobile systems using OFDM technology for mitigating the ISI effects at higher data rates.

UNIT – 1

INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS& CELLULAR CONCEPT:

Evolution of Mobile Radio Communication Systems, Examples of Wireless Communication Systems, 1G, 2G, 2.5G, and 3G Wireless Cellular Networks and Standards, Frequency Reuse Concept, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems, Problem Solving.

UNIT - 2

MOBILE RADIO PROPAGATION:

Large Scale Path Loss: Introduction, Free Space Propagation Model, *Propagation Mechanisms* – Reflection, Diffraction, and Scattering, Practical Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models.

Small Scale Fading and Multipath: Small Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small Scale Multipath Measurements, Parameters of Mobile Channels, Types of Small Scale Fading (all variations*), Statistical Models* – Clarke's Model for Flat Fading, Jake's Model, Level Crossing Rate, Simulation of Clarke's/Jake's Model, Two Ray Rayleigh Fading Model, Problem Solving.

UNIT -3

EQUALIZATION & DIVERSITY TECHNIQUES:
Equalization: Survey of Equalization Techniques, Linear and Non-linear Equalizers – Linear Transversal Equalizer, Decision Feedback Equalizer (DFE), Algorithms for Adaptive Equalization – Zero Forcing, LMS, RLS, Fractionally Spaced Equalizers.
Diversity Techniques: Realization of Independent Fading Paths, *Receiver Diversity* – System Model, Selection Combining, Threshold Combining, Maximal Ratio Combining, Rake receiver, Equal Gain Combining, *Transmit Diversity*–Channel known at Transmitter, Channel unknown at Transmitter – the Alamouti Scheme, analysis.

UNIT - 4

MULTIPLE ACCESS TECHNIQUES & NETWORKING:
Introduction to Multiple Access: FDMA, TDMA, CDMA, SDMA, Packet Radio, Capacity of Cellular Systems, Problem Solving.
Introduction to Wireless Networking: Introduction to Wireless Networks, Differences between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling.

UNIT - 5

MULTICARRIER MODULATION:
Data Transmission using Multiple Carriers, Multicarrier Modulation with Overlapping Subchannels, Discrete Implementation of Multicarrier Modulation, The Cyclic Prefix, Orthogonal Frequency Division Multiplexing (OFDM), Matrix Representation of OFDM, Vector Coding, Challenges in Multicarrier Systems, Problem Solving.

References:

1. T. S. Rappaport, "Wireless Communications, Principles and Practice," Prentice Hall, 2nd Edition, 2002.
2. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.
3. David Tse, PramodViswanath, "Fundamentals of Wireless Communications," Cambridge University Press, 2006.
4. Dr. KamiloFeher, "Wireless Digital Communications," Prentice Hall, 1995.

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

EMBEDDED SYSTEM DESIGN (13D38204A)
(ELECTIVE - III)

Course Objectives:

- To study about current technologies, integration methods and hardware and software design concepts associated with processor in Embedded Systems.
- To study about different types of memory and memory management schemes and various interfacing devices related to design of an Embedded System
- To get detail knowledge regarding testing and hardware software co- design issues pertaining to design of an Embedded System

Learning Outcomes:

After completion of this course the students will be able to understand

- Gets clear knowledge regarding current technologies and issues relating to hardware and software design concepts associated with processor in Embedded Systems.
- Get complete knowledge pertaining to different types of memory and memory management schemes and various interfacing devices related to design of an Embedded System.
- Different techniques related to testing and hardware software co- design issues pertaining to design of an Embedded System.

UNIT-I: Introduction

An Embedded System-Definition, Examples, Current Technologies, Integration in system Design, Embedded system design flow, hardware design concepts, software development, processor in an embedded system and other hardware units, introduction to processor based embedded system design concepts.

UNIT-II: Embedded Hardware

Embedded hardware building blocks, Embedded Processors – ISA architecture models, Internal processor design, processor performance, Board Memory – ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and performance.

Embedded board Input / output – Serial versus Parallel I/O, interfacing the I/O components, I/O components and performance, Board buses – Bus arbitration and timing, Integrating the Bus with other board components, Bus performance.

UNIT-III: Embedded Software

Device drivers, Device Drivers for interrupt-Handling, Memory device drivers, On-board bus device drivers, Board I/O drivers, Explanation about above drivers with suitable examples.

Embedded operating systems – Multitasking and process Management, Memory Management, I/O and file system management, OS standards example – POSIX, OS performance guidelines, Board support packages, Middleware and Application Software – Middle ware, Middleware examples, Application layer software examples.

UNIT-IV: Embedded System Design, Development, Implementation and Testing

Embedded system design and development lifecycle model, creating an embedded system architecture, introduction to embedded software development process and tools- Host and Target machines, linking and locating software, Getting embedded software into the target system, issues in Hardware-Software design and co-design.

Implementing the design-The main software utility tool, CAD and the hardware, Translation tools, Debugging tools, testing on host machine, simulators, Laboratory tools, System Boot-Up.

UNIT-V: Embedded System Design-Case Studies

Case studies- Processor design approach of an embedded system –Power PC Processor based and Micro Blaze Processor based Embedded system design on Xilinx platform-NiosII Processor based Embedded system design on Altera platform-Respective Processor architectures should be taken into consideration while designing an Embedded System.

References:

1. Tammy Noergaard, “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier (Singapore) Pvt.Ltd.Publications, 2005.
2. Frank Vahid, Tony D. Givargis, “Embedded system Design: A Unified Hardware/Software Introduction”, John Wily & Sons Inc.2002.
3. Peter Marwedel, “Embedded System Design”, Science Publishers, 2007.
4. Arnold S Burger, “Embedded System Design”, CMP.
5. Rajkamal, “Embedded Systems: Architecture, Programming and Design”, TMH Publications, Second Edition, 2008.

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

FUZZY SYSTEMS AND NEURAL NETWORKS (13D38204B)
(ELECTIVE - III)

Course Objectives:

- To analyze basic neural computational models.
- To get in detail knowledge regarding different algorithms related to neural learning
- To study about different issues related probability and fuzziness and different types of fuzzy associative memories.

Learning Outcomes:

After completion of this course the students will be able to

- Understand functioning of basic neural computational models.
- Get complete knowledge regarding different algorithms related to neural learning
- Understand about different issues related probability and fuzziness and different types of fuzzy associative memories.

UNIT-I

BASIC NEURAL COMPUTATIONAL MODELS: Basic concepts of Neural Nets, Inference and learning , Classification models (single layer Perceptrons, multi layer perceptrons), Association models (Hop field Nets, Bidirectional associative memories)

UNIT - II

Supervised and Unsupervised learning; Statistical learning; Neural Network learning (Back propagation, Radial basis Function Networks, ART Networks)

UNIT - III

Rule-Based Neural networks; Network Training; Decision Tree Based NN's;
INCREMENTAL LEARNING: Principles; Symbolic methods; Neural Network Approaches (Probabilistic NN's); Incremental RBCN.

UNIT-IV

FUZZINESS VS PROBABILITY: Fuzzy Sets & Systems; The Geometry of Fuzzy sets; The Fuzzy Entropy Theorem; The Subsethood Theorem; The Entropy Subsethood Theorem.

UNIT - V

FUZZY ASSOCIATIVE MEMORIES: Fuzzy & Neural Function Estimators; Fuzzy Hebbian FAMs; Adaptive FAMs.

COMPARISON OF FUZZY & NEURAL SYSTEMS: Case Studies.

References:

1. Limin Fu,Neural, “Networks in Computer Intelligence”, McGraw Hill Co., 1994.
2. B.Kosko, “Neural Networks & Fuzzy Systems”, Prentice Hall (India) Ltd., 1992.
3. S.Haykin “Neural Networks - A Comprehensive Foundation”, Maxwell Macmillan International, 1991.

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

WIRELESS SENSOR NETWORKS (13D38204C)
(ELECTIVE - III)

Course Objectives:

- To study about different types of sensor networks, advantages, applications and the mechanism of transportation and processing involved in Wireless Sensor Networks.
- To study about representation and different protocols and mechanisms involved in routing of Wireless Sensor Networks.
- To study about tools and simulators associated with Wireless Sensor Networks.

Learning Outcomes:

After completion of this course the students will be able to

- Understand different types of sensor networks, advantages, applications and the mechanism of transportation and processing involved in Wireless Sensor Networks.
- Understand about representation and different protocols and mechanisms involved in routing of Wireless Sensor Networks.
- Gets complete knowledge regarding different tools and simulators associated with Wireless Sensor Networks.

UNIT-I

Sensor networks, advantages and applications, Sensor Network Applications - Habitat Monitoring, Smart Transportation, Collaborative Processing

UNIT - II

Localization and tracking,- sensing model, Distributed Representation, Tracking Multiple Objects networking sensors- Medium Access Control, *Energy-Aware Routing to a Region,* Attribute-Based Routing

UNIT-III

Infrastructure Establishment -Clustering and time synchronizations, Localization and localization services, Sensor tracking and control - Task-Driven Sensing, Information-Based Sensor Tasking, Sensor Group Management

UNIT-IV

Sensor Network data bases - Sensor Database Challenges , Query Interfaces , Data-Centric Storage, Multidimensional Indices for Orthogonal Range Searching, Locality-Preserving Hashing

UNIT - V

Sensor Network Platforms and Tools -Sensor Network hardware, Node level software, Node-Level Simulators, wireless sensor networks positioning and location management.

References:

1. F. Zhao, C Guibas, “Wireless Sensor Networks”, Elsevier, Morgan Kaufmann, 2004.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, “Wireless Sensor Networks -Technology, Protocols and Applications”, John Wiley & Sons, 2007.

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

SPEECH PROCESSING (13D38204D)
(ELECTIVE - IV)

Course Objectives:

- To understand how speech signals are processed for Analysis and Synthesis. Also to understand speech processing in the context of its creation (anatomy, classification of sounds, etc.) as well as in its perception (psychology & neuroscience).
- To analyze tools that are needed for analysis and synthesis, in the areas of digital signal processing for time-frequency analysis.

Learning Outcomes:

- After completing the course, the student will be familiar with the principles and the techniques used in speech processing. This includes speech synthesis, speech coding and speech recognition.

UNIT I

FUNDAMENTALS OF DIGITAL SPEECH PROCESSING: Anatomy & Physiology of Speech organs, the process of speech production, the acoustic theory of speech production, Digital models for speech signals.

TIME DOMAIN MODELS FOR SPEECH PROCESSING: Introduction- Window considerations, Short time energy and average magnitude Short time average zero crossing rate ,Speech vs silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

UNIT II

LINEAR PREDICTIVE CODING (LPC) ANALYSIS: Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition, Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

UNIT III

HOMOMORPHIC SPEECH PROCESSING: Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, the Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder.

SPEECH ENHANCEMENT: Nature of interfering sounds, Speech enhancement techniques, Spectral subtraction, Enhancement by re-synthesis.

UNIT IV

AUTOMATIC SPEECH RECOGNITION: Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System,. Continuous digit Recognition System

SPEAKER RECOGNITION: Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System.

UNIT V

HIDDEN MARKOV MODEL (HMM) FOR SPEECH: Hidden markov model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS, Adapting to variability in speech, Language models.

References:

1. L.R Rabiner and S.W.Schafer, “Digital processing of speech signals”, Pearson.
2. Douglas O Shaughnessy, “Speech communication”, Second Edition Oxford University press, 2000.
3. L.R Rabinar and B.H.Juang, “Fundamentals of Speech Recognition”
4. Thomas F. Quateri, “Discrete Time Speech Signal Processing”, 1/e, Pearson
5. Ben Gold & Nelson Morgan, “Speech & Audio Signal Processing”, 1/e, Wiley

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

SOFTWARE DEFINED RADIO (13D38204E)

(ELECTIVE - IV)

Course Objectives:

- To study about requirements, benefits and different models for Software Defined Radio
- To study in detail about Soft ware Defined Radio Architectures for performance optimization
- To get complete knowledge regarding functioning of different blocks and techniques associated with Software Defined Radio.

Learning Outcomes:

After completion of this course the students will be able to

- Analyze requirements, benefits and different models for Software Defined Radio.
- Understand in detail about Soft ware Defined Radio Architectures for performance optimization.
- Gets complete knowledge regarding functioning of different blocks and techniques associated with Software Defined Radio.

UNIT-I

Requirement for Software defined radio, Benefits of multi-standard terminals, Operational requirements, models for SDR, Smart antenna systems,

UNIT – II

Software defined radio architectures, Hardware specifications, Digital aspects of Software defined radio, Current technology limitations, minimum power consumption, ADC performance trends

UNIT-III

Flexible RF receiver architectures, Digital receiver, Single carrier and multi-carrier designs, undersampling, oversampling, Noise figure, Receiver sensitivity, ADC spurious signals

UNIT-IV

Multiband Flexible receiver design, RF Transmit / receive switch, Image rejection mixing, Dynamic range enhancement, Feed forward techniques, cascaded non-linearity techniques

UNIT - V

Flexible transmitters,, Power amplifiers, Analog quadrature upconvertion, Interpolated bandpass upconversion, PLL based modulator transmitter, All-pass filtering, Polyphase filtering

References:

1. P Kenington, "RF and Baseband Techniques for Software Defined Radio", Artec House, 2005
2. Jouko Vanakka, "Digital Synthesizers And Transmitter For Software Radio", Springer, 2005
3. Wally H. W. Tuttlebee**, "**Software Defined Radio: Baseband Technologies for 3G Handsets and Base stations", John Wiley & sons , 2003

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

MULTIMEDIA COMMUNICATIONS (13D38204F)
(ELECTIVE - IV)

Course Objectives:

- To study basic requirements of Multimedia Communications.
- To study about different coding schemes involved in Multimedia Communications.
- To study about different standards and protocols related Multimedia Communications and its networks.

Learning Outcomes:

After completion of this course the students will be able to

- Gets knowledge regarding fundamentals of Multimedia Communications
- Understand about different coding schemes involved in Multimedia Communications.
- Gets complete knowledge regarding different standards and protocols related Multimedia Communications and its networks.

UNIT-I

Multimedia communications - multimedia requirements, Audio Visual integration - Lip synchronization, Audio-to-visual mapping, Bio-model person verification, Joint Audio-Video coding

UNIT - II

Multimedia information processing, Perceptual coding of digital audio signals - hybrid coder - differential perceptual audio coder, Image coding, Video coding, Water marking

UNIT-III

ANNS for multimedia processing - NN techniques for motion estimation, face detection and recognition, Distributed multimedia systems, IP based networks, Multimedia Operating Systems.

UNIT-IV

Multimedia Communication Standards - overview of MPEG 1 ,MPEG-2, MPEG-4 and MPEG-7., Real time multimedia transmission across the Internet

UNIT - V

Multimedia Communication across networks - packet audio / video , Streaming video across internet, Multimedia transport across IP/ATM Networks and Wireless networks

References:

1. KR RAO et al, “Multimedia Communication Systems: Techniques and Standards”, Pearson, 2002.
2. Tay Vaughan, “Multimedia- Making it Work”, TMH, 5th Edn, 2001
3. PK ANDLEIGH , K. THAKKAR, “Multimedia Systems Design”, PHI,2002

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

ADVANCED COMMUNICATIONS LAB

Course Objectives:

- To generate random data at given rates and employ different modulation schemes over generated data.
- To simulate different modulated signals and diversity schemes over AWGN, and estimate data reception using different algorithms.
- To implement RAKE receiver and estimate its performance through BER curve.

Learning Outcomes:

After completion of this course the students will be able to

- Generate random data at given rates and employ different modulation schemes over generated data.
- Simulate different modulated signals and diversity schemes over AWGN, and estimate data reception using different algorithms.
- Implement RAKE receiver and estimate its performance through BER curve.

List of Experiments:

Generation of Random data at a given data rate (Hardware & Software) – (M-Sequence).

1. Simulation of Rayleigh fading channel incorporating speed of the mobile & Power delay profile
2. Simulation of BPSK system over AWGN channel & finding its performance with BER plot.
3. Implementation of Equalization at the receiver to remove ISI caused due to Low channel bandwidth
4. Simulation of CDMA signal using QPSK modulation scheme &obtain matched filter response over AWGN Channel
5. Implementation of RAKE receiver & finding its performance through BER Curve
6. Implementation of L.M.S algorithm to estimate the original data when it is corrupted by noise & channel.
7. Implementation of R.L.S algorithm to estimate the original data when it is corrupted by noise & channel.

Tools Required: MATLAB – 7.0 & above

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

DECS I-IISEMESTER

IMAGE & VIDEO PROCESSING LAB

Course Objectives:

- To read, write and perform various operations on different types of images and videos.
- To simulate various enhancement, segmentation, compression and various morphological operation on images.
- To simulate spatio-temporal sampling, motion estimation, filtering and various compression techniques on various types of videos.
-

Learning Outcomes:

After completion of this course the students will be able to

- Enable to develop knowledge and understating and technical skills in Image & Video Processing systems and relevant areas of engineering.
- Simulate various operations on images and videos using different algorithms.
- Provides experience of analytical and imaging and video techniques relevant for various applications.

List of Experiments:

The students are required to simulate the following experimental parts on the MATLAB environment by considering the relevant application based examples.

PART-A: Image Processing

1. Image Enhancement.
2. Enhancement in Frequency Domain.
3. Image Segmentation.
4. Image Compression.
5. Morphological Operations.

PART-B: Video Processing

1. Representation of Digital video: Read, Write, View Videos and conversion of videos in different formats.
2. Spatio-temporal sampling of Videos
3. Video motion estimation
4. Videos filtering.
5. Video Compression.

Tools Required: MATLAB – 7.0 & above

TWO YEAR COURSE STRUCTURE

FOR

M.TECH – DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)

w.e.f.

2017-2018 ADMITTED BATCH

R-17 REGULATIONS

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COLLEGE OF ENGINEERING (AUTONOMOUS) :: PULIVENDULA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

PULIVENDULA – 516390, Y.S.R. (DIST), ANDHRA PRADESH, INDIA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA – 516 390 (A. P.)

Academic regulations for M. Tech. (Regular) program
with effect from academic year 2017-18

1. ELIGIBILITY FOR ADMISSION:

Admission to the above program shall be made subject to the eligibility, qualification and specialization prescribed by the University for each Program from time to time.

i. Admission shall be made either on the basis of merit/rank obtained by the qualifying candidates in GATE/PGECET or otherwise specified, whichever is relevant.

2. AWARD OF M.TECH. DEGREE:

A student will be declared eligible for the award of the M. Tech. degree if he/she fulfills the following academic regulations:

i. He/she has pursued a course of study for not less than four semesters and not more than eight semesters.
ii. Students, who fail to fulfill all the academic requirements for the award of the degree within eight semesters from the year of their admission, shall forfeit their seat in the course and their seat shall stand cancelled.
iii. Register for 68 credits and secure all 68 credits

3. COURSES OFFERED:

s.no.	Department	Specialization
01.	Electrical & Electronics Engineering (EEE)	*Electrical Power Systems (EPS)*
02.	Mechanical Engineering (ME)	*Computer Aided Design & Computer Aided Manufacturing (CAD&CAM)*
03.	Electronics & Communication Engineering (ECE)	*Digital Electronics & Communication Systems (DECS)*
04.	Computer Science & Engineering (CSE)	*Computer Science & Engineering (CSE)*

And any other course as approved by the competent authorities from time to time.

4. COURSE WORK:

The programs are offered on a Semester basis consisting of four Semesters.

i. The candidates shall undergo ***five theory*** and ***two laboratory*** courses in ***each semester*** during the first and second semesters. During the third and fourth semesters the candidates pursue the dissertation in the concerned specialization only. The theme of dissertation should conform to the specialization.
ii. There shall be one comprehensive online examinations conducted by the respective department one at the end of 1st year with 60 objective questions for 60 marks on the subjects studied in the respective years of both semesters. The heads of the respective department are given the responsibility of preparing question paper and conducting the online examination by maintaining confidentiality. A student shall acquire Two credit assigned to the online examination only when he/she secure 40% or more marks. In case, if a student fails in comprehensive online examination, he shall re- register by following a similar procedure adopted for the lab examinations.

iii. There shall be ***two seminars*** (*seminar-I, and seminar -II*) related to thesis/dissertation. Out of two seminars related to thesis/dissertation, *seminar-I* shall be conducted in the 3rd semester and the *seminar-II* will be in 4th semester.

iv. A candidate has to either present a paper in any national or international conference organized by AICTE recognized college/institution, or, publish a paper in peer-reviewed journals/Conferences proceedings before the submission of thesis.

v. Only on completion of all the prescribed courses, the candidate will be permitted to submit the thesis/dissertation. Three copies of the thesis / dissertation certified by the concerned supervisor in the prescribed form shall be submitted to the College. Once a student fails to submit the thesis within the stipulated period of four semesters, extension of time up to eight semesters may be permitted by the Principal with recommendation of the College Academic Committee.

vi. The Thesis/Dissertation will be adjudicated by one external examiner from reputed institutions/industry appointed by the competent authority.

vii. If the report of the external examiner is favorable, a viva-voce examination shall be conducted by a board consisting of Head of the department as Chairman, the supervisor and the examiner who adjudicated the thesis/ dissertation. The board shall jointly report the candidate's work as:

A - Excellent
B - Good
C - Satisfactory
D - Unsatisfactory

viii. If the report of the viva-voce is not satisfactory, the candidate will retake the viva-voce examination after three months. If he/she fails to get a satisfactory report at the second viva-voce examination, he/she will not be eligible for the award of the degree unless the candidate is asked to revise and resubmit the thesis/dissertation. The resubmitted copy shall be evaluated by the same board.

5. EVALUATION:

The performance of the candidate in each semester program shall be evaluated subject wise, with a maximum of 100 marks for theory and 100 marks for practical examination, on the basis of Internal Evaluation and End Examination.

i. For the theory subjects, 60% of the marks will be for the End Examination and 40% of the marks will be for Internal Evaluation.

Final Internal marks for a total of 40 marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage to the better mid exam and 20% to the other. The two midterm examinations shall be held during the semester, one in the middle of the program and the other one during the last week of instruction. **A student shall answer all three questions in 2 hours of time without seeking any choice**.

The following pattern shall be followed in the End-Examination.

a. Five questions shall be set from each of the five units with either/or type for 12 marks each, and the total marks of 60.
b. All the questions have to be answered compulsorily.
c. Each question may consist of one, two or more bits.

ii. For practical subjects, 60 marks shall be for the End Examinations and 40 marks will be for internal evaluation based on the day to day performance. The end semester practical examination shall be conducted by the concerned laboratory teacher and senior expert in the same subject of the department nominated by the Principal.

iii. Comprehensive Online Examination shall be evaluated for 60 marks ad seminar-I and seminar-II shall be evaluated for internal marks of 50 each. There is no external evaluation for them. A candidate has

to secure a minimum of 50% to be declared successful in all the three evaluations. If the candidate fails, he/she has to re-register for Comprehensive Online Examination /seminars. Assessment of these three shall be done by a board consisting of Head of the Department, concerned thesis supervisors, and senior faculty members of the department.

iv. A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

v. In case the candidate does not secure the minimum aggregate marks as specified in 5 (iv) he/she has to reappear for the semester examination either the supplementary or regular in that subject or repeat the course as and when next offered or do any other specified subject as may be required. *However the candidate is permitted to appear for two courses per semester only*.

6. ATTENDANCE:

A student shall be eligible to appear for end semester examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the subjects in a semester.

i. Condonation of shortage of attendance up to 10% in any subject i.e. from 65% and above and less than 75% may be given by the College Academic Committee.

ii. **Shortage of Attendance below 65% in aggregate shall in NO case be condoned**.

iii. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

iv. Students whose shortage of attendance is not condoned in any semester are not eligible to take their external Examination of that class and their registration shall stand cancelled.

v. A student will not be promoted to the next semester unless he/she satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester as and when offered next.

vi. A stipulated fee shall be payable towards condonation of shortage of attendance to the institution.

7. Grading System is to be introduced. After each subject is evaluated for 100 marks, the marks obtained in each subject will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

vii. Table – Conversion into Grades and Grade Points assigned

Academic performance	Letter Grade	Grade points Assigned
≥ 95%	S	10
≥90% - < 95%	A++	9.5
≥ 85% - <90%	A+	9
≥80% - <85%	A	8.5
≥75% - <80%	B++	8
≥70% - <75%	B+	7.5
≥65% - <70%	B	7
≥60% - <65%	C++	6.5
≥55% - <60%	C+	6
≥50% - <55%	C	5.5
≥45% -< 50%	D	5
≥40%- < 45%	E	4.5
Below 40%	F(Fail)	0
Absent	Ab (Absent)	0

i. The following procedure shall be adopted to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA);

ii. The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$SGPA = \Sigma (C_i \times G_i) / \Sigma C_i$$

Where, Ci is the number of credits of the i^{th} subject and Gi is the grade point scored by the student in the i^{th} course.

ii. The Cumulative Grade Point Average (CGPA) will be computed in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

$$CGPA = \Sigma (C_i \times S_i) / \Sigma C_i$$

Where 'Si' is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

iii. Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv. While computing the GPA/CGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.
Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D, E and F.

8. AWARD OF DEGREE AND CLASS:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree he/she shall be placed in one of the following four classes:

Class Awarded	**CGPA Secured**
First Class with Distinction	≥ 7.5
First Class	≥ 6.5 < 7.5
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 4.0 < 5.5

(The marks in internal evaluation and external Examination shall be shown separately in the marks memorandum)
Further, CGPA to a maximum of extent of 0.05 shall be added which is just sufficient to effect change of class from pass class to Second class, Second class to First class, First class to First class with distinction for all the courses being offered, without adding any marks to the original marks secured by the students
A candidate shall be eligible for the award of respective degree if he/she satisfies the minimum academic requirements in every subject and secures at least satisfactory report on his/her thesis / dissertation and viva-voce.

9. WITHHOLDING OF RESULTS

The result of a candidate shall be withheld if:

i. He/she has not cleared any dues to the Institution / Hostel.
ii. A case of disciplinary action against him/her is pending disposal.

10. TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course are eligible for re-admission to the same or equivalent subjects as and when subjects are offered, subject to the conditions mentioned in 5-(iv) and 2-(ii).

11. GENERAL:

The academic regulations should be read as a whole for purpose of any interpretation.

i. The college reserves the right of altering the regulations as and when necessary. The regulations altered may be applicable to all the candidates on rolls.

ii. Wherever the word he, him or his occur, it will also includes she, her, hers.

iii. There shall be no place for transfer of candidate within the constituent colleges of Jawaharlal Nehru Technological University during the entire course of the programme.

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JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

Course structure for M.Tech. DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (Regular) with effective from 2017-2018

I M.Tech I Semester

S.NO	Course code	Subject Name	Theory	Lab	Credits
1.	17D38101	STRUCTURAL DIGITAL SYSTEM DESIGN	4		4
2.	17D38102	IMAGE AND VIDEO PROCESSING	4		4
3.	17D38103	DIGITAL COMMUNICATION TECHNIQUES	4		4
4.	 17D38104 17D38105 17D38106	**ELECTIVE-I** ADVANCED OPERATING SYSTEMS MOBILE NETWORKS TRANSFORM TECHNIQUES	4		4
5.	 17D38107 17D38108 17D38109	**ELECTIVE-II** NANO ELECTRONICS SECURED COMMUNICATIONS ADAPTIVE SIGNAL PROCESSING	4		4
6.	 17D38110	STRUCTURAL DIGITAL SYSTEM DESIGN LAB		3	2
7.	17D38111	IMAGE & VIDEO PROCESSING LAB		3	2
			20	6	
		CONTACT PERIODS/WEEK		26	
		TOTAL CREDITS (5 THEORY + 2 LABS)			24

I M.Tech II Semester

S.NO	Course code	Subject Name	Theory	Lab	Credits
1.	17D38201	WIRELESS COMMUNICATIONS	4		4
2.	17D38202	DETECTION AND ESTIMATION THEORY	4		4
3.	17D38203	MIXED SIGNAL DESIGN	4		4
4.	17D38204 17D38205 17D38206	**ELECTIVE-III** EMBEDDED SYSTEM DESIGN FUZZY SYSTEMS AND NEURAL NETWORKS WIRELESS SENSOR NETWORKS	4		4
5.	17D38207 17D38208 17D38209	**ELECTIVE-IV** SPEECH PROCESSING INTERNET OF THINGS MULTIMEDIA COMMUNICATIONS	4		4
6.	17D38210	ADVANCED COMMUNICATIONS LAB		3	2
7.	17D38211	MIXED SIGNAL DESIGN LAB		3	2
	17D38212	COMPREHENSIVE ONLINE EXAMINATION			2
	Contact periods/week		20	6	
	Total/week		26		
	Total Credits (5 Theory + 2 Lab +1 online Exam)		26		

II M.Tech I Semester

S.NO	Course Code	Subject	Maximum Marks		Total	Min. Marks/ Grades to Pass	Credits
			Internal	External			
1	17D38301	Seminar-I	50	-	50	25	-

II M.Tech II Semester

S.NO	Course Code	Subject	Maximum Marks		Total	Min. Marks/ Grades to Pass	Credits
			Internal	External			
1	17D38401	Seminar-II	50	-	50	25	-
2	17D38402	**Project Work** Grades : A, B, C, D A - Excellent B - Good C – Satisfactory D - Unsatisfactory	-	-	-	-	18

I M.Tech I Semester

JNTUA COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

STRUCTURAL DIGITAL SYSTEM DESIGN (17D38101)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study about structural functionality of different Digital blocks (Both combinational and Sequential)
2. To provide an exposure to ASM charts, their notations and their realizations.
3. To provide an exposure to VHDL/Verilog and different styles of modelling using VHDL.
4. To introduce concept of micro programming and study issues related to micro programming

UNIT-I

COMBINATIONAL CIRCUIT BUILDING BLOCKS: Multiplexers, Demultiplexers, Encoders, Decoders, Comparators, Adders, ALU, Carry look Ahead adder.

SEQUENTIAL CIRCUIT BUILDING BLOCKS: Flip-flops, registers, Memory elements, Shift Registers, Sequence Generators, Timing Generators.

UNIT-II

MODELLING WITH HDL:

Introduction to VHDL/Verilog, Modelling Styles in VHDL/Verilog (Data Flow, Behavioral, Structural and Mixed style modeling using HDL).

SYSTEM DESIGN METHODOLOGY:

Finite State Machine, RTL Design, Realization and implementation of Dice Game, Micro Programming, Linked State machines, RTL Implementation Options.

UNIT-III

DESIGN OF COMBINATIONAL LOGIC:

BCD to 7-Segment Display decoder, BCD Adder, Arithmetic and Logic Unit (ALU), State graphs for control circuits, score board and controller, Synchronization and debouncing, A Shift and Add Multiplier, Array Multiplier, Booth Multiplier.

UNIT-IV

DESIGN OF SEQUENTIAL LOGIC:

Design Procedure for sequential circuits, Design Example- code Converter, Design of Iterative circuits, Design of sequential circuits using ROMs and PLAs, sequential circuit design using CPLD, FPGAs, Reduction of state and Flow Tables, Race-Free State Assignment Hazards.

Design Examples: UART, Traffic Light Controller

UNIT-V

HARDWARE TESTING AND DESIGN FOR TESTABILITY: Testing combinational Logic, Testing sequential Logic, Scan Testing, Boundary Scan, Built in Self Test.

Course Outcomes: After Completion of this course students will be able to

a. Understand structural functionality of different digital blocks
b. Represent and Realize their designs in ASM charts
c. Represent their designs in different modelling styles by using VHDL
d. Understand concept of Micro program and issues related to micro programming

TEXT BOOKS:

1. Charles H.Roth Jr, Lizy Kurian John, "Digital System Design Using VHDL," 2nd Edition, Cengage Learning, 2013.
2. Ming-Bio Lin, "Digital System Design and Pratices using Verilog HDL and FPGAs," Willey India Edition, 2012.

REFERENCES:

1. Charles H. Roth, Jr., "Fundamentals of Logic Design", 5th Edition, Cengage Learning, 2012.
2. Z. Kohavi, "Switching & finite Automata Theory," 3rd Edition, Cambridge University Press, 2009.
3. Michael D. Cilleti, "Advanced Digital Design with Verilog HDL", PHI, 2013.

IMAGE AND VIDEO PROCESSING (17D38102)

L	T	P	C
4	0	0	4

Course Objectives:

1. To understand different transforms related to gray scale and color images.
2. To get complete knowledge regarding different techniques associated with Image Enhancement, Image Restoration, Image Segmentation and Image Compression.
3. To get clear knowledge regarding motion estimation, video filtering and video standards

UNIT I

IMAGE FUNDAMENTALS & TRANSFORMS: Gray scale and colour Images, image sampling and quantization. Two dimensional orthogonal transforms: DFT, WHT, Haar transform, KLT, DCT.

UNIT II

IMAGE ENHANCEMENT: Filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Edge detection, non-parametric and model based approaches, LOG filters, localization problem.

IMAGE RESTORATION: Degradation Models, PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.

UNIT III

IMAGE SEGMENTATION: Pixel classification, Bi-level Thresholding, Multi-level Thresholding, P-tile method, Adaptive Thresholding, Spectral & spatial classification, Edge detection, Hough transform, Region growing.

UNIT IV

IMAGE COMPRESSION: Compression models, Information theoretic perspective, Fundamental coding theorem. Huffman Coding, Arithmetic coding, Bit plane coding, Run length coding, Lossy compression: Transform coding, Image compression standards.

UNIT V

VIDEO PROCESSING: Representation of Digital Video, Spatio-temporal sampling, Motion Estimation. Video Filtering, Video Compression, Video coding standards.

Course Outcomes: After completion of this course the students will be able to

a. Different transforms related to gray scale and color images.
b. Complete knowledge regarding different techniques associated with Image Enhancement, Image Restoration, Image Segmentation and Image Compression.
c. Understand basic concepts regarding to motion estimation, video filtering and video standards.

TEXT BOOKS:

1. R. C. Gonzalez, R. E. Woods,"Digital Image Processing", Pearson Education. 2nd edition,2002
2. Bovik, "Handbook of Image & Video Processing", Academic Press, 2000

REFERENCES:

1. Rosenfold and A. C. Kak, "Digital Image Processing," Vols. 1 and 2, Prentice Hall, 1986.
2. H. C. Andrew and B. R. Hunt, "Digital Image Restoration," Prentice Hall, 1977
3. R. Jain, R. Kasturi and B.G. Schunck, "Machine Vision," McGraw-Hill International Edition, 1995

I M.Tech I Semester

DIGITAL COMMUNICATION TECHNIQUES (17D38103)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study about base band signal concepts and different equalizers.
2. To study in detail about coherent detection schemes such as ASK, FSK, PSK
3. To study in detail about M-ary signaling schemes like QPSK, QAM, MSK.

UNIT I

***Review of Random Variables and Random Processes*:** Random variable, Moment generating function, Markov's inequality, Chebyshev's inequality, Central limit theorem, Different distributions – Gaussian, Poisson, Chi square, Rayleigh, Rician; Correlation - Auto-correlation, Cross correlation, Correlation matrix; Stationary processes, Wide sense stationary processes, Gaussian & Ergodic processes, Problem solving.

UNIT II

***Baseband Signal Concepts*:** Baseband data transmission, Nyquist criterion for zero ISI, Correlative level coding, Data Detection, Optimum design of transmit and receive filters, Equalization - Linear, adaptive, fractionally spaced and decision feedback equalizers.

UNIT III

***Digital Modulation Schemes*:** Detection using matched filter – Optimum receivers for arbitrary binary signals and M'ary Orthogonal signals, Analysis of coherent detection schemes for ASK, PSK and DPSK, M'ary signalling schemes – QPSK, QAM, MSK, Performance of the data transmission schemes under AWGN. Trellis coded Modulation.

UNIT IV

***Synchronization*:** Receiver synchronization, costas loop, symbol synchronization, synchronization with CPM – data aided and Non aided synchronization- synchronization methods based on properties of wide sense cyclo-stationary random process – Carrier recovery circuits – Symbol clock estimation schemes.

UNIT V

***Spread Spectrum Systems*:** PN sequences, Generation of PN sequences, DS spread spectrum systems, FH spread spectrum systems and performance of DSSS & FHSS in AWGN – Synchronization – Jamming considerations – Commercial Applications, Cellular subsystems.

Course Outcomes:

a. Students will be aware of base band signal concepts and different equalizers.
b. Students will be able to get complete knowledge regarding coherent detection schemes like ASK, FSK, PSK.
c. Students will be able to design M-ary signaling schemes like QPSK, QAM, MSK

TEXT BOOKS:

1. J.G.Proakis, Digital Communication (4/e), McGraw- Hill, 2001
2. Bernard Sklar, "Digital Communications–Fundamentals & Applications," Prentice Hall, 2001.

REFERENCE BOOKS:

1. R.E.Zimer & R.L.Peterson, "Introduction to Digital Communication", PHI, 2001.
2. G. R. Cooper & C. D. Mc Gillem, "Modern Communications & Spread Spectrum," McGraw Hill, 1986.
3. L.Hanzo et.al, "Turbo Coding, Turbo Equalization & Space-Time Coding," Wiley, 2002.

ADVANCED OPERATING SYSTEMS (17D38104)

L	T	P	C
4	0	0	4

Course Objectives:

1. To Study in detail about kernel structures associated with various Operating systems
2. To Study in detail about various systems calls, statements and their arguments associated with Unix.
3. To Study in detail about various systems calls, statements and their arguments associated with Linux.

UNIT I
INTRODUCTION
General Overview of the System: History – System structure – User perspective – Operating system services – Assumptions about hardware.
Introduction to the Kernel: Architecture of the UNIX operating system – Introduction to system concepts.
The Buffer Cache: Buffer headers – Structure of the buffer pool – Scenarios for retrieval of a buffer – Reading and writing disk blocks – Advantages and disadvantages of the buffer cache.

UNIT II
UNIX I*:* Overview of UNIX system, Structure, files systems, type of file, ordinary & special files, file permissions, Introduction to shell. UNIX basic commands & command arguments, Standard input / output Input / output redirection, filters and editors, System calls related file structures, input / output process creation & termination.

UNIT III
INTERPROCESS COMMUNICATION IN UNIX: Introduction, file and record locking, Client – Server example, pipes, FIFOs, Streams & Messages, Name Speces, Systems V IPC, Message queues, Semaphores, Shared Memory, Sockets & TLI.

UNIT IV
INTRODUCTION TO NETWORKS AND NETWORK PROGRAMMING IN UNIX: Network Primer, TCP/IP, Internet Protocols, Socket Programming, Introduction & overview, UNIX domain protocols, Socket Addresses, Elementary Socket system calls, Simple examples.

UNIT V
LINUX: Introduction to LINUX System, Editors and Utilities, Type of Shells, Shell Operations, File structure, File Management, Operations. Memory Management Policies: Swapping – Demand paging. The I/O Subsystem: Driver Interface – Disk Drivers – Terminal Drivers– Streams – Inter process communication.

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

a. Get complete knowledge regarding different types of operating systems and their Kernel structures.
b. To work effectively on Unix Platform
c. To work effectively on Linux Platform

TEXT BOOKS:

1. Maurice J.Bach, “The design of the UNIX Operating Systems”, PHI
2. Kernighan & Pike, “The UNIX Programming Environment”, PHI

REFERENCES:

1. W.Richard Stevens, “UNIX Network Programming”, PHI, 1998.
2. Richard Peterson, “The Complete reference LINUX”, TMH
3. Ritchie & Yates, “UNIX User Guide”.

MOBILE NETWORKS (17D38105)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study different wireless communication systems
2. To study in detail about different multiples accessing schemes
3. To study about different architectures in mobile networks such as wireless LAN, Hyper LAN and so on
4. To study about dynamic routing and different routing protocols employed in mobile networks

UNIT-I

Wireless communication standards, Cellular communications, GSM protocol architecture,, 3G mobile wireless systems, Beyond 3G

UNIT - II

Multiple Access Techniques - GDMA, TDMA, CDMA, Mobile Data Networks - CDPD, GPRS

UNIT-III

Wireless LAN architecture, physical & MAC layers, Wireless ATM architecture, HIPERLAN, Wireless Personal Area (WPAN) networks - Home RF, Bluetooth.

UNIT-IV

Mobility management in Wireless Networks, Handoff management, Location management, Mobile IP, TCP Wireless Application Protocol

UNIT - V

Mobile Adhoc Networks, Dynamic routing, Route discovery, Routing protocols, Mobile Multimedia Adhoc Networks, MPLS

Course Outcomes: After completion of the course the student will be able to

a. Gain complete knowledge regarding different wireless communication systems.
b. Gain complete knowledge regarding different multiples accessing schemes.
c. Know the architectures of different mobile networks such as wireless LAN , Hyper LAN and so on
d. Know about different routing mechanisms by employing different routing protocols.

TEXT BOOKS:

1. JW Mark **,** W Zhuang, "Wireless communications & Networking", PHI, 2005
2. Kaveh Pahlavan, Prashant Krishnamurthy, "Principles of Wireless Networks", PHI, 2010
3. George Aggelou, "Mobile Adhoc Networks", TMH, 2009.

REFERENCES:

1. William Stallings, "Wireless Communications and Networks", Prentice Hall, 2004.
2. Siva Ram Murthy C. and Manoj B. S., "Ad Hoc Wireless Networks: Architectures and Protocols", 2nd Edition. Pearson Education 2005.
3. Toh C. K., "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR, 2001.
4. Yi-Bing and Imrich Chlamtac, "Wireless and Mobile Networks Architectures", John Wiley & Sons, 2001.

TRANSFORM TECHNIQUES (17D38106)

L	T	P	C
4	0	0	4

Course Objectives:

1. Study of different types of transforms which can be applicable for different types of signals.
2. To study the application of wavelets for different types of signals.
3. To study the applications of Multi rate systems and filter banks.

UNIT I:

REVIEW OF TRANSFORMS: Signal spaces, concept of convergence, Hilbert spaces for energy signals, Orthogonality, Ortho normality, Fourier basis, FT-failure of FT-need for time-frequency analysis, spectrogram plot-phase space plot in time-frequency plane, Continuous FT, DTFT, Discrete Fourier Series and Transforms, Z-Transform.

ADVANCE TRANSFORMS: Relation between CFT-DTFT, DTFT-DFS, DFS-DFT, DCT (1D&2D), Walsh, Hadamard, Haar, Slant, KLT, Hilbert Transforms – definition, properties and applications.

UNIT II:

CWT & MRA: Time-frequency limitations, tiling of time-frequency plane for STFT, Heisenberg uncertainty principle, Short time Fourier Transform (STFT) analysis, short comings of STFT.

NEED FOR WAVELETS: Wavelet Basis- Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT.

UNIT III:

NEED FOR SCALING FUNCTION: Multi resolution analysis, Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat Meyer, Shannon, Daubechies.

SPECIAL TOPICS: Wavelet Packet Transform, Bi-orthogonal basis- B-splines, Lifting Scheme of Wavelet Generation-implementation.

UNIT IV:

MULTIRATE SYSTEMS, FILTER BANKS AND DWT: Basics of Decimation and Interpolation in time & frequency domains, Two-channel Filter bank, Perfect Reconstruction Condition, Relationship between Filter Banks and Wavelet basis, DWT Filter Banks for Daubechies Wavelet Function.

UNIT V:

APPLICATIONS OF TRANSFORMS: Signal De-noising, Sub-band Coding of Speech and Music, Signal Compression - Use of DCT, DWT, KLT.

Course Outcomes: After completion of the course the student will be able to

a. Use different 1-d and 2-d transforms for different signals.
b. Apply wavelet transforms for different signals and will be able to appreciate its differences with other transformations.
C. Use different advanced transforms such as DCT, DWT and KLT for different applications like signal de noisy, sub band coding of speech and music and signal compression.

TEXT BOOKS:

1. Jaideva C Goswami, Andrew K Chan, “Fundamentals of Wavelets- Theory, Algorithms and Applications”, John Wiley & Sons, Inc, Singapore, 1999.
2. Raghuveer M.Rao and Ajit S. Bopardikar, “Wavelet Transforms-Introduction theory and applications” Pearson edu, Asia, New Delhi, 2003.
3. Soman.K.P, Ramachandran K.I, “Insight into Wavelets from Theory to practice”, Printice Hall India, First Edition, 2004.

REFERENCES:

1. Vetterli M. Kovacevic, “Wavelets and sub-band coding”, PJI, 1995.
2. C. Sydney Burrus, “Introduction to Wavelets and Wavelet Transforms”, 1st Edition, PHI, 1997.
3. Jayaraman, “Digital Image Processing”, TMH, 2009

NANO ELECTRONICS (17D38107)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study about different quantum devices
2. To study in detail about nano devices and nano architectures and their computations
3. To study about Molecular nano Electronics

UNIT – I: Quantum Devices:

Charge and spin in single quantum dots- Coulomb blockade – Electrons in mesoscopic structures - single electron transfer devices (SETs) – Electron spin transistor – resonant tunnel diodes, tunnel FETs - quantum interference transistors (QUITs) - quantum dot cellular automata (QCAs) - quantum bits (qubits).

UNIT – II: Nano Electronic Devices:

Electronic transport in 1, 2 and 3 dimensions- Quantum confinement - energy subbands - Effective mass - Drude conduction - mean free path in 3D - ballistic conduction - phase coherence length - quantized conductance - Buttiker-Landauer formula- electron transport in pn junctions - short channel NanoTransistor –MOSFETs - Advanced MOSFETs - Trigate FETs, FinFETs - CMOS.

UNIT – III: Molecular Nano Electronics:

Electronic and optoelectronic properties of molecular materials - Electrodes & contacts – functions – molecular electronic devices - elementary circuits using organic molecules- Organic materials based rectifying diode switches – TFTs- OLEDs- OTFTs – logic switches.

UNIT – IV: Spintronics:

Spin tunneling devices - Magnetic tunnel junctions- Tunneling spin polarization - Giant tunneling using MgO tunnel barriers - Tunnel-based spin injectors - Spin injection and spin transport in hybrid nanostructures - spin filters -spin diodes - Magnetic tunnel transistor - Memory devices and sensors - ferroelectric random access memory- MRAMS - Field Sensors - Multiferro electric sensors- Spintronic Biosensors.

UNIT – V: Nano Electronic Architectures & Computations:

Architecture Principles: Mono and Multi processor systems – Parallel data processing – Power Dissipation and Parallelism – Classic systolic arrays - Molecular devices-properties - Self-organization – Size dependent - limitations. Computation: Monte Carlo Simulations- Computational methods and Simulations from ab initio to multiscale Modeling- Modeling of Nanodevices.

Course Outcomes: After completion of the course the student will be able to

a. Gain complete knowledge regarding different Quantum Devices.
b. Know about nano devices and nano architectures and their computations.
c. Know about Molecular Nano Electronics

TEXT BOOKS:

1. V. Mitin, V. Kochelap, M. Stroscio, “Introduction to Nanoelectronics,” Cambridge University Press, 2008.
2. Rainer Waser, “Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices,” Wiley-VCH, 2003.

REFERENCES:

1. Karl Goser, Peter Glosekotter, Jan Dienstuhl, “Nanoelectronics and Nanosystems,” Springer, 2004.
2. Sadamichi Maekawa, “Concepts in Spin Electronics,” Oxford University Press, 2006.
3. L. Banyai and S.W.Koch, “Semiconductor Quantum Dots,” World Scientific, 1993.
4. Edward L. Wolf, “Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience,” Wiley-VCH, 2006.

SECURED COMMUNICATIONS (17D38108)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study security and different types of attacks.
2. To study about different techniques associated with encryption.
3. To study about different algorithms associated with security.
4. To study about IP security architecture and designing issues related to fire walls.

UNIT-I

Information security, Types of attacks, Info security services - Confidentiality, Integrity, Availability, security process - assessment, Implement security, training

UNIT - II

Security technologies - Firewalls, VPNs ; Encryption - Private Key Encryption, Public key encryption, Key management; Concepts of intrusion detection.

UNIT-III

Message authentications and Hash functions, Digital signatures, e-mail security, IP security architecture, Web security

UNIT-IV

Authentication and authorization in WLANs -802.1X authentication, RADIUS protocol; Extensible Authentication protocol, Transport Layer Security and certificates

UNIT - V

Data protection in WLANs - WEP, 802.11i security, RSNA, CCMP, TKIP, wireless roaming security, WMAN security.

Course Outcomes: After completion of this course students will be able to know

a. The need and role of security.
b. Gain knowledge about different techniques associated with encryption.
c. Functioning of different algorithms associated with security.
d. Gain knowledge regarding IP security architecture and designing issues related to fire walls.

TEXT BOOKS:

1. Eric Maiwald**, "**Fundamental of Network Security", Dreamtech press Osborne MGH, 2004
2. W. Stallings, "Cryptography & Network Security", 3/e, PHI 2003
3. Thomas Hardjono , RD Lakshminath**, "**Security in Wireless LAN & MAN", Artech House, 2005

REFERENCES:

1. Roger J. Sutton, "Secure Communications: Applications and Management", WILEY,2002.
2. Don J. Torrieri, "Principles of secure communication systems", 2nd Eedition, ArtechHouse Publishers, 1992.
3. Cryptography and secure Communications by M.Y. Rhee, Mc Graw Hill

ADAPTIVE SIGNAL PROCESSING (17D38109)

L T P C
4 0 0 4

Course Objectives:

1. To study in detail about adaptive Systems.
2. To study about various Linear optimum filtering techniques.
3. To study about various techniques related Linear and Non Linear adaptive filtering.

UNIT I:

Introduction to Adaptive Systems: *Eigen Analysis* - Eigen Value problem, Properties of eigen values and eigen vectors, Eigen filters, Eigen value computations, *Adaptive Systems* - Definitions, Characteristics, Applications and Examples of Adaptive systems, The adaptive linear combiner – Description, weight vectors, Desired response performance function, Gradient and Mean square error(MSE).

UNIT II:

Linear Optimum Filtering: *Wiener Filters* – Linear optimum filtering, Principle of Orthogonality, Wiener-Hopf equations, Error performance surface, Channel Equalization, Linearly constrained minimum variance filter, *Linear Prediction* – Forward and Backward linear prediction, Levinson-Durbin Algorithm, Properties of prediction error filters, AR modeling of stationary stochastic process, Lattice predictors, Joint process estimation, *Kalman Filters* - Recursive mean square estimation for scalar random variables, Kalman filtering problem, The innovations process, Estimation of the state using innovations process, Filtering, Initial conditions, Variants of the Kalman filter, Extended Kalman filter, Problem Solving.

UNIT III:

Linear Adaptive Filtering-I: Method of Steepest descent algorithm and its stability, *Least Means Square (LMS) algorithm* – Structure & operation of LMS algorithm, Examples, Stability & performance analysis of the LMS algorithm, Simulations of Adaptive equalization using LMS algorithm, Convergence aspects, *Method of Least Squares (LS)* - Statement, Data windowing, Minimum sum of error squares, Normal equations and linear least squares filters, Properties.

UNIT IV

Linear Adaptive Filtering-II *Recursive Least Squares (RLS) Algorithm* – Matrix inversion lemma, The exponentially weighted RLS algorithm, Update recursion for the sum of weighted error squares, Example, Convergence Analysis, Simulation of adaptive equalization using RLS algorithm, *Order Recursive Adaptive Filters* – Adaptive forward and backward linear prediction, Least squares Lattice predictor, QR-Decomposition based Least squares Lattice filters & their properties, Simulation of Adaptive equalization using Lattice Filter.

UNIT V:

Non linear Adaptive Filtering: *Blind deconvolution* – Theoretical and practical considerations, Bussgang algorithm for blind equalization for real base band channels, Special cases of Bussgang algorithm, Simulation studies of Bussgang algorithms, Problem solving.

***Course Outcomes*:** After the course students is expected to be able to:

a. Get complete knowledge regarding adaptive systems
b. Design various Linear optimum filters by employing different techniques associated with them
c. Understand various techniques related to with Linear and Non linear adaptive filtering and their design considerations

TEXT BOOKS:

1. Simon Haykin, "Adaptive Filter Theory," Prentice Hall, 4th Edition, 2002.
2. Bernard Widrow, Samuel D. Strearns, "Adaptive Signal Processing," Prentice Hall, 2005.

REFERENCES:

1. Paulo S.R. Diniz, Adaptive Filtering Algorithms and Practical Implementation, Third Edition,Springer, Kluwer Academic Publishers.
2. Alexander D Poularikas, Zayed M Ramadan, Adaptive Filtering Primer with MATLAB, CRC Press Taylor & Francis Group, 2008 Indian Edition.
3. Ali H. Sayed, Adaptive filters, IEEE Press, Wiley-Interscience, A john Wiley & Sons, INC.,Publication.
4. S. Thomas Alexander, "Adaptive Signal Processing-Theory & Applications," Springer –Verlag, 1986

I M.Tech I Semester

STRUCTURAL DIGITAL SYSTEM DESIGN LAB (17D38110)

L	T	P	C
0	0	3	2

Objectives:

1. To understand about VHDL and Verilog Programming in all available styles.
2. To understand differences between Verilog and VHDL.
3. To represent the different digital blocks in Verilog and VHDL in all available styles of modeling

Using VHDL and Verilog do the following experiments

1. Design of 4-bit adder
2. Design of Booth Multiplier
3. Design of 4 bit / 32 Bit ALU
4. Design of Counters & Shift Registers
5. Design of MIPS Processor
6. Fire Detection and Control System using Combinational Logic circuits.
7. Traffic Light Controller using Sequential Logic circuits
8. Pattern Detection using Moore Machine.
9. Finite State Machine(FSM) based logic circuit.

Mini Project

Learning Out Comes: After completion of this course the students will be able to understand

a. Different modeling styles available in VHDL and Verilog and difference between them
b. Difference between Verilog and VHDL
c. Representation of different digital modules in different modeling styles available in VHDL and Verilog

I M.Tech I Semester

IMAGE & VIDEO PROCESSING LAB (17D38111)

L	T	P	C
0	0	3	2

Course Objectives:

1. To read, write and perform various operations on different types of images and videos.
2. To simulate various enhancement, segmentation, compression and various morphological operation on images.
3. To simulate spatio-temporal sampling, motion estimation, filtering and various compression techniques on various types of videos.

List of Experiments:

The students are required to simulate the following experimental parts on the MATLAB environment by considering the relevant application based examples.

PART-A: Image Processing

1. Image Enhancement.
2. Enhancement in Frequency Domain.
3. Image Segmentation.
4. Image Compression.
5. Morphological Operations.

PART-B: Video Processing

1. Representation of Digital video: Read, Write, View Videos and conversion of videos in different formats.
2. Spatio-temporal sampling of Videos
3. Video motion estimation
4. Videos filtering.
5. Video Compression.

Tools Required: MATLAB – 7.0 & above

Course Outcomes:

After completion of this course the students will be able to

a. Enable to develop knowledge and understating and technical skills in Image & Video Processing systems and relevant areas of engineering.
b. Simulate various operations on images and videos using different algorithms.
c. Provides experience of analytical and imaging and video techniques relevant for various applications.

WIRELESS COMMUNICATIONS (17D38201)

L	T	P	C
4	0	0	4

Course Objectives:

1. To understand basics of Wireless Communications and its evolution process.
2. To learn about the mechanism of radio mobile propagation and its effects.
3. To understand various types of diversity and equalization techniques to counter balance the effects of Wireless Channel.
4. To Study about importance of Wireless Networking and multiple access techniques in the present day mobile communications
5. To design and analyze mobile systems using OFDM technology for mitigating the ISI effects at higher data rates.

UNIT – 1

Introduction to Wireless Communication Systems & Cellular Concept:
Evolution of Mobile Radio Communication Systems, Examples of Wireless Communication Systems, 1G, 2G, 2.5G, and 3G Wireless Cellular Networks and Standards, Frequency Reuse Concept, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems, Problem Solving.

UNIT - 2

Mobile Radio Propagation:
Large Scale Path Loss: Introduction, Free Space Propagation Model, *Propagation Mechanisms* – Reflection, Diffraction, and Scattering, Practical Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models.
Small Scale Fading and Multipath: Small Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small Scale Multipath Measurements, Parameters of Mobile Channels, Types of Small Scale Fading (all variations*), Statistical Models* – Clarke's Model for Flat Fading, Jake's Model, Level Crossing Rate, Simulation of Clarke's/Jake's Model, Two Ray Rayleigh Fading Model, Problem Solving.

UNIT -3

Equalization & Diversity Techniques:
Equalization: Survey of Equalization Techniques, Linear and Non-linear Equalizers – Linear Transversal Equalizer, Decision Feedback Equalizer (DFE), Algorithms for Adaptive Equalization – Zero Forcing, LMS, RLS, Fractionally Spaced Equalizers.
Diversity Techniques: Realization of Independent Fading Paths, *Receiver Diversity* – System Model, Selection Combining, Threshold Combining, Maximal Ratio Combining, Rake receiver, Equal Gain Combining, *Transmit Diversity*–Channel known at Transmitter, Channel unknown at Transmitter – the Alamouti Scheme, analysis.

UNIT - 4

Multiple Access Techniques & Networking:
Introduction to Multiple Access: FDMA, TDMA, CDMA, SDMA, Packet Radio, Capacity of Cellular Systems, Problem Solving.
Introduction to Wireless Networking: Introduction to Wireless Networks, Differences between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling.

UNIT - 5

Multicarrier Modulation:
Data Transmission using Multiple Carriers, Multicarrier Modulation with Overlapping Subchannels, Discrete Implementation of Multicarrier Modulation, The Cyclic Prefix, Orthogonal Frequency Division Multiplexing (OFDM), Matrix Representation of OFDM, Vector Coding, Challenges in Multicarrier Systems, Problem Solving.

***Course Outcomes**:* After completion of this course the students will be able to

a. Understand basics of Wireless Communications and its evolution process.
b. Know about the mechanism of radio mobile propagation and its effects.
c. Apply various types of diversity and equalization techniques to counter balance the effects of Wireless Channel.
d. Recognize the importance of Wireless Networking and multiple access techniques in the present day mobile communications
e. Analyze and design mobile systems using OFDM technology for mitigating the ISI effects at higher data rates.

TEXT BOOKS:

1. Aditya K Jagannatham, "Principles of Modern Wireless Communications Systems," 1st Edition, McGraw Hill, 2015.
2. T. S. Rappaport, "Wireless Communications, Principles and Practice," Prentice Hall, 2nd Edition, 2002.

REFERENCES:

1. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.
2. David Tse, PramodViswanath, "Fundamentals of Wireless Communications," Cambridge University Press, 2006.
3. Dr. KamiloFeher, "Wireless Digital Communications," Prentice Hall, 1995.

I M.Tech II Semester

DETECTION AND ESTIMATION THEORY (17D38202)

L	T	P	C
4	0	0	4

Course Objectives:

1. To provide knowledge about various estimation, and detection techniques.
2. To analyze different methods & to detect and estimate the signal from noisy signal.
3. Estimate and detect the signals in the presence of noise.

UNIT - I

Introduction to Estimation and Detection:

Introduction, Detection and Estimation in Signal Processing, the Mathematical Detection& Estimation problem, Assessing Estimator Performance, Hierarchy of detection problems, Role of asymptotics.

Estimation

UNIT - II

Minimum Variance Unbiased Estimation:

Unbiased Estimators, Minimum Variance Criterion, Existence of the minimum Variance Unbiased Estimator, Finding the Minimum Variance Unbiased Estimator,

Cramer-Rao Lower Bound - Estimator of Accuracy Considerations, Cramer-Rao Lower Bound (CRLB), General CRLB for Signals in White Gaussian Noise, Transformation of Parameters, Extension to a Vector Paramter, Vector Parameter CRLB for Transformations, CRLB for the general Gaussian case,

Linear Models -Definition and Properties, Linear Model Examples, Extension to the Linear Model,

General Minimum Variance Unbiased Estimation: Introduction, Sufficient Statistics, Finding Sufficient Statistics.

UNIT - III

Best Linear Unbiased Estimators:

Definition of BLUE, Finding the BLUE, Extension to Vector Parameter,

Estimation Methods - Maximum Likelihood Estimation (MLE), Finding MLE, Properties of MLE, MLE for Transformed Parameters, Numerical Determination of the MLE, Extension to a Vector Parameter, The Least Squares Approach, Linear Least Squares, Method of Moments, Extension to a Vector Parameter, Statistical Evaluation of Estimators.

The Basian Philosophy - Prior Knowledge and Estimation, Choosing a Prior PDF, Properties of Gaussian PDF, Basian Linear Model, Minimum Mean Square Error (MMSE) Estimators, Maximum A Posteriori Estimators, Performance Description, Linear Basian Estimators – Introduction, Linear MMSE Estimation, Geometrical Interpretations, The Vector LMMSE Estimator.

Detection

UNIT - IV

Statistical Decision Theory I:

Introduction, Neyman-Pearson Theorem, Receiver Operating Characteristics, Minimum Probability of Error, Bayes Risk, Multiple Hypothesis Testing,

Deterministic Signals - Matched Filters, Development of Detector, Performance of Matched Filter, Performance of Generalized Matched Filters, Multiple Signals – Binary Case and its performance, M-ary Case, Linear Model, **Random Signals**– Estimator Correlator, Linear Model.

UNIT - V

Statistical Decision Theory II:

Introduction, Summary of Composite Hypothesis, Composite Hypothesis Testing (CHT),

CHT approaches – Bayesian Approach, Generalized Likelihood Approach, Performance of GLRT for Large Data Records, Equivalent Large Data Records Tests.

Course Outcomes:

a. The students will be able to apply various methods of signal estimation knowing the significance of each method.
b. The students will be able to know Cramer-Rao Lower bound in estimating a signal.
c. By applying suitable criterion the students will be able to detect the signals with minimum errors in the presence of noise.

Text Books:

1. Steven M. Kay, "Fundamentals of Statistical Signal Processing – Estimation Theory," Pearson, 2010.
2. Shanmugam and Breipohl, "Detection of Signals in Noise and Estimation," John Wiley& Sons, 2004.

References:

1. Mischa Schwartz, L.Shaw, "Signal Processing: Discrete Sprectral Analysis, Detection, and Estimation," McGraw Hill.
2. Harry L.Van Trees, Kristine L.Bell, Zhi Tian, "Detection Estimation and Modulation Theory, Part I: Detection, Estimation and Filtering Theory," 2nd Edition, Wiley, 2013.

MIXED SIGNAL DESIGN (17D38203)

L	T	P	C
4	0	0	4

Course Objectives: students will be able to

1. To understand the design of circuits in IC form especially both digital and analog designs.
2. To gain knowledge on power amplifiers and different feed concepts.
3. To acquire knowledge on design different architectures in mixed signal mode.
4. To gain the knowledge on data converters like Digital to Analog and Analog to Digital Converters.

UNIT – I:

Current Sources & Sinks: The cascode connection, sensitivity and temperature analysis, transient response, layout of simple Current Mirror, matching in MOSFET mirrors, other Current Sources/Sinks. Voltage dividers, current source self-biasing, band gap voltage references, Beta Multiplier Referenced Self-biasing.

UNIT – II:

Amplifiers: Gate Drain connected loads, Current Source Loads, Noise and Distortion, Class AB Amplifier. Feedback Amplifiers: Feedback Equation, properties of negative feedback and amplifier design, feedback topologies, amplifiers employing the four types of feedback, Stability.

UNIT – III:

Differential Amplifiers: The Source Coupled pair, the Source Cross-Coupled pair, cascode loads, Wide-Swing Differential Amplifiers, Operational Amplifiers: Basic CMOS Op-Amp Design, Operational Trans conductance Amplifiers, Differential Output Op-Amp.

UNIT – IV:

Non-Linear & Dynamic Analog Circuits: Basic CMOS Comparator Design, Adaptive Biasing, Analog Multipliers, MOSFET Switch, Switched Capacitor circuits: Switched Capacitor Integrator, dynamic circuits.

UNIT – V:

Data Converter Architectures: Data Converter Fundamentals, DAC & ADC specifications, Mixed Signal Layout issues, DAC architectures, ADC architectures.

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

a. Design mixed signal based circuits starting from basic constraints to advanced constraints.
b. Demonstrate in-depth knowledge in Data Converters – ADC and DAC, power amplifiers.
c. Design circuits like Various feedback concepts and op-amp circuits.
d. Understand the design of non-linear and dynamic analog circuits.

TEXT BOOKS:

1. Baker, Li, Boyce, "CMOS Circuit Design, Layout and Simulation," 1st Edition, Tata McGraw Hill,
2. Rudy Van De Plassche, "CMOS Integrated Analog-to-Digital and Digital-to Analog converters," Kluwer Academic Publishers, 2003

REFERENCES:

1. R. Jacob Baker, "CMOS Mixed-Signal Circuit Design", Wiley Interscience, 2009.
2. David A.Johns, Ken Martin, "Analog Integrated Circuit Design," John-Wiley & Sons, 1997.
3. B. Razavi, "Design of Analog CMOS Circuits," McGraw Hill, 2003.

EMBEDDED SYSTEM DESIGN (17D38204)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study about current technologies, integration methods and hardware and software design concepts associated with processor in Embedded Systems.
2. To study about different types of memory and memory management schemes and various interfacing devices related to design of an Embedded System
3. To get detail knowledge regarding testing and hardware software co- design issues pertaining to design of an Embedded System

UNIT-I: Introduction

An Embedded System-Definition, Examples, Current Technologies, Integration in system Design, Embedded system design flow, hardware design concepts, software development, processor in an embedded system and other hardware units, introduction to processor based embedded system design concepts.

UNIT-II: Embedded Hardware

Embedded hardware building blocks, Embedded Processors – ISA architecture models, Internal processor design, processor performance, Board Memory – ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and performance.

Embedded board Input / output – Serial versus Parallel I/O, interfacing the I/O components, I/O components and performance, Board buses – Bus arbitration and timing, Integrating the Bus with other board components, Bus performance.

UNIT-III: Embedded Software

Device drivers, Device Drivers for interrupt-Handling, Memory device drivers, On-board bus device drivers, Board I/O drivers, Explanation about above drivers with suitable examples.

Embedded operating systems – Multitasking and process Management, Memory Management, I/O and file system management, OS standards example – POSIX, OS performance guidelines, Board support packages, Middleware and Application Software – Middle ware, Middleware examples, Application layer software examples.

UNIT-IV:

Embedded System Design, Development, Implementation and Testing

Embedded system design and development lifecycle model, creating an embedded system architecture, introduction to embedded software development process and tools- Host and Target machines, linking and locating software, Getting embedded software into the target system, issues in Hardware-Software design and co-design.

Implementing the design-The main software utility tool, CAD and the hardware, Translation tools, Debugging tools, testing on host machine, simulators, Laboratory tools, System Boot-Up.

UNIT-V: Embedded System Design-Case Studies

Case studies- Processor design approach of an embedded system –Power PC Processor based and Micro Blaze Processor based Embedded system design on Xilinx platform-NiosII Processor based Embedded system design on Altera platform-Respective Processor architectures should be taken into consideration while designing an Embedded System.

Course Outcomes: After completion of this course the students will be able to

a. Know clear knowledge regarding current technologies and issues relating to hardware and software design concepts associated with processor in Embedded Systems.
b. Understand complete knowledge pertaining to different types of memory and memory management schemes and various interfacing devices related to design of an Embedded System.
c. Explain different techniques related to testing and hardware software co- design issues pertaining to design of an Embedded System.

TEXT BOOKS:

1. Tammy Noergaard, “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier (Singapore) Pvt.Ltd.Publications, 2005.
2. Frank Vahid, Tony D. Givargis, “Embedded system Design: A Unified Hardware/Software Introduction”, John Wily & Sons Inc.2002.

REFERENCES:

1. Peter Marwedel, “Embedded System Design”, Science Publishers, 2007.
2. Arnold S Burger, “Embedded System Design”, CMP.
3. Rajkamal, “Embedded Systems: Architecture, Programming and Design”, TMH Publications, Second Edition, 2008.

I M.Tech II Semester

FUZZY SYSTEMS AND NEURAL NETWORKS (17D38205)

L	T	P	C
4	0	0	4

Course Objectives:

1. To analyze basic neural computational models.
2. To get in detail knowledge regarding different algorithms related to neural learning
3. To study about different issues related probability and fuzziness and different types of fuzzy associative memories.

UNIT-I

Basic Neural Computational Models:
Basic concepts of Neural Nets, Inference and learning , Classification models (single layer Perceptrons, multi layer perceptrons), Association models (Hop field Nets, Bidirectional associative memories)

UNIT - II

Supervised and Unsupervised learning; Statistical learning; Neural Network learning (Back propagation, Radial basis Function Networks, ART Networks)

UNIT - III

Rule-Based Neural networks; Network Training; Decision Tree Based NN's;
Incremental Learning: Principles; Symbolic methods; Neural Network Approaches (Probabilistic NN's); Incremental RBCN.

UNIT-IV

Fuzziness Vs Probability: Fuzzy Sets & Systems; The Geometry of Fuzzy sets; The Fuzzy Entropy Theorem; The Subsethood Theorem; The Entropy Subsethood Theorem.

UNIT - V

Fuzzy Associative Memories: Fuzzy & Neural Function Estimators; Fuzzy Hebbian FAMs; Adaptive FAMs. comparison of fuzzy & neural systems: Case Studies.

Course Outcomes: After completion of this course the students will be able to

a. Understand functioning of basic neural computational models.
b. Get complete knowledge regarding different algorithms related to neural learning
c. Understand about different issues related probability and fuzziness and different types of fuzzy associative memories.

Text Books:

1. B.Kosko, "Neural Networks & Fuzzy Systems", Prentice Hall (India) Ltd., 1992.
2. Yegna Narayanan, "Artificial Neural Networks". 8th Printing, PHI, 2003.

References:

1. Limin Fu,Neural, "Networks in Computer Intelligence", McGraw Hill Co., 1994.
2. S.Haykin "Neural Networks - A Comprehensive Foundation", Maxwell Macmillan International, 1991.

WIRELESS SENSOR NETWORKS (17D38206)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study about different types of sensor networks, advantages, applications and the mechanism of transportation and processing involved in Wireless Sensor Networks.
2. To study about representation and different protocols and mechanisms involved in routing of Wireless Sensor Networks.
3. To study about tools and simulators associated with Wireless Sensor Networks.

UNIT-I

Sensor networks, advantages and applications, Sensor Network Applications - Habitat Monitoring, Smart Transportation, Collaborative Processing

UNIT - II

Localization and tracking,- sensing model, Distributed Representation, Tracking Multiple Objects networking sensors- Medium Access Control, Energy-Aware Routing to a Region, Attribute-Based Routing

UNIT-III

Infrastructure Establishment -Clustering and time synchronizations, Localization and localization services, Sensor tracking and control - Task-Driven Sensing, Information-Based Sensor Tasking, Sensor Group Management

UNIT-IV

Sensor Network data bases - Sensor Database Challenges , Query Interfaces , Data-Centric Storage, Multidimensional Indices for Orthogonal Range Searching, Locality-Preserving Hashing

UNIT - V

Sensor Network Platforms and Tools -Sensor Network hardware, Node level software, Node-Level Simulators, wireless sensor networks positioning and location management.

Course Outcomes: After completion of this course the students will be able to

a. Understand different types of sensor networks, advantages, applications and the mechanism of transportation and processing involved in Wireless Sensor Networks.
b. Understand about representation and different protocols and mechanisms involved in routing of Wireless Sensor Networks.
c. Gets complete knowledge regarding different tools and simulators associated with Wireless Sensor Networks.

REFERENCES:

1. F. Zhao, C Guibas, “Wireless Sensor Networks”, Elsevier, Morgan Kaufmann, 2004.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, “Wireless Sensor Networks -Technology, Protocols and Applications”, John Wiley & Sons, 2007.

SPEECH PROCESSING (17D38207)

L	T	P	C
4	0	0	4

Course Objectives:

1. To understand how speech signals are processed for Analysis and Synthesis. Also to understand speech processing in the context of its creation (anatomy, classification of sounds, etc.) as well as in its perception (psychology & neuroscience).
2. To analyze tools those are needed for analysis and synthesis, in the areas of digital signal processing for time-frequency analysis.

UNIT I

FUNDAMENTALS OF DIGITAL SPEECH PROCESSING: Anatomy & Physiology of Speech organs, the process of speech production, the acoustic theory of speech production, Digital models for speech signals.

TIME DOMAIN MODELS FOR SPEECH PROCESSING: Introduction- Window considerations, Short time energy and average magnitude Short time average zero crossing rate ,Speech vs silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

UNIT II

LINEAR PREDICTIVE CODING (LPC) ANALYSIS: Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition, Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

UNIT III

HOMOMORPHIC SPEECH PROCESSING: Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, the Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder.

SPEECH ENHANCEMENT: Nature of interfering sounds, Speech enhancement techniques, Spectral subtraction, Enhancement by re-synthesis.

UNIT IV

AUTOMATIC SPEECH RECOGNITION: Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System,. Continuous digit Recognition System

SPEAKER RECOGNITION: Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System.

UNIT V

HIDDEN MARKOV MODEL (HMM) FOR SPEECH: Hidden markov model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS, Adapting to variability in speech, Language models.

Course Outcomes: After completing the course, the student will be familiar with the principles and the techniques used in speech processing. This includes speech synthesis, speech coding and speech recognition.

TEXT BOOKS:

1. L.R Rabiner and S.W.Schafer, "Digital Processing of Speech Signals", Pearson, 2007.
2. Thomas F. Quateri, "Discrete Time Speech Signal Processing", 1st Edition, Pearson Edition.

REFERENCES:

1. Douglas O Shaughnessy, "Speech communication", Second Edition Oxford University press, 2000.
2. L.R Rabinar and B.H.Juang, "Fundamentals of Speech Recognition," PHI, 1993.
3. Ben Gold & Nelson Morgan, "Speech & Audio Signal Processing", 1st Edition, Wiley.

INTERNET OF THINGS (17D38208)

L	T	P	C
4	0	0	4

Course Objectives:

1. To introduce the terminology, technology and its applications.
2. To introduce the raspberry PI platform, that is widely used in IoT applications.
3. To introduce the implementation of web based services on 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 enabled 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.

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, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT III:

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

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.

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

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

a. Understand the new computing technologies
b. Apply the latest computing technologies like cloud computing technology and Big Data
c. Introduce the concept of Machine to Machine (M2M) with necessary protocols
d. Acquire the skill to write programs using python scripting language used in many IoT devices

TEXT BOOKS:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach,” 1st Edition, Universities Press, 2015.
2. Matt Richardson & Shawn Wallace, “Getting Started with Raspberry Pi,” Maker Media Inc., O'Reilly, 2014.

MULTIMEDIA COMMUNICATIONS (17D38209)

L	T	P	C
4	0	0	4

Course Objectives:

1. To study basic requirements of Multimedia Communications.
2. To study about different coding schemes involved in Multimedia Communications.
3. To study about different standards and protocols related Multimedia Communications and its networks.

UNIT-I

Multimedia communications - multimedia requirements, Audio Visual integration - Lip synchronization, Audio-to-visual mapping, Bio-model person verification, Joint Audio-Video coding

UNIT - II

Multimedia information processing, Perceptual coding of digital audio signals - hybrid coder -differential perceptual audio coder, Image coding, Video coding, Water marking

UNIT-III

ANNS for multimedia processing - NN techniques for motion estimation, face detection and recognition, Distributed multimedia systems, IP based networks, Multimedia Operating Systems.

UNIT-IV

Multimedia Communication Standards - overview of MPEG 1, MPEG-2, MPEG-4 and MPEG-7., Real time multimedia transmission across the Internet

UNIT - V

Multimedia Communication across networks - packet audio / video, Streaming video across internet, Multimedia transport across IP/ATM Networks and Wireless networks

Course Outcomes: After completion of this course the students will be able to

a. Gets knowledge regarding fundamentals of Multimedia Communications
b. Understand about different coding schemes involved in Multimedia Communications.
c. Gets complete knowledge regarding different standards and protocols related Multimedia Communications and its networks.

TEXT BOOKS:

1. K R Rao et al, “Multimedia Communication Systems: Techniques and Standards”, Pearson, 2002.

REFERENCES:

1. Tay Vaughan, “Multimedia- Making it Work”, TMH, 5th Edition, 2001.
2. Pk Andleigh , K. Thakkar, “Multimedia Systems Design”, PHI,2002.

ADVANCED COMMUNICATIONS LAB (17D38210)

L	T	P	C
0	0	3	2

Course Objectives:

1. To generate random data at given rates and employ different modulation schemes over generated data.
2. To simulate different modulated signals and diversity schemes over AWGN, and estimate data reception using different algorithms.
3. To implement RAKE receiver and estimate its performance through BER curve.

List of Experiments:

1. Generation of Random data at a given data rate (Hardware & Software) – (M-Sequence).
2. Simulation of Rayleigh fading channel incorporating speed of the mobile & Power delay profile
3. Simulation of BPSK system over AWGN channel & finding its performance with BER plot.
4. Implementation of Equalization at the receiver to remove ISI caused due to Low channel bandwidth
5. Simulation of CDMA signal using QPSK modulation scheme &obtain matched filter response over AWGN Channel
6. Implementation of RAKE receiver & finding its performance through BER Curve
7. Implementation of L.M.S algorithm to estimate the original data when it is corrupted by noise & channel.
8. Implementation of R.L.S algorithm to estimate the original data when it is corrupted by noise & channel.

Tools Required: MATLAB – 7.0 & above

Course Outcomes: After completion of this course the students will be able to

a. Generate random data at given rates and employ different modulation schemes over generated data.
b. Simulate different modulated signals and diversity schemes over AWGN, and estimate data reception using different algorithms.
c. Implement RAKE receiver and estimate its performance through BER curve.

MIXED SIGNAL DESIGN LAB (17D38211)

L	T	P	C
0	0	3	2

Course Objectives: students will be able to

1. Know basic electronics involved in the design of MOS circuits.
2. To design a schematic and layout for Combinational and Sequential Circuits
3. Analyze the power and timing of Combinational and Sequential Circuits using EDA tools

List of experimental Concepts:

1. Analog circuit simulation.
2. Digital circuit simulation.
3. Mixed signal simulation.
4. Layout Extraction.
5. Parasitic values estimation from layout.
6. Layout Vs Schematic.
7. Net List Extraction.
8. Design Rule Checks

Equipment/Software Required:

- EDA Tools - Industry Standard software-latest version like Mentor/ Synopsys /Equivalent.
- Personal computer with necessary peripherals.

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

a. Make models of transistor circuits and simulate them for various operational requirements.
b. Design of analog and digital circuits using EDA tools.
c. Analyze and design of VLSI circuits.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
COLLEGE OF ENGINEERING (AUTONOMOUS), PULIVENDULA
YSR (KADAPA) District 516 390, (A.P) INDIA

M.Tech. Digital Electronics & Communication Systems (DECS)

Semester-I							
S.No.	**Course Code**	**Course Name**	**Category**	**Hours per**			**Credits**
				L	**T**	**P**	
1.		Advanced Digital System Design	PC	3	0	0	3
2.		Wireless and Mobile Communications	PC	3	0	0	3
3.		**Program Elective– 1** a. Design of Fault Tolerant Systems b. CMOS Digital IC Design c. Fuzzy Systems and Neural Networks	PE	3	0	0	3
4.		**Program Elective– 2** a. Coding Theory and Techniques b. Advanced Digital Signal Processing c. 5G Communications	PE	3	0	0	3
5.		Advanced Digital System Design Lab	PC	0	0	4	2
6.		Wireless and Mobile Communications Lab	PC	0	0	4	2
7.		Research Methodology and IPR	MC	2	0	0	2
8.		Audit Course 1	AC	2	0	0	0
				Total			**18**

Semester-II							
S.No.	**Course Code**	**Course Name**	**Category**	**Hours per**			**Credits**
				L	T	**P**	
1.		Analog and Mixed Signal Design	PC	3	0	0	3
2.		Advanced Communications and Networks	PC	3	0	0	3
3.		**Program Elective – 3** a. Low Power VLSI Design b. SoC Architecture c. Wireless Sensor Networks	PE	3	0	0	3
4.		**Program Elective – 4** a. Software Defined Radio b. Image and Video Processing c. Transform Techniques	PE	3	0	0	3
5.		Analog and Mixed Signal Design Lab	PC	0	0	4	2
6.		Advanced Communications and Networks Lab	PC	0	0	4	2
7.		Technical Seminar	PR	0	0	4	2
8.		Audit Course 2	AC	2	0	0	0
				Total			**18**

Semester-III							
S.No.	**Course Code**	**Course Name**	**Category**	**Hours per**			**Credits**
				L	T	**P**	
1.		**Program Elective –5** a. Detection and Estimation Theory b. Embedded Systems c. Artificial Intelligence and Machine Learning	PE	3	0	0	3
2.		Open Elective	OE	3	0	0	3
3.		Dissertation Phase – I	PR	0	0	20	10
4		Co-Curricular Activities	PR				02
					Total		**18**

Semester-IV							
S.No.	**Course Code**	**Course Name**	**Category**	**Hours per**			**Credits**
				L	T	**P**	
1.		Dissertation Phase – II	PR	0	0	32	16
					Total		**16**

Open Elective:

1. Business Analytics
2. Industrial Safety
3. Operation Research
4. Cost Management of Engineering Projects
5. Composite Materials
6. Waste to Energy

Audit course I:

1. English for Research Paper Writing
2. Value Education
3. Pedagogy Studies

Audit course II:

1. Disaster Management
2. Constitution of India
3. Personality Development through Life Enlightenment Skills.

Guidelines for Awarding Credits for Co-curricular Activities:

Name of the Activity	**Maximum Credit Points Eligible / Activity**
Participation in Seminar/Conference/Workshop/Symposium/ Training Programs within India (related to the specialization of the student)	1
Participation in Seminar/Conference/Workshop/Symposium/ Training Programs outside India (related to the specialization of the student)	2
Academic Award/Research Award from State Level/National Agencies	1
Academic Award/Research Award from International Agencies	2
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	1
Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)	2

Course Code		ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To understand processor arithmetic operations and basic binary codes.
- To learn and design different combinational logic circuits.
- To implement sequential logic circuit design.
- To design different subsystems using various combinational circuits.
- To design and analyze different subsystems using various sequential circuits.

Course Outcomes (CO): Student will be able to

- Understand processor arithmetic operations and basic binary codes.
- Design different combinational logic circuits.
- Implement sequential logic circuit design.
- Design different subsystems using various combinational circuits.
- Design and analyze different subsystems using various sequential circuits.

UNIT - I		Lecture Hrs:

Processor Arithmetic: Two's complement number system - Arithmetic operations; Fixed point number system; Floating point number system - IEEE 754 format, Basic binary codes.

UNIT - II		Lecture Hrs:

Combinational circuits: CMOS logic design, Static and dynamic analysis of Combinational circuits, timing hazards. Functional blocks: Decoders, Encoders, Three-state devices, Multiplexers, Parity circuits, Comparators, Adders, Subtractors, Carry look-ahead adder – timing analysis. Combinational multiplier structures.

UNIT - III		Lecture Hrs:

Sequential Logic: Latches and Flip-Flops, Sequential logic circuits - timing analysis (Set up and hold times), State machines - Mealy & Moore machines, Analysis, FSM design using D flip-flops, FSM optimization and partitioning; Synchronizers and metastability. FSM Design examples: Vending machine, Traffic light controller, Washing machine. Design and architecture of CPLD and FPGA.

UNIT - IV		Lecture Hrs:

Subsystem Design using Combinational Circuits: Design different logical blocks involving mostly combinational circuits: ALU, 4-bit combinational multiplier, Barrel shifter, Simple fixed point to floating point encoder, Dual Priority encoder, Cascading comparators.

UNIT - V		Lecture Hrs:

Subsystem Design using Sequential Circuits: Design different logical blocks involving mostly sequential circuits: Pattern (sequence) detector, Programmable Up-down counter, Round robin arbiter with 3 requesters, Process Controller, FIFO.

Textbooks:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Pearson Education; 6th Edition, 2018.
2. John F. Wakerly, "Digital Design", Prentice Hall, 3rd Edition, 2002.

Reference Books:

1. N. N. Biswas, "Logic Design Theory", PHI.
2. Samuel C. Lee, "Digital Circuits and Logic Design", PHI.

Online Learning Resources:

Course Code		WIRELESS AND MOBILE COMMUNICATIONS	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To study about the channel planning for Wireless systems.
- To know about the large scale path loss in Mobile Radio Propagation.
- To learn about the small scale fading and multipath fading in Mobile Radio Propagation.
- To comprehend the concepts of Equalizers and Diversity techniques.
- To study about the Wireless networks and their standards.

Course Outcomes (CO): Student will be able to

- Know about the channel planning for Wireless systems.
- Learn about the large scale path loss in Mobile Radio Propagation.
- Understand the small scale fading and multipath fading in Mobile Radio Propagation.
- Comprehend the concepts of Equalizers and Diversity techniques.
- Know about the Wireless networks and their standards.

UNIT - I		Lecture Hrs:

The Cellular Concept: System design fundamentals: Introduction, Frequency reuse, Channel assignment Strategies, Handoff strategies- Prioritizing handoffs, Practical handoff considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for wireless systems, Adjacent channel interference, Power control for reducing interference, Trunking and Grade of service, Improving coverage & capacity in Cellular systems- Cell splitting, sectoring.

UNIT - II		Lecture Hrs:

Mobile Radio Propagation-Large-Scale Path Loss: Introduction to Radio wave propagation, Free space propagation model, relating power to electric field, Three basic propagation mechanisms, Reflection, Ground reflection (Two-Ray) model, Diffraction, Scattering, Outdoor propagation models, Indoor propagation models, Signal penetration into buildings, Ray tracing and Site specific modeling.

UNIT - III		Lecture Hrs:

Mobile Radio Propagation - Small Scale Fading and Multipath Fading : Small scale multipath propagation, factors influencing small scale fading, Doppler shift, Impulse response model of a multipath channel, relationship between bandwidth and received power, Small-scale multipath measurements, Parameters of mobile multipath channels, Types of Small-scale fading- fading effects due to multipath time delay spread, fading effects due to Doppler spread, statistical models for multipath fading channels, Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh fading model.

UNIT - IV		Lecture Hrs:

Equalization and Diversity: Introduction, Fundamentals of equalization, Training a generic adaptive equalizer, equalizers in a communication receiver, Linear equalizers, Non-linear equalization, Algorithms for adaptive equalization. Diversity techniques - Derivation of selection, diversity improvement, Derivation of maximal ratio combining improvement, Practical space diversity consideration, Polarization diversity, Frequency diversity, Time diversity, RAKE receiver.

UNIT - V		Lecture Hrs:

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.

Textbooks:
1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI. 2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
Reference Books:
1. Wireless Digital Communications – Kamilo Feher, 1999, PHI. 2. Wireless Communication and Networking – William Stallings, 2003, PHI. 3. Principles of Wireless Networks – KavehPah Laven and P. Krishna Murthy, 2002, PE. 4. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.
Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 1	L	T	P	C
Semester	I	DESIGN OF FAULT TOLERANT SYSTEMS	3	0	0	3

Course Objectives:

- To provide broad understanding of fault diagnosis and tolerant design approach.
- To illustrate the framework of test pattern generation using semi and fully automatic approach.
- To acquire the knowledge of scan architectures.
- To understand the design concepts of built-in-self test.
- To learn about various standard test access methods.

Course Outcomes (CO): Student will be able to

- Understand fault diagnosis and tolerant design approach.
- Illustrate the framework of test pattern generation using semi and fully automatic approach.
- Comprehend the knowledge of scan architectures.
- Understand the design concepts of built-in-self test.
- Learn about various standard test access methods.

UNIT - I — Lecture Hrs:

Fault Tolerant Design: Basic concepts: Reliability concepts, Failures & faults, Reliability and failure rate, Relation between reliability and mean time between failure, maintainability and availability, reliability of series, parallel and parallel-series combinational circuits. Fault tolerant design - Basic concepts - static, dynamic, hybrid, triple modular redundant system (TMR), 5MR reconfiguration techniques, Data redundancy, Time redundancy and software redundancy concepts.

UNIT - II — Lecture Hrs:

Self-Checking Circuits & Fail-Safe Design: Basic concepts of self-checking circuits, Design of totally self-checking checker, Checkers using m out of n codes, Berger code, Low-cost residue code. Fail safe design- Strongly fault secure circuits, fail safe design of sequential circuits using partition theory and Berger code, totally self-checking PLA design.

UNIT - III — Lecture Hrs:

Design for Testability: Design for testability for combinational circuits: Basic concepts of testability, Controllability and observability, The Reed Muller's expansion technique, use of control and syndrome testable designs.

Design for testability by means of scan: Making circuits testable, Testability insertion, Full scan DFT technique- Full scan insertion, flip-flop structures, Full scan design and test, Scan architectures-full scan design, Shadow register DFT, Partial scan methods, multiple scan design, other scan designs.

UNIT - IV — Lecture Hrs:

Logic Built – In - Self-Test (BIST) : Basics-Memory-based BIST, BIST effectiveness, BIST types, Designing a BIST, Test pattern generation- engaging TPGs, exhaustive counters, ring counters, twisted ring counter, Linear feedback shift register, Output response analysis-engaging ORA's, One's counter, transition counter, parity checking, Serial LFSRs, Parallel signature analysis, BIST architectures-BIST related terminologies, A centralized and separate board-level BIST architecture, Built-in evaluation and self-test (BEST), Random test socket(RTS), LSSD On-chip self-test, Self – testing using MISR and SRSG, Concurrent BIST, BILBO, Enhancing coverage, RT level BIST design-CUT design, simulation and synthesis, RTS BIST insertion, Configuring the RTS BIST, incorporating configurations in BIST, Design of STUMPS, RTS and STUMPS results.

UNIT - V — Lecture Hrs:

Standard IEEE Test Access Methods: Boundary scan basics, Boundary scan architecture- test access port, boundary scan registers, TAP controller, the decoder unit, select and other units, Boundary scan test instructions -Mandatory instructions, Board level scan chain structure-One serial scan chain, multiple-scan chain with one control test port, multiple-scan chains with one TDI,TDO but multiple TMS, Multiple-scan chain, multiple access port, RT Level boundary scan-inserting boundary scan test hardware for CUT, Two module test case, virtual boundary scan tester, Boundary Scan Description language.

Textbooks:
1. Fault Tolerant & Fault Testable Hardware Design- Parag K. Lala, PHI, 1984. 2. Digital System Test and Testable Design using HDL models and Architectures –Zainalabedin Navabi, Springer International Ed.
Reference Books:
1. Digital Systems Testing and Testable Design- Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Jaico Books. 2. Essentials of Electronic Testing- Bushnell &Vishwani D. Agarwal, Springers. 3. Design for Test for Digital IC's and Embedded Core Systems- Alfred L. Crouch, 2008.
Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 1	L	T	P	C
Semester	I	CMOS DIGITAL IC DESIGN	3	0	0	3

Course Objectives:

- To understand the fundamental properties of digital integrated circuits using MOSFET's .
- To learn the basics of CMOS Digital IC design using Combinational MOS logic circuits.
- To know the basics of CMOS Digital IC design using Sequential MOS logic circuits.
- To understand the fundamentals of Dynamic logic circuits.
- To analyze and compare different semiconductor memories.

Course Outcomes (CO): Student will be able to

- Learn the fundamental properties of digital integrated circuits using MOSFET's .
- Understand the basics of CMOS Digital IC design using Combinational MOS logic circuits.
- Know the basics of CMOS Digital IC design using Sequential MOS logic circuits.
- Understand the fundamentals of Dynamic logic circuits.
- Analyze and compare different semiconductor memories.

UNIT - I		Lecture Hrs:

MOS Design Pseudo NMOS Logic: Inverter, Inverter threshold voltage, output high voltage, Output low voltage, gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT - II		Lecture Hrs:

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates–NOR & NAND gate, Complex Logic circuits design–Realizing boolean expressions using NMOS gates and CMOS gates, AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

UNIT - III		Lecture Hrs:

Sequential MOS Logic Circuits: Behavior of bi-stable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT - IV		Lecture Hrs:

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT - V		Lecture Hrs:

Semiconductor Memories: Types, RAM array organization, DRAM – Types, Operation, DRAM timing analysis, Leakage currents in DRAM cell and refresh operation, SRAM operation, SRAM timing analysis, Leakage currents in SRAM cells, Flash Memory-NOR flash and NAND flash.

Textbooks:

1. Neil Weste, David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson, 2010.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Edition, 2011.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2ndEdition, PHI.
3. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 1 FUZZY SYSTEMS AND NEURAL NETWORKS	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To analyze basic neural computational models.
- To get in detail knowledge about supervised and un-supervised learning.
- To understand different types of associative memories.
- To study about different issues related probability and fuzziness.
- To learn about different types of fuzzy associative memories.

Course Outcomes (CO): Student will be able to

- Analyze basic neural computational models.
- Gain knowledge about supervised and un-supervised learning.
- Understand different types of associative memories.
- Analyze the issues related probability and fuzziness.
- Learn different types of fuzzy associative memories.

UNIT - I		Lecture Hrs:

Introduction: History of Neural networks, Structure and functions of biological and artificial neuron, Neural network architectures, learning methods, evaluation of neural networks. McCulloch-Pitt's neuron model, perception learning, Delta learning, Windrow-Hoff learning rules, linear separability, Adaline, Modifications.

UNIT - II		Lecture Hrs:

Supervised Learning: Architectures, Madalines, Back propagation algorithm, importance of learning parameter and momentum term, radial basis functions.

Unsupervised Learning: Winner – Take – all learning, out star learning, learning vector quantizers, Counter propagation networks, Kohonen self – organizing networks, Grossberg layer, adaptive resonance theory, Hamming net.

UNIT - III		Lecture Hrs:

Associative Memories: Hebbian learning rule, continues and discrete Hopfield networks, recurrent and associative memory, Boltzmann machines, Bi-directional associative memory.

UNIT - IV		Lecture Hrs:

Fuzziness vs Probability: Fuzzy Sets & Systems; The Geometry of Fuzzy sets; The Fuzzy Entropy Theorem; The Subset hood Theorem; The Entropy Subset Hood Theorem.

UNIT - V		Lecture Hrs:

Fuzzy Associative Memories: Fuzzy & Neural Function Estimators; Fuzzy Hebbian FAMs; Adaptive FAMs.

Textbooks:

1. J.M. Zurada, "Introduction to Artificial Neural Systems" - Jaico Publishing House, Bombay,2001.
2. Kishan Mehrotra, Chelkuri. K. Mohan, Sanjay Ranka, "Elements of Artificial Neural Networks", Penram International.

Reference Books:

1. S. N Sivanandham, S. Sumathi, S.N. Deepa, "Introduction to Neural networks using matlab6.0", Tata McGraw Hill, New Delhi, 2005.
2. B. Kosko, "Neural Networks & Fuzzy Systems", Prentice Hall (India) Ltd., 1992.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 2 CODING THEORY AND TECHNIQUES	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To learn the measurement of information and errors.
- To obtain knowledge in designing Cyclic codes.
- To construct tree and trellies diagrams for convolution codes.
- To design the Turbo codes and their applications.
- To analyze the Space time codes and their applications.

Course Outcomes (CO): Student will be able to

- Learn the measurement of information and errors.
- Obtain knowledge in designing Cyclic codes.
- Construct tree and trellies diagrams for convolution codes.
- Design the Turbo codes and their applications.
- Analyze the Space time codes and their applications.

UNIT - I		Lecture Hrs:

Coding for Reliable Digital Transmission and storage: Mathematical model of information, A logarithmic measure of information, Average and mutual information and entropy, Types of errors, Error control strategies.

Linear Block Codes: Introduction to Linear block codes, Syndrome and error detection, Minimum distance of a block code, Error detecting and Error correcting capabilities of a block code, Standard array and Syndrome decoding, Probability of an undetected error for Linear codes over a BSC, Hamming codes. Applications of block codes for error control in data storage system.

UNIT - II		Lecture Hrs:

Cyclic codes: Description, Generator and Parity-check matrices, Encoding, Syndrome computation and error detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT - III		Lecture Hrs:

Convolutional Codes: Encoding of convolutional codes, Structural and distance properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of convolution codes. Application of Viterbi decoding and sequential decoding, Applications of convolutional codes in ARQ system.

UNIT - IV		Lecture Hrs:

Turbo Codes: LDPC Codes- Codes based on sparse graphs, decoding for binary erasure channel, Log-likelihood algebra, Brief propagation, Product codes, Iterative decoding of product codes, Concatenated convolutional codes- Parallel concatenation, The UMTS turbo code, Serial concatenation, Parallel concatenation, Turbo decoding.

UNIT - V		Lecture Hrs:

Space-Time Codes: Introduction, Digital modulation schemes, Diversity, Orthogonal space- time block codes, Alamouti's schemes, Extension to more than two transmit antennas, Simulation results, Spatial Multiplexing: General concept, Iterative APP preprocessing and per-layer Decoding, Linear multilayer detection, Original BLAST detection, QL Decomposition and interface cancellation, Performance of Multi –layer detection schemes, Unified description by linear dispersion codes.

Textbooks:

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

Reference Books:

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
2. Digital Communications- John G. Proakis, 5th ed. TMH, 2008.
3. Error Correction Coding- Mathematical methods & algorithms-Todd K. Moon, Wiley India,2006.
4. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Edition, TMH, 2009.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 2 ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To study about the digital signal processing algorithms.
- To learn about the multi rate signal processing.
- To gain knowledge about the power spectral estimation and their parametric methods.
- To study about the effects of finite word length in fixed-point DSP systems.
- To understand various applications of Digital signal processing.

Course Outcomes (CO): Student will be able to

- Learn about the digital signal processing algorithms.
- Know about the multi rate signal processing.
- Gain knowledge about the power spectral estimation and their parametric methods.
- Appreciate the effects of finite word length in fixed-point DSP systems.
- Understand various applications of Digital signal processing.

UNIT - I		Lecture Hrs:

DSP Algorithms: Fast DFT algorithms based on Index mapping, Sliding discrete fourier transform, DFT computation over a narrow frequency band, Split radix FFT, Linear filtering approach to computation of DFT using Chirp Z-Transform.

UNIT - II		Lecture Hrs:

Multi Rate Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter design & Implementation for sampling rate conversion.

UNIT - III		Lecture Hrs:

Power Spectral Estimation: Estimation of spectra from finite duration observation of signals, non-parametric methods: Bartlett, Welch & Blackmann , Tukey methods.
Parametric Methods for Power Spectrum Estimation: Relation between auto correlation & model parameters, Yule-Waker & Burg Methods, MA & ARMA models for power spectrum estimation.

UNIT - IV		Lecture Hrs:

Analysis of Finite Word length effects in Fixed-Point DSP Systems: Fixed, Floating-Point Arithmetic – ADC quantization noise & signal quality, Finite word length effect in IIR digital filters – Finite word-length effects in FFT algorithms.

UNIT - V		Lecture Hrs:

Applications of Digital Signal Processing: Dual tone multi-frequency signal detection, Spectral analysis of sinusoidal signals, Spectral analysis of Non-stationary Signals, Musical sound processing, Over sampling A/D Converter, Over sampling D/A Converter, Discrete-Time analytic signal Generation.

Textbooks:

1. Sanjit K Mitra, “Digital Signal Processing”, Tata McGraw Hill Publications.
2. J G Proakis, D G Manolokis, “Digital Signal Processing Principles, Algorithms, Applications” PHI.

Reference Books:

1. A V Oppenhiem, R W Schafer, “Discrete-Time Signal Processing”, Pearson Education.
2. Emmanuel C Ifeacher Barrie. W. Jervis, “DSP- A Practical Approach”, Pearson Education.
3. S. M. Kay, “Modern spectral Estimation Techniques” PHI, 1997.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 2 5G COMMUNICATIONS	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To know about the evolution and advancements of mobile technologies.
- To learn about the channel models and their requirements.
- To understand the requirements of transmission over 5G and modulation techniques.
- To acquire knowledge on D2D and M2M communications.
- To gain the knowledge about millimeter wave communications.

Course Outcomes (CO): Student will be able to

- Know about the evolution and advancements of mobile technologies.
- Learn about the channel models and their requirements.
- Understand the requirements of transmission over 5G and modulation techniques.
- Acquire knowledge on D2D and M2M communications.
- Gain the knowledge about millimeter wave communications.

UNIT - I		Lecture Hrs:

Overview of 5G Broadband Wireless Communications: Evolution of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An overview of 5G requirements, Regulations for 5G, Spectrum analysis and sharing for 5G.

UNIT - II		Lecture Hrs:

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

UNIT - III		Lecture Hrs:

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

UNIT - IV		Lecture Hrs:

Device-to-Device (D2D) and Machine-to-Machine (M2M) type Communications: Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multihop and multi-operator D2D communications.

UNIT - V		Lecture Hrs:

Millimeter-wave Communications: Spectrum regulations, deployment scenarios, beamforming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with imperfect CSI, Multi-cell Massive MIMO, Pilot contamination, Spatial modulation (SM).

Textbooks:

1. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
2. Afif Osseiran, Jose.F. Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks", Cambridge University Press.

Reference Books:

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk "Essentials of LTE and LTE-A", Cambridge University Press
3. Athanasios G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, "New Directions in Wireless Communication Systems from Mobile to 5G", CRC Press.
4. Theodore S. Rappaport, Robert W. Heath, Robert C. Danials, James N. Murdock "Millimeter

Wave Wireless Communications", Prentice Hall Communications.
Online Learning Resources:

Course Code		ADVANCED DIGITAL SYSTEM DESIGN LAB	L	T	P	C
Semester	I		0	0	4	2

Course Objectives:

- To familiarize the HDL simulator / synthesis tool.
- To design and implement given combinational circuits on FPGA device.
- To design and implement given sequential circuits on FPGA device.

Course Outcomes (CO): Student will be able to

- Familiarize the HDL simulator / synthesis tool.
- Design and implement given combinational circuit on FPGA device.
- Design and implement given sequential circuit on FPGA device.

List of Experiments:

Student must design ANY TWELVE experiments using standard HDL simulator / Synthesis tool for target FPGA device.

1. HDL code to realize all the logic gates
2. Design and Simulation of adder, Serial Binary Adder, Multi Precession Adder, Carry Look Ahead Adder.
3. Design of 2-to-4 decoder, 8-to-3 encoder (without and with parity)
4. Design of 8-to-1 multiplexer
5. Design of 4 bit binary to gray converter
6. Design of Multiplexer/ Demultiplexer, comparator
7. Design of Full adder using 3 modeling styles
8. Design of flip flops: SR, D, JK, T
9. Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence counter
10. Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out.
11. Design of Sequence Detector (Finite State Machine- Mealy and Moore Machines).
12. Design of 4- Bit Multiplier, Divider.
13. Design of ALU to Perform – ADD, SUB, AND-OR, 1's and 2's Compliment,
14. Design of Finite State Machine.
15. Implementing the above designs on Xilinx/Altera/Cypress/equivalent based FPGA/CPLD kits.

Software Requirements:

Xilinx Vivado

Hardware Requirements: Xilinx Spartan 6 FPGA board.

References:

Online learning resources/Virtual labs:

Course Code		WIRELESS AND MOBILE COMMUNICATIONS LAB	L	T	P	C
Semester	I		0	0	4	2

Course Objectives:

- To understand the concepts of GSM/CDMA technologies.
- To implement signal processing algorithms for the given specifications.
- To implement wireless communication algorithms for the given specifications.

Course Outcomes (CO): Student will be able to

- Understand the concepts of GSM/CDMA technologies.
- Implement signal processing algorithms for the given specifications.
- Implement wireless communication algorithms for the given specifications.

List of Experiments:

Student must do ALL TWELVE experiments using MATLAB/NetSim/Qualnet simulator.

1. Implementation of Convolutional Encoder and Decoder.
2. Simulation of the following Outdoor Path loss propagation models using MATLAB.
   a. Free Space Propagation model
   b. Okumura model
   c. Hata model
3. Simulation of Adaptive Linear Equalizer using MAT LAB software.
4. Measurement of call blocking probability for GSM network using Netsim software.
5. Measurement of call blocking probability for CDMA network using Netsim software.
6. Study of GSM handset for various signaling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
7. Study of transmitter and receiver section in mobile handset and measure frequency.
8. Band signal and GMSK modulating signal.
9. Simulation of RAKE Receiver for CDMA communication using MAT LAB software.
10. Simulate and test various types of PN codes, chip rate, spreading factor and processing gain on performance of DSSS in CDMA.
11. Simulate and test the 3G Network system features using GSM AT Commands. (Features of 3G Communication system: Transmission of voice, video calls, SMS, MMS, TCP/IP, HTTP, GPS).
12. Modelling of communication system using Simulink.

Software Requirements:

MATLAB/NetSim/Qualnet simulator

References:

Online learning resources/Virtual labs:

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Course Code		RESEARCH METHODOLOGY AND IPR	L	T	P	C
Semester	I		2	0	0	2

Course Objectives:

- To know how to identify an appropriate research problem in their interesting domain.
- To understand the ethical issues in the preparation of a research report.
- To learn about different types of Intellectual property rights.
- To gain knowledge about the law of patent rights and copyrights.
- To know about the new developments in IPR.

Course Outcomes (CO): Student will be able to

- Know how to identify an appropriate research problem in their interesting domain.
- Understand the ethical issues in the preparation of a research report.
- Learn about different types of Intellectual property rights.
- Gain knowledge about the law of patent rights and copyrights.
- Know about the new developments in IPR.

UNIT - I		Lecture Hrs:

Research problem: Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II		Lecture Hrs:

Literature study : Effective literature studies, approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper developing a research proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III		Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Process of patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT.

UNIT - IV		Lecture Hrs:

Patent Rights: Scope of patent rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT - V		

New Developments in IPR: Administration of patent system, New developments in IPR, IPR of biological systems, Computer software etc., Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

Reference Books:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.

Course Code		ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I)	L	T	P	C
Semester	I		2	0	0	0

Course Objectives:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT - I		Lecture Hrs:

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT - II		Lecture Hrs:

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT - III		Lecture Hrs:

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT - IV		Lecture Hrs:

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT - V		Lecture Hrs:

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Textbooks:

1. Goldbort R (2006) Writing for Science
2. Day R (2006) How to Write and Publish a Scientific Paper

Reference Books:

1. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
2. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Code		ANALOG AND MIXED SIGNAL DESIGN	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To understand the design of circuit in IC form especially both analog and digital designs.
- To study about power amplifiers and different feedback concepts.
- To acquire knowledge on different design architectures in mixed signal mode.
- To analyze CMOS based switched capacitor circuits.
- To learn the basics of data converters.

Course Outcomes (CO): Student will be able to

- Understand the design of circuit in IC form especially both analog and digital designs.
- Learn about power amplifiers and different feedback concepts.
- Acquire knowledge on different design architectures in mixed signal mode.
- Analyze CMOS based switched capacitor circuits.
- Learn the basics of data converters.

UNIT - I		Lecture Hrs:

Current Sources and Sinks: General considerations, MOS I/V characteristics, Small-cignal model for the MOS transistor, Channel modulation, back gate effect, influence of body bias, Single stage amplifiers with differential loads, the cascode connection , sensitivity and temperature analysis, transient response , layout of simple current mirror , matching in MOSFET mirrors , other current sources or sinks. Voltage dividers, current source self-biasing, band gap voltage references, Beta multiplier referenced self-baising.

UNIT - II		Lecture Hrs:

Amplifiers: Gate drain connected loads, Current sources loads, Noise and distortion, Class AB Amplifier.

Feedback Amplifiers: Feedback equation, properties of negative feedback and amplifier design, feedback topologies, amplifiers employing the four types of feedback, Stability.

UNIT - III		Lecture Hrs:

Differential Amplifiers: The source coupled pair, the source cross –coupled pair, cascode loads, Wide-swing differential amplifiers.

Operational Amplifiers: Basic CMOS Op-Amp design, Operational transconductance amplifiers, Differential output Op-amp.

UNIT - IV		Lecture Hrs:

Non-Linear Circuits: Basic CMOS comparator design, Adaptive biasing, Analog multipliers.

Dynamic Analog Circuits: MOSFET Switch, Switched capacitor circuits, Switched capacitor integrator, dynamic circuits.

UNIT - V		Lecture Hrs:

Data Converter Fundamentals and Architectures : DAC & ADC specifications, Mixed signal layout issues. DAC architectures, ADC architectures. Floor planning methods, Global interconnect, Floor plan design, Off-chip connections.

Textbooks:

1. CMOS Circuits Design, Layout and Simulation – Baker, Li, Boyce, 1st ed., TMH
2. Rudy Van De Plassche, "CMOS Integrated Analog-to-Digital and Digital-to Analog converters," Kluwer Academic Publishers, 2003 .

Reference Books:

1. R. Jacob Baker, "CMOS Mixed-Signal Circuit Design", Wiley Interscience, 2009.
2. David A.Johns, Ken Martin, "Analog Integrated Circuit Design," John-Wiley & Sons, 1997.
3. B. Razavi, "Design of Analog CMOS Circuits," McGraw Hill, 2003.

Online Learning Resources:

Course Code		ADVANCED COMMUNICATIONS AND NETWORKS	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To understand various spread spectrum communication techniques.
- To know about the different aspects related to OFDM.
- To study the basic concepts of MIMO systems.
- To learn about the protocols used in wireless networks.
- To study about the protocols used in broadband wireless networks.

Course Outcomes (CO): Student will be able to

- Understand various spread spectrum communication techniques.
- Know about the different aspects related to OFDM.
- Learn the basic concepts of MIMO systems.
- Gain information about the protocols used in wireless networks.
- Know about the protocols used in broadband wireless networks.

UNIT - I		Lecture Hrs:

Spread Spectrum Communications: Spreading sequences- Properties of spreading sequences, Pseudo- noise sequence, gold sequences, Kasami sequences, Walsh sequences, Orthogonal variable spreading factor sequences, Barker sequence, Complementary codes.

Direct sequence spread spectrum: DS-CDMA model, Conventional receiver, Rake receiver, Synchronization in CDMA, Power control, Soft handoff, Multiuser detection – Optimum multiuser detector, Liner multiuser detection.

UNIT - II		Lecture Hrs:

Orthogonal Frequency Division Multiplexing: Basic principles of orthogonality, Single vs Multicarrier systems, OFDM block diagram and its explanation, OFDM signal mathematical representation, Selection parameter for modulation, Pulse shaping in OFDM signal and spectral efficiency, Window in OFDM signal and spectrum, Synchronization in OFDM, Pilot insert in OFDM transmission and channel estimation, Amplitude limitations in OFDM, FFT point selection constraints in OFDM, CDMA vs OFDM, Hybrid OFDM.

UNIT - III		Lecture Hrs:

MIMO Systems: Introduction, Space diversity and system based on space diversity, Smart antenna system and MIMO, MIMO based system architecture, MIMO exploits multipath, Space – time processing, Antenna consideration for MIMO, MIMO channel modelling, MIMO channel measurement, MIMO channel capacity, Cyclic delay diversity (CDD), Space time coding, advantages and applications of MIMO in present context, MIMO Applications in 3G Wireless system and beyond, MIMO-OFDM

UNIT - IV		Lecture Hrs:

Wireless LANs/IEEE 802.11x: Introduction to IEEE802.11x technologies, Evolution of wireless LANs, IEEE 802.11 design Issues, IEEE 802.11 services, IEEE 802.11 MAC layer operations, IEEE 802.11 Layer1, IEEE 802.11 a/b/g Higher rate standards, Wireless LAN security, Computing wireless technologies, Typical WLAN hardware.

UNIT - V		Lecture Hrs:

Wireless PANs/IEEE 802.15x: Introduction to IEEE 802.15x technologies: Wireless PAN applications and architecture, IEEE 802.15.1 physical layer details, Bluetooth link controllers basics, Bluetooth link controllers operational states, IEEE 802.15.1 protocols and host control interface. Evaluation of IEEE 802.15 standards

Broad Band Wireless MANs/IEEE 802.16x: Introduction to WMAN/IEEE 802.16x technology, IEEE 802.16 Wireless MANs, IEEE 802.16 MAC layer details, IEEE 802.16 physical layer details, IEEE 802.16 physical layer details for 2-11 GHz, IEEE 802.16 common system operations.

Textbooks:
1.Gary J. Mullett, "Introduction to Wireless Telecommunications Systems and Networks", CENGAGE 2. UpenaDalal, "Wireless Communication", Oxford University Press, 2009
Reference Books:
1. Ke-Lin Du & M N S Swamy, "Wireless Communication System", Cambridge University Press, 2010 2. Gottapu Sasibhusan Rao, "Mobile Cellular Communication", 1st Edition, Pearson Education, 2012
Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 3	L	T	P	C
Semester	II	LOW POWER VLSI DESIGN	3	0	0	3

Course Objectives:

- To understand the basic concepts related to low power circuit design.
- To implement Low power design approaches for system level and circuit level measures.
- To design different types of low voltage low power adders.
- To design and analyze different types of low voltage multipliers.
- To gain knowledge on different types of memories for efficient design of systems.

Course Outcomes (CO): Student will be able to

- Understand the basic concepts related to low power circuit design.
- Implement Low power design approaches for system level and circuit level measures.
- Design different types of low voltage low power adders.
- Design and analyze different types of low voltage multipliers.
- Gain knowledge on different types of memories for efficient design of systems.

UNIT - I		Lecture Hrs:

Fundamentals: Need for low power circuit design, Sources of power dissipation – Static and dynamic power dissipation, Short circuit 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		Lecture Hrs:

Low-Power Design Approaches: Low-Power design through Voltage scaling – VTCMOS circuits, MTCMOS circuits, Architectural level approach –Pipelining and parallel processing approaches. Switched capacitance minimization approaches: System level measures, Circuit level measures, Mask level measures.

UNIT - III		Lecture Hrs:

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		Lecture Hrs:

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

UNIT - V		Lecture Hrs:

Low-Voltage Low-Power Memories: Basics of ROM, Low-power ROM technology, future trends 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 trends and development of DRAM.

Textbooks:

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 Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
3. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 3	L	T	P	C
Semester	II	SoC ARCHITECTURE	3	0	0	3

Course Objectives:

- To understand the basics of SoC architecture and different approaches related to SoC design.
- To select an appropriate robust processor for SoC design.
- To know about the memory requirements for SoC design.
- To learn about customization and configurability in SoC design.
- To realize real time case studies.

Course Outcomes (CO): Student will be able to

- Understand the basics of SoC architecture and different approaches related to SoC design.
- Select an appropriate robust processor for SoC design
- Know about the memory requirements for SoC design.
- Learn about customization and configurability in SoC design.
- Realize real time case studies.

UNIT - I — Lecture Hrs:

Introduction to the System Approach: Compare SoC, ASIC, SOP, SIP and MCM, System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory & Addressing. System level interconnection, An approach for SoC Design, System Architecture and Complexity.

UNIT - II — Lecture Hrs:

Processors: Introduction, Processor selection for SoC, Basic concepts in processor architecture, Basic concepts in processor micro-architecture, Basic elements in instruction handling. Buffers: minimizing pipeline delays, Branches, More robust processors, Vector processors and Vector instruction extensions, VLIW processors, Superscalar processors.

UNIT - III — Lecture Hrs:

Memory Design for SoC: Overview: SoC external memory, SoC internal memory, Size, Scratchpads and cache memory, Cache organization, Cache data, Write policies, Strategies for line replacement at miss time, Other types of Cache, Split – I, and D – Caches, Multilevel Caches, SOC memory system, Models of simple processor – memory interaction.

UNIT - IV — Lecture Hrs:

Interconnect, Customization and Configurability: Interconnect architectures, Bus: Basic architectures, SoC standard buses, Analytic bus models, Using the bus model, Effects of bus transactions and contention time.

SoC Customization: An overview, customizing instruction processor, reconfigurable technologies, Mapping design onto reconfigurable devices, Instance- specific design, Customizable soft processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable parallelism.

UNIT - V — Lecture Hrs:

Application Studies / Case Studies: SoC Design approach; AES-algorithms, Design and evaluation; Image compression–JPEG compression.

Textbooks:

1. "Computer System Design System-on-Chip", Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. "ARM System on Chip Architecture", Steve Furber, 2ndEdition, 2000, Addison Wesley Professional.

Reference Books:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer.
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM.
3. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 3 WIRELESS SENSOR NETWORKS	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To study about different types of sensor networks, their advantages and applications.
- To understand the concepts of localization and tracking control.
- To learn about the protocols used in routing of Wireless sensor networks.
- To know the mechanisms involved in routing of Wireless sensor networks.
- To study about the tools and simulators associated with Wireless sensor networks.

Course Outcomes (CO): Student will be able to

- To study about different types of sensor networks, their advantages and applications.
- To understand the concepts of localization and tracking control.
- To learn about the protocols used in routing of Wireless sensor networks.
- To know the mechanisms involved in routing of Wireless sensor networks.
- To study about the tools and simulators associated with Wireless sensor networks.

UNIT - I		Lecture Hrs:

Introduction: Sensor networks, advantages and applications, Sensor network applications – Habitat monitoring, Smart transportation, Collaborative processing.

UNIT - II		Lecture Hrs:

Localization and tracking: Sensing model, Distributed representation, Tracking multiple objects networking sensors- Medium access control, Energy-aware routing to a region, Attribute-based routing.

UNIT - III		Lecture Hrs:

Infrastructure Establishment: Clustering and time synchronizations, Localization and localization services, Sensor tracking and control - Task-driven sensing, Information-based sensor tasking, Sensor group management.

UNIT - IV		Lecture Hrs:

Sensor Network data bases: Sensor database challenges, Query interfaces, Data-centric storage, Multidimensional indices for orthogonal range searching, Locality-preserving hashing.

UNIT - V		Lecture Hrs:

Sensor Network Platforms and Tools: Sensor network hardware, Node level software, Node-level simulators, Wireless sensor networks positioning and location management.

Textbooks:

1. F. Zhao, C Guibas, “Wireless Sensor Networks”, Elsevier, Morgan Kaufmann, 2004.
2. Kazem Sohraby, Daniel Minoli, TaiebZnati, “Wireless Sensor Networks -Technology, Protocols and Applications”, John Wiley & Sons, 2007.

Reference Books:

1. P.Nicopolitidis, M.S.Obaidat, G.I.Papadimitria, A.S. Pomportsis, “Wireless Networks”, John wiley & sons, 2003.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 4 SOFTWARE DEFINED RADIO	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To know the requirements, benefits and different models of Software Defined Radio.
- To learn about Software Defined Radio Architectures for performance optimization.
- To study in detail about flexible RF receiver architectures of Software Defined Radio.
- To understand the design of multiband flexible receiver and its performance.
- To study about the flexible transmitters receiver design.

Course Outcomes (CO): Student will be able to

- Know the requirements, benefits and different models of Software Defined Radio.
- Learn about Software Defined Radio Architectures for performance optimization.
- Study in detail about flexible RF receiver architectures of Software Defined Radio.
- Understand the design of multiband flexible receiver and its performance.
- Learn about the flexible transmitters receiver design.

UNIT - I		Lecture Hrs:

Introduction: Requirement for Software defined radio, Benefits of multi-standard terminals, Operational requirements, models for SDR, Smart antenna systems.

UNIT - II		Lecture Hrs:

Basic Architecture of a Software Defined Radio: Software defined radio architectures, Hardware specifications, Digital aspects of Software defined radio, Current technology limitations, minimum power consumption, AD performance trends.

UNIT - III		Lecture Hrs:

Flexible RF Receiver Architectures: Digital receiver, Single carrier and multi-carrier designs, under sampling, oversampling, Noise figure, Receiver sensitivity, ADC spurious signals.

UNIT - IV		Lecture Hrs:

Multi-Band and General Coverage Systems: Multiband Flexible receiver design, RF Transmit / receive switch, Image rejection mixing, Dynamic range enhancement, Feed forward techniques, cascaded non-linearity techniques.

UNIT - V		Lecture Hrs:

Flexible Transmitters and Power Amplifiers: Flexible transmitters, Power amplifiers, Analog quadrature up-conversion, interpolated bandpass up conversion, PLL based modulator transmitter, All-pass filtering, Polyphase filtering

Textbooks:

1. P Kenington, "RF and Baseband Techniques for Software Defined Radio", Artec House, 2005
2.Wally H. W. Tuttlebee, "Software Defined Radio: Baseband Technologies for 3G Handsets and Base stations", John Wiley &sons, 2003

Reference Books:

1. JoukoVanakka, "Digital Synthesizers and Transmitter for Software Radio", Springer, 2005.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 4 IMAGE AND VIDEO PROCESSING	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To understand the fundamentals of image processing.
- To study about the different Image enhancement methods.
- To learn about the fundamentals concepts of Image Compression.
- To understand the representation of video and its basic principles.
- To gain the knowledge about different methods of motion estimation.

Course Outcomes (CO): Student will be able to

- Understand the fundamentals of image processing.
- Study about the different Image enhancement methods.
- Learn about the fundamentals concepts of Image Compression.
- Understand the representation of video and its basic principles.
- Gain the knowledge about different methods of motion estimation.

UNIT - I		Lecture Hrs:

Fundamentals of Image Processing and Image Transforms: Basic steps of Image processing system, Sampling and quantization of an image, Basic relationship between pixels.
Image Segmentation: Segmentation concepts, Point, Line and edge detection, Thresholding, region based segmentation.

UNIT - II		Lecture Hrs:

Image Enhancement: Spatial domain methods: Histogram processing, Fundamentals of spatial filtering, smoothing spatial filters, Sharpening spatial filters.
Frequency Domain Methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

UNIT - III		Lecture Hrs:

Image Compression: Image compression fundamentals, Coding redundancy, Spatial and temporal redundancy, Compression models: Lossy & lossless, Huffman coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, Lossy predictive coding, JPEG Standards.

UNIT - IV		Lecture Hrs:

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		Lecture Hrs:

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, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in video coding.

Textbooks:

1. Digital Image Processing – Gonzaleze and Woods, 4th Ed., Pearson, 2018.
2. Digital Video Processing – M. Tekalp, Prentice Hall International.

Reference Books:

1. Video Processing and Communication – Yao Wang, Joem Ostermann and Ya–quin Zhang. 1st Ed., PH Int.
2. Digital Image Processing – S. Jayaraman, S. Esakkirajan, T. Veera Kumar –TMH, 2009

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 4	L	T	P	C
Semester	II	TRANSFORM TECHNIQUES	3	0	0	3

Course Objectives:

- To study about different types of transforms for different types of signals.
- To understand the application of wavelets for different types of signals.
- To learn the need for scaling function.
- To study the applications of Multi rate systems and filter banks.
- To know the applications of transforms.

Course Outcomes (CO): Students will be able to

- Study about different types of transforms for different types of signals.
- Understand the application of wavelets for different types of signals.
- Learn the need for scaling function.
- Study the applications of Multi rate systems and filter banks.
- Know the applications of transforms.

UNIT - I		Lecture Hrs:

Review of Transforms: Signal spaces, concept of convergence, Hilbert spaces for energy signals, Orthogonality, Ortho normality, Fourier basis, FT-failure of FT-need for time-frequency analysis, spectrogram plot-phase space plot in time-frequency plane, Continuous FT, DTFT, Discrete fourier series and transforms, Z-Transform.

Advance Transforms: Relation between CFT-DTFT, DTFT-DFS, DFS-DFT, DCT (1D&2D), Walsh, Hadamard, Haar, Slant, KLT, Hilbert Transforms – definition, properties and applications.

UNIT - II		Lecture Hrs:

CWT and MRA: Time-frequency limitations, tiling of time-frequency plane for STFT, Heisenberg uncertainty principle, short time Fourier Transform (STFT) analysis, short comings of STFT.

Need for Wavelets: Wavelet Basis- Concept of scale and its relationship with frequency, Continuous time wavelet transform equation- Series expansion using Wavelets- CWT.

UNIT - III		Lecture Hrs:

Need for Scaling Function: Multi resolution analysis, Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat Meyer, Shannon, Daubechies.

Special Topics: Wavelet packet transform, Bi-orthogonal basis- B-splines, Lifting scheme of wavelet generation-implementation

UNIT - IV		Lecture Hrs:

Multirate Systems, Filter Banks and DWT: Basics of Decimation and Interpolation in time & frequency domains, Two-channel filter bank, Perfect reconstruction condition, Relationship between filter banks and Wavelet basis, DWT filter banks for Daubechies wavelet function.

UNIT - V		Lecture Hrs:

Applications of Transforms: Signal de-noising, Sub-band coding of speech and music, Signal Compression - Use of DCT, DWT, KLT.

Textbooks:

1. Jaideva C Goswami, Andrew K Chan, "Fundamentals of Wavelets- Theory, Algorithms and Applications", John Wiley & Sons, Inc, Singapore, 1999.
2. Raghuveer M. Rao and Ajit S. Bopardikar, "Wavelet Transforms-Introduction theory and applications" Pearson edu, Asia, New Delhi, 2003.

Reference Books:

1. Vetterli M. Kovacevic, "Wavelets and sub-band coding", PJI, 1995.
2. C. Sydney Burrus, "Introduction to Wavelets and Wavelet Transforms", PHI, 1st Edition, 1997.
3. S. Jayaraman, S. Esakkirajan, T. Veera Kumar, "Digital Image Processing", TMH, 2009
4. Soman.K. P, Ramachandran K.I, "Insight into Wavelets from Theory to practice", Prentice Hall India, First Edition, 2004.

Online Learning Resources:

Course Code		ANALOG AND MIXED SIGNAL DESIGN LAB	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- To understand the layout design rules and design a schematic & layout for Combinational and Sequential Circuits.
- To learn the implementation of Layout, Physical Verification and place & routing for complex designs.
- To verify the layouts, DRC and LVS.

Course Outcomes (CO): Students will be able to

- Understand the layout design rules and design a schematic & layout for Combinational and Sequential Circuits.
- Learn the implementation of Layout, Physical Verification and place & routing for complex designs.
- Verify the layouts, DRC and LVS.

List of Experiments:

Introduction to layout design rules. Layout, physical verification, placement & routing for complex design, static timing analysis and IR drop analysis for all following **TWELVE** experiments need to be done

1. Design and verify the CMOS inverter.
2. Design CMOS NAND and NOR gates.
3. Design CMOS XOR/XNOR by using NAND/NOR gates.
4. Design CMOS 1-bit full adder and verify the circuit using transient analysis.
5. Design CMOS 1-bit full Subtractor and verify the circuit using transient analysis.
6. Design a multiplexer and perform all the analysis to verify its characteristics.
7. Design and Implementation of RS –Latch.
8. Design and Implementation of D –Latch.
9. Design and Implementation of Asynchronous Counter.
10. Design and Implementation of Static SRAM Cell.
11. Analog Circuit simulation (AC analysis) – CS (Common Source) amplifier.
12. Analog Circuit simulation (AC analysis) – Differential amplifier.

Equipment/Software Required:

- EDA Tools - Industry Standard software-latest version like Mentor/ Synopsys /Equivalent.
- Personal computer with necessary peripherals.

References:
Online learning resources/Virtual labs:

Course Code		ADVANCED COMMUNICATIONS AND NETWORKS LAB	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- To implement digital filters for the given specifications.
- To design and simulate different modulation schemes for the given specifications.
- To design and implement demodulation schemes for the given specifications.

Course Outcomes (CO): Student will be able to

- Implement digital filters for the given specifications.
- Design and simulate different modulation schemes for the given specifications.
- Design and implement demodulation schemes for the given specifications.

List of Experiments:

Student must do ANY **TWELVE** experiments.

1. Implementation of Matched Filters.
2. Optimum receiver for the AWGN channel.
3. Design FIR (LP/HP/BP) filter using Window method.
4. Measurement of effect of Inter Symbol Interference.
5. Generation of constant envelope PSK signal wave form for different values of M.
6. Simulation of PSK system with M=4.
7. Simulation of DPSK system with M=4.
8. Design of FSK system.
9. Simulation of correlation type demodulation for FSK signal.
10. BPSK Modulation and Demodulation techniques.
11. QPSK Modulation and Demodulation techniques.
12. DQPSK Modulation and Demodulation techniques.
13. 8-QAM Modulation and Demodulation techniques.
14. DQAM Modulation and Demodulation techniques.
15. Verification of Decimation and Interpolation of a given signal.
16. Power spectrum estimation using AR model.

Software Requirements:

MATLAB, Qualnet simulator

References:

Online learning resources/Virtual labs:

Course Code		PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (Audit Course - II)	L	T	P	C
Semester	II		2	0	0	0

Course Objectives:

- To learn to achieve the highest goal happily Learn about what to write in each section
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT - I		Lecture Hrs:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT - II		Lecture Hrs:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT - III		Lecture Hrs:

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT - IV		Lecture Hrs:

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT - V		Lecture Hrs:

- Chapter 2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter 18 – Verses 37,38,63

Textbooks:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Reference Books:

Course Code		PROGRAM ELECTIVE – 5	L	T	P	C
Semester	III	DETECTION AND ESTIMATION THEORY	3	0	0	3

Course Objectives:

- To gain knowledge about various estimation and detection methods.
- To analyze different methods of minimum variance unbiased estimation techniques.
- To understand best linear unbiased estimators in detecting signals in the presence of noise.
- To learn about statistical decision theory and deterministic signals.
- To know about composite hypothesis testing and its approaches.

Course Outcomes (CO): Students will be able to

- Gain knowledge about various estimation and detection methods.
- Analyze different methods of minimum variance unbiased estimation techniques.
- Understand best linear unbiased estimators in detecting signals in the presence of noise.
- Learn about statistical decision theory and deterministic signals.
- Know about composite hypothesis testing and its approaches.

UNIT - I		Lecture Hrs:

Introduction to Estimation and Detection: Introduction, Detection and estimation in signal processing, the mathematical detection & estimation problem, Assessing estimator performance, Hierarchy of detection problems, Role of asymptotic.

UNIT - II		Lecture Hrs:

Minimum Variance Unbiased Estimation: Unbiased estimators, Minimum variance criterion, Existence of the minimum variance unbiased estimator, Finding the minimum variance unbiased estimator.

Cramer-Rao Lower Bound: Estimator of accuracy considerations, Cramer-Rao lower bound (CRLB), General CRLB for signals in white Gaussian noise, Transformation of parameters, Extension to a vector parameter, Vector parameter CRLB for transformations, CRLB for the general Gaussian case.

Linear Models: Definition and properties, Linear model examples, Extension to the linear model.

General Minimum Variance Unbiased Estimation: Introduction, Sufficient statistics, Finding sufficient statistics.

UNIT - III		Lecture Hrs:

Best Linear Unbiased Estimators: Definition of BLUE, Finding the BLUE, Extension to vector parameter.

Estimation Methods: Maximum likelihood estimation (MLE), Finding MLE, Properties of MLE, MLE for transformed parameters, Numerical determination of the MLE, Extension to a vector parameter, Least squares approach, Linear least squares, Method of moments, Extension to a vector parameter, Statistical evaluation of estimators.

The Basian Philosophy: Prior knowledge and estimation, Choosing a prior PDF, Properties of Gaussian PDF, Basian linear model, Minimum mean square error (MMSE) estimators, Maximum A posteriori estimators, Performance description, Linear basian estimators – Introduction, Linear MMSE estimation, Geometrical interpretations, Vector LMMSE estimator.

UNIT - IV		Lecture Hrs:

Statistical Decision Theory I: Introduction, Neyman-Pearson theorem, Receiver operating characteristics, Minimum probability of error, Bayes risk, Multiple hypothesis testing.

Deterministic Signals: Matched filters, Development of detector, Performance of matched filter, Performance of generalized matched filters, Multiple signals – Binary case and its performance, M-ary case, Linear model.

Random Signals: Estimator correlator, Linear model

UNIT - V		Lecture Hrs:

Statistical Decision Theory II: Introduction, Summary of composite hypothesis, Composite hypothesis testing (CHT).

CHT Approaches: Bayesian approach, Generalized likelihood approach, Performance of GLRT for

large data records, Equivalent large data records tests.
Textbooks:
1. Steven M. Kay, "Fundamentals of Statistical Signal Processing – Estimation Theory," Pearson, 2010. 2. Shanmugam and Breipohl, "Detection of Signals in Noise and Estimation", John Wiley& Sons, 2004.
Reference Books:
1. Mischa Schwartz, L. Shaw, "Signal Processing: Discrete Spectral Analysis, Detection, and Estimation," McGraw Hill.
Online Learning Resources:

Course Code		EMBEDDED SYSTEMS	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To know about the basics of embedded systems their classification and application.
- To provide knowledge on the building blocks of embedded system.
- To understand the requirement of embedded firmware and its role in API.
- To learn about the role of real time operating system in embedded design.
- To gain the knowledge about task level communication in an embedded system.

Course Outcomes (CO): Student will be able to

- Know the basics of embedded systems their classification and application.
- Gain knowledge on the building blocks of embedded system.
- Understand the requirement of embedded firmware and its role in API.
- Learn about the role of real time operating system in embedded design.
- Gain the knowledge about task level communication in an embedded system.

UNIT - I		Lecture Hrs:

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT - II		Lecture Hrs:

Typical Embedded System: Core of the Embedded System, General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces. DDR, Flash, NVRAM

UNIT - III		Lecture Hrs:

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT - IV		Lecture Hrs:

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT - V		Lecture Hrs:

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Textbooks:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded Systems – Lyla, Pearson, 2013
3. An Embedded Software Primer - David E. Simon, Pearson Education.

Online Learning Resources:

Course Code		PROGRAM ELECTIVE – 5	L	T	P	C
Semester	III	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	3	0	0	3

Course Objectives:

- To learn the basics of AI and problem solving techniques.
- To understand concepts of logic programming.
- To study the phases in building expert systems and their applications.
- To gain knowledge on machine learning systems and artificial neural networks.
- To learn different knowledge representation techniques.

Course Outcomes (CO): Student will be able to

- To learn the basics of AI and problem solving techniques.
- To understand concepts of logic programming.
- To study the phases in building expert systems and their applications.
- To gain knowledge on machine learning systems and artificial neural networks.
- To learn different knowledge representation techniques.

UNIT - I — Lecture Hrs:

Introduction: History, Intelligent systems, Foundations of AI, Sub areas of AI, Applications.
Problem Solving – State Space Search and Control Strategies: Introduction, General problem solving, Characteristics of problem, Exhaustive searches, Heuristic search techniques, Iterative-deepening, Constraint satisfaction. Game playing, Bounded lsook-ahead strategy and use of evaluation functions, Alpha-Beta pruning

UNIT - II — Lecture Hrs:

Logic Concepts and Logic Programming: Introduction, Propositional calculus, Propositional logic, Natural deduction system, Axiomatic system, Semantic tableau system in propositional logic, Resolution refutation in propositional logic, Predicate logic, Logic programming.
Knowledge Representation: Introduction, Approaches to knowledge representation, Knowledge representation using semantic network, Extended semantic networks for KR, Knowledge representation using frames.

UNIT - III — Lecture Hrs:

Expert System and Applications: Introduction, Phases in building expert systems, Expert system architecture, Expert systems Vs Traditional systems, Truth maintenance systems, Application of expert systems, List of shells and tools.
Uncertainty Measure – Probability Theory: Introduction, Probability theory, Bayesian belief networks, Certainty factor theory, Dempster-Shafer theory.

UNIT - IV — Lecture Hrs:

Machine-Learning Paradigms: Introduction, Machine learning systems, supervised and unsupervised learning, Inductive learning, Learning decision trees, Deductive learning, Clustering, Support vector Machines.
Artificial Neural Networks: Introduction, Artificial neural networks, Single- layer feed-forward networks, Multi-layer feed-forward networks, Radial- Basis function networks, Design issues of artificial neural networks, Recurrent networks.

UNIT - V — Lecture Hrs:

Advanced Knowledge Representation Techniques: Case grammars, Semantic web natural language processing: Introduction, Sentence analysis phases, Grammars and parsers, Types of parsers, Semantic analysis, Universal networking knowledge.

Textbooks:

1. Saroj Kaushik. Artificial Intelligence. Cengage Learning, 2011.
2. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python A Guide for Data Scientists", O'Reilly, 1st Edition, 2016.

Reference Books:

1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition 2009.
2. Russell, Norvig: Artificial intelligence, A Modern Approach, Pearson Education, 2nd Edition, 2004.
3. Jason brownlee "Statistical methods for machine learning – Discover how to transform data into knowledge with python", Machine learning mastery, 2018.

Online Learning Resources:

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Course Code		COST MANAGEMENT OF ENGINEERING PROJECTS (Open Elective)	L	T	P	C
Semester	III		3	0	0	3

Course Objectives:

- Understand the cost concepts, Project Management for planning to execution of projects.
- Enable them to comprehend the fundamentals of Project execution, Costing, Quantitative techniques.
- Apply the different methods to manage the projects, profit planning and cost.
- Develop the contemporary project management tools and methodologies in Indian context..

UNIT - I — Lecture Hrs:

COST CONCEPTS :Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision – making; Relevant cost – Differential cost Incremental cost and Opportunity cost – Objectives of a Costing System – Inventory valuation – Creation of a Database for operational control – Provision of data for Decision – Making.

UNIT - II — Lecture Hrs:

PROJECT MANAGEMENT :Project: meaning – Different types– Why to manage– Cost overruns centers – Various stages of project execution: conception to commissioning – Project execution as conglomeration of technical and nontechnical activities – Detailed Engineering activities – Pre-project execution main clearances and documents Project team: Role of each member – Importance Project site: Data required with significance – Project contracts – Types and contents. Project execution Project cost control – Bar charts and Network diagram – Project commissioning: mechanical and process.

UNIT - III — Lecture Hrs:

COST BEHAVIOR AND PROFIT PLANNING :Cost Behavior and Profit Planning Marginal Costing – Distinction between Marginal Costing and Absorption Costing – Break-even Analysis – Cost-Volume-Profit Analysis – Various decision – making problems – Standard Costing and Variance Analysis – Pricing strategies – Pareto Analysis – Target costing – Life Cycle Costing – Costing of service sector – Just-in-time approach – Material Requirement Planning – Enterprise Resource Planning – Total Quality Management and Theory of constraints.

UNIT - IV — Lecture Hrs:

COST MANAGEMENT :Activity-Based Cost Management – Bench Marking – Balanced Score Card and Value-Chain Analysis – Budgetary Control – Flexible Budgets – Performance budgets – Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT - V — Lecture Hrs:

QUANTITATIVE TECHNIQUES : Quantitative techniques for cost management – Linear Programming – PERT/CPM – Transportation problems – Assignment problems – Simulation – Learning Curve Theory.

Textbooks:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.
2. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting.

REFERENCE BOOKS:
1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher.
2. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Code		WASTE TO ENERGY (Open Elective)	L	T	P	C
Semester	III		3	0	0	3

Course Objectives:

- To understand the concept of waste to energy.
- To analyze technical and management principles for production of energy from waste.
- To apply the best available technologies for waste to energy.
- To develop the process for thermal conversion, bio-chemical and waste to energy conversion.

UNIT - I		Lecture Hrs:

Introduction to Energy from Waste : Classification of waste as fuel – Agro based – Forest residue – Industrial waste – MSW – Conversion devices – Incinerators – Gasifiers – Digestors.

UNIT - II		Lecture Hrs:

Biomass Pyrolysis : Pyrolysis – Types – Slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases – Yields and applications.

UNIT - III		Lecture Hrs:

Biomass Gasification : Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT - IV		Lecture Hrs:

Biomass Combustion : Biomass stoves – Improved challahs – Types, Some exotic designs – Fixed bed combustors– Types – Inclined grate combustors – Fluidized bed combustors – Design – Construction and operation – Operation of all the above biomass combustors.

UNIT - V		Lecture Hrs:

Introduction to Biogas : Properties of biogas (Calorific value and composition) – Biogas plant technology and status – Bio energy system – Design and constructional features – Biomass resources and their classification – Biomass conversion processes – Thermo chemical conversion – Direct combustion – Biomass gasification – Pyrolysis and liquefaction – Biochemical conversion – anaerobic digestion Types of biogas Plants – Applications – Alcohol production from biomass – Bio diesel production – Urban waste to energy conversion – Biomass energy programme in India.

Textbooks:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II,Tata McGraw Hill Publishing Co. Ltd., 1983.

Reference Books: