JNTUA COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
COURSE STRUCTURE
***M.TECH (Regular)* - Digital Electronics and Communication Systems (DECS)**
(w.e.f 2015-16 Admitted Batch)

M.Tech I Semester

S.No	Subject Code	Subject	Theory	Lab	Credits
1.	15D41101	Structural Digital System Design	4	-	4
2.	15D41102	Advanced Computer Networks	4	-	4
3.	15D42101	Digital Communication Techniques	4	-	4
4.	15D42102	Advanced Digital Signal Processing	4	-	4
5.	 15D41105 15D42103 15D42104 15D41108	Elective-I a. Advanced Operating Systems b. Mobile Networks c. Transform Techniques d. Quality & Reliability	4	-	4
6.	 15D41109 15D42105 15D42106 15D41111	Elective-II a. Nano Electronics b. Secured Communications c. Adaptive Signal Processing d. Cloud Computing	4	-	4
7.	15D41112	Structural Digital System Design Lab	-	3	2
Contact periods/week			**24**	**03**	**26**
			Total/week	**27**	

M.Tech II Semester

S.No	Subject Code	Subject	Theory	Lab	Credits
1.	15D41201	Embedded System Design	4	-	4
2.	15D41202	Image & Video Processing	4	-	4
3.	15D42201	Detection and Estimation Theory	4	-	4
4.	15D42202	Wireless Communications	4	-	4
5.	 15D42203 15D42204 15D42205 15D41208	Elective-III a. Error Control Coding b. Speech Processing c. Software Defined Radio d. Big Data	4	-	4
6.	 15D41209 15D42206 15D41212 15D41210	Elective-IV a. Fuzzy Systems and Neural Networks b. Multimedia Communications c. Wireless Sensor Networks d. MEMs and its Applications	4	-	4
7.	15D54201	Research Methodology (Audit Course)	2	-	-
8.	15D42207	Advanced Communications Lab	-	3	2
Contact periods/week			**26**	**03**	**26**
			Total/Week	**29**	

M.Tech III & IV SEMESTERS

Code	Name of the Subject	T	P	C
15D42301	**III Semester** Seminar- I	0	4	2
15D42401	**IV Semester** Seminar- II	0	4	2
15D42302	**III & IV Semester** PROJECT WORK	--	--	44
	Total	**24**	**8**	**48**

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M.Tech I Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D41101) STRUCTURED DIGITAL SYSTEM DESIGN

Course Objective:

- 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

Course Outcome:

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-1

BUILDING BLOCKS FOR DIGITAL DESIGN: Multiplexer, Demultiplexer, Decoder, Encoder, Comparator, Adder, ALU, Carry-look-ahead adder.

BUILDING BLOCKS WITH MEMORY: Clocked building blocks, register building blocks, RAM, ROM, PLA, PAL, Timing devices.

UNIT -II

DESIGN METHODS: Elements of design style, top-down design, separation of controller and architecture, refining architecture, and control algorithm, Algorithmic State Machines, ASM chart notations.

UNIT-III

REALISING ASMS - Traditional synthesis from ASM chart, multiplexer controller method, one-shot method, ROM based method.

ASYNCHRONOUS INPUTS AND RACES - Asynchronous ASMs, Design for testability, test vectors, fault analysis tools.

UNIT-IV

MICROPROGRAM AND DESIGN: Microprogramming, Microprogramme sequencer 2910, designing microprogrammed computer. Power distribution noise, cross talk, reflections, line drivers and receivers.

UNIT-V

MODELLING WITH VHDL: CAD tools, simulators, schematic entry, synthesis from VHDL.

DESIGN CASE STUDIES: Single pulser, system clock, serial to parallel data conversion, traffic light controller.

Text Books:

- Prosser and Winkel, "The Art of Digital Design", Prentice Hall.
- Roth, “Digital System Design using VHDL”, Mc. Graw Hill, 2000

References:

- William Fletcher, An Engineering Approach to Digital Design, 1st Edition, Prentice-Hall India, 1997.
- William J Dally and John W Poulton, Digital Systems Engineering, Cambridge University Press, 2008.
- Jayaram Bhasker, A VHDL Primer, 3rd edition, Prentice-Hall India, 2009.
- VHDL for Programmable Logic – Kevin Skahill, Cypress Semiconductors

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M.Tech I Sem	T	P	C
	4	0	4

(15D41102) ADVANCED COMPUTER NETWORKS

Course Objective:

- 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.

Course Outcome:

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

References:

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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	4	**0**	**4**

(15D42101) DIGITAL COMMUNICATION TECHNIQUES

Course Objective:

- 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.

Course Outcome:

- 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.

References:

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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M.Tech I Sem	**T**	**P**	**C**
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(15D42102) ADVANCED DIGITAL SIGNAL PROCESSING

Course Objective:

- To study about the digital signal processing algorithms and multi rate signal processing
- To study about the power spectral estimation by using Barlett, Welch & Blackmann & Tukey methods.
- The study about the effects of finite word length in fixed-point dsp systems..

Course Outcome:

After completion of the course students will be able to

- Get complete knowledge regarding various algorithms associated with Digital signal processing and multi rate signal processing.
- Verify the power spectral estimation by using Barlett, Welch & Blackmann & Tukey methods.
- Understand the effects of finite word length in fixed-point DSP systems by using ADC and FFT algorithms.

UNIT I

DSP ALGORITHEMS: 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

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

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

ANALYSIS OF FINITE WORDLENGTH 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

APPLICATIONS OF DIGITAL SIGNAL PROCESSING: Dual Tone Multi-frequency Signal Detection, Spectral Analysis of Sinusoidal Signals, Spectral Analysis of Non stationary Signals, Musial Sound Processing, Over Sampling A/D Converter, Over Sampling D/A Converter, Discrete-Time Analytic Signal Generation.

Text books:

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.

References:

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

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(15D41105) ADVANCED OPERATING SYSTEMS
(ELECTIVE I)

Course Objective:

- 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

Course Outcome:

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:

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

References:

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

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(15D42103) MOBILE NETWORKS

Course Objective:

- 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

Course Outcome:

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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(15D42104) TRANSFORM TECHNIQUES

Course Objective:

- 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.

Course Outcome:

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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M.Tech I Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D41108) QUALITY & RELIABILITY

Course Outcomes: After completion of this subject, students will be able to

- Design any system or component or circuit with high reliability.
- Analyze reasons for the failures of circuits or systems and provide necessary repair for reliable functioning of those systems.
- Provide relevant mechanisms for proper availability and maintainability of the systems.

UNIT-I:

Elements of probability theory Probability distributions: Random variables, density and distribution functions. Mathematical expectation. Binominal distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Reliability: Definition of Reliability. Significance of the terms appearing in the definition. Component reliability, Hazard rate, derivation of the reliability functions in terms of the hazard rate. Hazard models.

UNIT-II:

Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Modes of failure. Bath tub curve. Effect of preventive maintenance. Measures of reliability: mean time to failure (MTTF) and mean time between failures (MTBF).

UNIT-III:

Reliability logic diagrams: (reliability block diagrams) Classification of engineering systems: series, parallel, series-parallel, parallel-series and non-series-parallel configurations (mainly for Electronic system configurations). Expressions for the reliability of the basic (Electronic systems) configurations.

UNIT-IV:

Reliability evaluation of Non-series-parallel configurations (mainly for Electronic systems configurations): minimal tie-set, minimal cut-set and decomposition methods. Deduction of the minimal cutsets from the minimal path sets. More than two components Electronics systems reliability evaluation: Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutest / failure mode approach.

UNIT-V:

Discrete Markov Chains: General modelling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation, absorbing states (mainly for Electronic systems). Continuous Markov Processes: Modelling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating limiting state Probabilities. Reliability evaluation of repairable systems (mainly for Electronic systems).

Text Book:

1. Reliability Evaluation of Engineering Systems", Roy Billinton and Ronald N Allan, Plenum Press.

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M.Tech I Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D41109) NANO ELECTRONICS

Course Objective:

- 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

Course Outcome:

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: NanoElectronic 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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M.Tech I Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D42105) SECURED COMMUNICATIONS

Course Objective:

- 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.

Course Outcome:

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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	4	**0**	**4**

(15D42106) ADAPTIVE SIGNAL PROCESSING

Course Objective:

- 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.

***Course outcome*:**

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.

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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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I B.Tech I Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D41111) CLOUD COMPUTING

Course Outcomes: After completion of this subject, students will be able to

- Understand the concepts of distributed systems, parallel computing, cluster computing and virtualization.
- Design and implement cloud networks for various applications.
- Maintain cloud data centers and cloud based information systems for cloud computing.

UNIT I:

Introductory concepts and overview: Distributed systems, Parallel computing architectures: Vector processing, Symmetric multi processing and Massively parallel processing systems, High performance Cluster computing, Grid computing, Service Oriented Architecture overview, Virtualization.

UNIT II:

Web services delivered from the cloud: Infrastructure as a service, Platform-as-a-service, Software-as-a-service. Building Cloud networks: Evolution from the MSP model to cloud computing and software-as-aservice, The cloud data center, SOA as step toward cloud computing, Basic approach to a data center based SOA.

UNIT III:

Federation Presence, Identity and Privacy in the cloud: Federation in the cloud, Presence in the cloud, Privacy and its relation to cloud based information system. Security in the Cloud: Cloud security challenges, Software-as-a-service security.

Common Standards in Cloud computing:The open cloud consortium, The distributed management task force, standards for application developers, standards for messaging, standards for security.

UNIT IV:

End user access to cloud computing: youtube, zimbra, Facebook, Zoho, DimDim Collaboration Mobile internet devices and the cloud: Smartphone, mobile operating systems for smart phones, Mobile Platform virtualization, Collaboration applications for mobile platforms, Future trends.

UNIT V:

Virtualization: Adding guest Operating system. Cloud computing case studies1: Amazon EC2, Amazon simple DB, Amazon S3, Amazon Cloud Front, Amazon SQS.

Text Books:

1. John W. Rittinghouse, James F. Ransome, “Cloud Computing implementation, management and security”, CRC Press, Taylor & Francis group, 2010.
2. Anthony T.velte, Toby J.velte Robert Elsenpeter “Cloud Computing: A practical approach”, Tata McGraw Hill edition, 2010.

References:

1. George Reese , “Cloud Application Architectures”, Oreilly publishers.
2. David S. Linthicum, Addison, “Cloud Computing and SOA convergence in your enterprise”, Wesley Publications.

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M.Tech I Sem	**T**	**P**	**C**
	0	**3**	**2**

(15D41112) STRUCTURAL DIGITAL SYSTEM DESIGN LAB

Course Objective:

- 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

Course Outcome:

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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(15D41201) EMBEDDED SYSTEM DESIGN

Course Objective:

- To study about current technologies, integration methods and hardware and software design concepts associated with processor in Embedded Systems.
- To study about a simple low power microcontrollers and their applications
- To get detail knowledge regarding testing and hardware software co- design issues pertaining to design of an Embedded System using low power microcontrollers

Course Outcome:

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

- The issues relating to hardware and software design concepts associated with processor in Embedded Systems.
- The concept of low power microcontrollers.
- The hardware software co- design issues pertaining to design of an Embedded System using low power microcontrollers.

UNIT – I

Introductionto Embedded Electronic Systems and Microcontrollers:

An Embedded System-Definition, Embedded System Design and Development Life Cycle, An Introduction to Embedded system Architecture, The Embedded Systems Model, Embedded Hardware:The Embedded Board and the von Neumann Model, Embedded Processors: ISAArchitectureModels, Internal Processor Design, Processor Performance, Board Memory: Read-Only Memory (ROM), Random-Access Memory (RAM), Auxiliary Memory, Memory Management of External Memory and Performance, Approaches to Embedded Systems, Small Microcontrollers, Anatomy of a Typical Small Microcontroller, Small Microcontrollers Memory, Embedded Software, Introduction to small microcontroller (MSP430).

UNIT-II

MSP430 – I:

Architecture of the MSP430 Processor: Central Processing Unit, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Examples, Reflections on the CPU and Instruction Set, Resets, Clock System, Memory and Memory Organization.

Functions, Interrupts, and Low-Power Mode: Functions and Subroutines, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Mixing C and Assembly Language, Interrupts, Interrupt Service Routines, Issues Associated with Interrupts, Low-Power Modes of Operation.

UNIT – III

MSP430 – II:

Digital Input, Output, and Displays: Parallel Ports, Digital Inputs, Switch Debounce, Digital Outputs, Interface between Systems, Driving Heavier Loads, Liquid Crystal Displays, Simple Applications of the LCD.

Timers: Watchdog Timer, Timer_A, Timer_A Modes, Timer_B,Timer_B Modes, Setting the Real-Time Clock, State Machines.

UNIT – IV

MSP430 Communication:

Communication Peripherals in the MSP430, Serial Peripheral Interface, SPI with the USI, SPI with the USCI, AThermometer Using SPI Modes,Inter-integrated Circuit Bus(I^2C) and its operations, State Machines for I^2C Communication, AThermometer Using I^2C, Asynchronous Serial Communication, Asynchronous Communication with the USCI_A, ASoftware UART Using Timer_A, Other Types of Communication.

UNIT – V

MSP430 Case Studies:

Introduction to Code Composer studio (CC Studio Ver. 6.1) a tutorial, A Study of blinking LED, Enabling LED using Switches, UART Communication, LCD interfacing, Interrupts, Analog to Digital Conversion, General Purpose input and output ports, I^2C.

Text Books:

1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt.Ltd.Publications, 2005.
2. John H. Davies "MSP430 Microcontroller Basics",Elsevier Ltd Publications, Copyright 2008.

References:

1. Manuel Jiménez Rogelio,PalomeraIsidoroCouvertier "Introduction to Embedded SystemsUsing Microcontrollers and the MSP430" Springer Publications, 2014.
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 Books, 2002.
5. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications,Second Edition, 2008.

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(15D41202) IMAGE AND VIDEO PROCESSING

Course Objective:

- 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

Course Outcome:

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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(15D42201) DETECTION AND ESTIMATION THEORY

Course Objective:

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.

Course Outcome:

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.

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.

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.

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(15D42202) WIRELESS COMMUNICATIONS

Course Objective:

- 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.

Course Outcome*:*

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 – I

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 - II

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 - III

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 – 1V

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 - V

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.

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M.Tech II Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D42203) ERROR CONTROL CODING

Course Objective:

- To understand mathematical concepts related to coding
- To get clear understanding in formulation and computation of Linear Block Codes, Cyclic Codes and Binary BCH Codes.
- To get complete understanding regarding Convolutional Codes and different algorithms associated with Convolutional Coding

Course Outcome:

After completion of this course the students will be able to

- .Understand mathematical concepts related to coding
- Understands concepts involved in formulation and computation of Linear Block Codes, Cyclic Codes and Binary BCH Codes.
- Get complete knowledge regarding Convolutional Codes and different algorithms associated with Convolutional Coding

UNIT – I

Introduction: Coding for Reliable Digital Transmission and Storage – Types of codes, Modulation and coding, Maximum likelihood decoding, Types of errors, Error control strategies, performance measures, Coded modulation, ***Introduction to Algebra*** - Groups & fields, Binary field arithmetic, Construction of Galois field and its basic properties, Computations, Vector spaces, matrices, problem solving.

UNIT – II

Linear Block Codes: Introduction linear block codes, Syndrome and Error detection, Error detection and Error correction capabilities of a Block code, Standard array and syndrome decoding, Probability of an undetected error for linear codes over a BSC, Single parity check codes, repetition codes, and self-dual codes, Hamming codes, A class of single error correcting and double error detecting codes, Reed-Muller codes and other constructions, The squaring construction of codes, The Golay code, Interleaved codes, Illustrative Problems.

UNIT – III

Cyclic and Binary BCH Codes: Description of Cyclic codes, Generator and parity – check matrices of cyclic codes, Encoding of Cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, Cyclic Hamming codes, The Golay code, Shortened cyclic codes, Cyclic product codes, Binary primitive BCH codes, Decoding of BCH codes, Iterative algorithm for finding the error location polynomial & its iterative algorithm, Finding the error location numbers and error correction, Correction of errors and erasures, Implementation of Galois Field arithmetic, Implementation of error correction, Weighted distribution & Error detection of binary BCH codes, Illustrative Problems.

UNIT – IV

Other Block Codes: q-ary Linear block codes, Primitive BCH codes, Reed Solomon codes, Decoding of Non-binary BCH and RS codes, Decoding with the Euclidean algorithm, Frequency domain decoding, Correction of errors and erasures, One step majority logic decoding and its variations, Multiple step majority logic decoding, Euclidean Geometry (EG) and its codes, Twofold EG codes, Projective geometry and projective geometry codes, Illustrative problems.

UNIT – V

Convolutional Codes: Encoding of Convolutional codes, Structural properties and distance properties of Convolutional codes, The Viterbi Algorithm, Performance bounds for Convolutional codes, Construction of good Convolutional codes, Implementation and performance of the Viterbi algorithm, The soft output of Viterbi algorithm (SOVA), The BCJR algorithm, Punctured and Tail-biting Convolutional codes, ZJ sequential decoding algorithm, The Fano Sequential Decoding algorithm, Performance characteristics and code construction of Sequential decoding, Majority Logic decoding and its performance characteristics, Code construction of Majority logic decoding, Illustrative problems.

References:

1. Shu Lin, Daniel J. Costello, Jr., "Error Control Coding," Pearson Publications, Second Edition, 2011.
2. Bernard Sklar, Pabitra Kumar Ray, "Digital Communications *Fundamentals and Applications,"* Pearson Publications, Second Edition, 2009.

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(15D42204) SPEECH PROCESSING

Course Objective:

- 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.

Course Outcome:

- 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

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(15D42205) SOFTWARE DEFINED RADIO

Course Objective:

- 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.

Course Outcome:

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

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(15D41208) BIG DATA

Course Outcomes: After completion of this subject, students will be able to

- Understand the concepts of RDMS, Grid computing and Big data technologies.
- Maintain and manage big data bases for various applications
- Utilize Hadoop related tools for implementation of different data models and formats.

UNIT I:

UNDERSTANDING BIG DATA

What is big data – why big data –.Data!, Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System , Grid Computing, Volunteer Computing, convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics

UNIT II:

NOSQL DATA MANAGEMENT

Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schema less databases – materialized views – distribution models – sharding — version – Map reduce – partitioning and combining – composing map-reduce calculations .

UNIT III:

BASICS OF HADOOP

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures

UNIT IV:

MAPREDUCE APPLICATIONS

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

UNIT V:

HADOOP RELATED TOOLS

Hbase – data model and implementations – Hbase clients – Hbase examples –praxis. Cassandra – Cassandra data model – cassandra examples – cassandra clients –Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

References:

1.VigneshPrajapati, Big data analytics with R and Hadoop, SPD 2013.
2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
4. Alan Gates, "Programming Pig", O'Reilley, 2011.

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DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS

M.Tech II Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D41209) FUZZY SYSTEMS AND NEURAL NETWORKS

Course Objective:

- 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.

Course Outcome:

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

INTRODUCTION: History of Neural Networks, Structure and functions of biological and artificial neuron, Neural network architectures, learning methods, evaluation of neural networks. McCulloch- Pitts neuron model, perception learning, Delta learning, Windrow-Hoff learning rules, linear seperability, Adaline, Modifications.

UNIT - II

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

ASSOCIATIVE MEMORIES: Hebbian learning rule, continues and discrete Hopfild networks, recurrent and associative memory, Boltzman machines, Bi-directional associative memory

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.

References:

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
3. S.N Sivanandham, S. sumathi, S.N.Deepa,“Introduction to Neural networks using matlab 6.0”, Tata McGraw Hill, New Delhi, 2005.
4. B.Kosko, “Neural Networks & Fuzzy Systems”, Prentice Hall (India) Ltd., 1992.

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M.Tech II Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D42206) MULTIMEDIA COMMUNICATIONS

Course Objective:

- 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.

Course Outcome:

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 synchronisation, 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

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M.Tech II Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D41212) WIRELESS SENSOR NETWORKS

Course Objective:

- 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.

Course Outcome:

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.

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M.Tech II Sem	**T**	**P**	**C**
	4	**0**	**4**

(15D41210) MEMS AND ITS APPLICATIONS

Course Objective:

- To study about fabrication processes involved in different types of sensors.
- To Study about characteristics of different MEMS materials.
- To get complete knowledge regarding working of MEMS Switches, relays, Inductors, Capacitors and Packing techniques associated with MEMS.

Course Outcome:

After completion of this course the students will be able to

- Understand different steps involved in fabrication processes of different types of sensors.
- Understand characteristics of different MEMS materials.
- Get complete knowledge regarding working of MEMS Switches, relays, Inductors, Capacitors and Packing techniques associated with MEMS.

\UNIT-I:

MEMS Fabrication processes & Sensors*:*

Introduction, MEMS Overview, Micro-fabrication of MEMS: Surface Micromachining, Bulk Micromachining, LIGA, micromachining of polymeric MEMS devices, Three-dimensional micro-fabrications. Electromechanical transducers: Piezoelectric transducers, Electro-strictive transducers, Magneto-strictive transducers, Electrostatic actuators, Electromagnetic transducers, Electro-dynamic transducers, Electro-thermal actuators, comparison of electro-thermal actuation process, Micro-sensing for MEMS: Piezo-resistive sensing, Capacitive sensing, Piezoelectric sensing, Resonant sensing, Surface Acoustic Wave sensors.

UNIT-II:

MEMS Materials and Fabrication techniques: Metals, semiconductors, thin films for MEMS and their deposition techniques, materials for polymer MEMS, Bulk micromachining for silicon based MEMS, Silicon surface micromachining, Micro-stereo-lithography for polymer MEMS.

UNIT-III:

MEMS Switches and Micro relays: Switch parameters, basics of switching, Switches for RF and microwave applications, actuation mechanisms for MEMS devices, bistable micro relays and micro-actuators, dynamics of switch operation, MEMS switch design considerations, modeling and evaluation.

UNIT- IV:

MEMS Inductors and Capacitors: MEMS Micro-machined passive elements: pros and cons, MEMS Inductors: self and mutual inductance, micro-machined inductors, reduction of stray capacitance, improvement of quality factor, folded inductors, modeling and design issues of planar inductors, variable inductor and polymer based inductor. MEMS Capacitors: MEMS gap tuning capacitor, MEMS area tuning capacitor, Dielectric Tunable capacitors.

UNIT-V:

MEMS packaging & MEMS RF Applications: MEMS packaging: Role of MEMS packaging, Types of MEMS packaging, flip-chip and multichip Unit packaging, RF MEMS packaging issues. MEMS RF applications: Micro-machined transmission line and components, micro-machined RF Filters, Micro-machined Phase shifters, and Micro-machined antenna, Gyros and Bio-MEMS.

References:

1. Gabriel M. Rebeiz, “RF MEMS: Theory, Design, and Technology,” John Wiley & Sons, 2003.
2. Vijay K. Varadan, K. J. Vinoy and K. A. Jose, “RF MEMS & Their Applications,” John Wiley & Sons, 2003.
3. Tai-Ran Hsu, “MEMS and Microsystems: Design and Manufacture,” McGraw- Hill.

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M.Tech II Sem	**T**	**P**	**C**
	2	**0**	**0**

(15D54201) RESEARCH METHODOLOGY
(Audit Course)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text books:

1. Research Methodology:Methods and Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step by Step Guide for Beginners- Ranjit Kumar, Sage Publications (Available as pdf on internet)
3. Research Methodology and Statistical Tools – P.Narayana Reddy and G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

References:

1. Scientists must Write - Robert Barrass (Available as pdf on internet)
2. Crafting Your Research Future –Charles X. Ling and Quiang Yang (Available as pdf on internet)

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M.Tech II Sem	**T**	**P**	**C**
	0	**3**	**2**

(15D42207) ADVANCED COMMUNICATIONS LAB

Course Objective:

- 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.

Course Outcome:

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:

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: Mat Lab – 7.0

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Course Structure of R21 Academic Regulations for M.Tech (Regular) Programs with effect from AY 2021-2022

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS

I SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D42101	Advanced Digital System Design	PC	3	0	0	3
2	21D42102	Wireless and Mobile Communication	PC	3	0	0	3
3	**Professional Elective – I**						
	21D42103	Design of Fault Tolerant Systems	PE	3	0	0	3
	21D42104	CMOS Digital IC Design					
	21D42105	Fuzzy Systems and Neural Networks					
4	**Professional Elective – II**						
	21D42106	Coding Theory and Techniques	PE	3	0	0	3
	21D42107	Advanced Digital Signal Processing					
	21D42108	5G Communications					
5	21D11109	Research Methodology and IPR	MC	2	0	0	2
6	21D11110	English for Research Paper Writing	AC	2	0	0	0
	21D11111	Value Education					
	21D11112	Pedagogy Studies					
7	21D42109	Advanced Digital System Design Lab	PC	0	0	4	2
8	21D42110	Wireless and Mobile Communication Lab	PC	0	0	4	2
Total				**16**	**00**	**08**	**18**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS

II SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D42201	Embedded System Design	PC	3	0	0	3
2	21D42202	Adaptive Signal Processing	PC	3	0	0	3
3	**Professional Elective – III**						
	21D42203	Low Power VLSI Design	PE	3	0	0	3
	21D42204	SoC Architecture					
	21D42205	Wireless Sensor Networks					
4	**Professional Elective – IV**						
	21D42206	Software Defined Radio	PE	3	0	0	3
	21D42207	Image and Video Processing					
	21D42208	Transform Techniques					
5	21D11209	Technical Seminar	PR	0	0	4	2
6	21D11210	Disaster Management	AC	2	0	0	0
	21D11211	Constitution of India					
	21D11212	Stress Management by Yoga					
7	21D42209	Embedded Systems Lab	PC	0	0	4	2
8	21D42210	Adaptive Signal Processing Lab	PC	0	0	4	2
Total				**14**	**00**	**12**	**18**

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III SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	**Professional Elective – V**						
	21D42301	Detection and Estimation Theory	PE	3	0	0	3
	21D42302	IoT and Its Applications					
	21D42303	Artificial Intelligence and Machine Learning					
2	**Open Elective**						
	21D40301	Network Security and Cryptography	OE	3	0	0	3
3	21D42304	Dissertation Phase – I	PR	0	0	20	10
4	21D00301	Co-Curricular Activities	PR				2
Total				**06**	**00**	**20**	**18**

IV SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D42401	Dissertation Phase – II	PR	0	0	32	16
Total				**00**	**00**	**32**	**16**

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42101	ADVANCED DIGITAL SYSTEM DESIGN (21D42101)	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To implement minimization of switching functions in different methods andimplementation of CAMP Algorithm.
- To synthesize logic and state machines using a PLA design andminimization and implementation of state machines using Field-Programmable GateArrays, CPLDs etc.
- To design a computer to be fault-tolerant for combinational circuits andsequential circuits.

Course Outcomes (CO): Student will be able to

- Perform minimization of switching functions in different methods.
- Implement CAMP Algorithm.
- Synthesize logic and state machines using a PLA design and minimization
- Design state machines using Field-Programmable Gate Arrays.
- Construct computer to be fault-tolerant for combinational and sequential circuits.

UNIT – I: Minimization Procedures and CAMP Algorithm

Review on minimization of switching functions using tabular methods, k-map, QM algorithm, CAMP I algorithm, Phase-I: Determination of Adjacencies, DA, CSC, SSMs and EPCs, CAMP-I algorithm, Phase-II: Passport checking, Determination of SPC, CAMP-II algorithm: Determination of solution cube, Cube based operations, determination of selected cubes is wholly within the given switching function or not, Introduction to cube-based algorithms.

UNIT –II: PLADesign, Minimization and Folding Algorithms

Introduction to PLDs, basic configurations and advantages of PLDs, PLA-Introduction, Block diagram of PLA, size of PLA, PLA design aspects, PLA minimization algorithm (IISc algorithm), PLA foldingAlgorithm (COMPACT algorithm)-Illustration of algorithms with suitable examples.

UNIT – III: Design of Large-Scale Digital Systems

Algorithmic state machine charts-Introduction, Derivation of SM Charts, Realization of SM Chart, control implementation, control unit design, data processor design, ROM design, PAL design aspects, digital system design approaches using CPLDs, FPGAs and ASICs.

UNIT – IV: Fault Diagnosis in Combinational Circuits

Faults classes and models, fault diagnosis and testing, fault detection test, test generation, testing process, obtaining a minimal complete test set, circuit under test methods- Path sensitization method, Boolean difference method, properties of Boolean differences, Kohavi algorithm, faults in PLAs, DFT schemes, built in self-test.

UNIT – V: Fault Diagnosis in Sequential Circuits

Fault detection and location in sequential circuits, circuit test approach, initial state identification, Homing experiments, synchronizing experiments, machine identification, distinguishing experiment, adaptive distinguishing experiments.

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Textbooks:

1. Logic Design Theory-N. N. Biswas, PHI
2. Switching and Finite Automata Theory-Z. Kohavi , 2nd Edition, 2001, TMH
3. Digital system Design using PLDs-Lala

Reference Books:

1. Fundamentals of Logic Design – Charles H. Roth, 5th Ed., Cengage Learning.
2. Digital Systems Testing and Testable Design – MironAbramovici, Melvin A. Breuer and Arthur D. Friedman- John Wiley & Sons Inc.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42102	WIRELESS AND MOBILE COMMUNICATIONS (21D42102)	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To recapitulate the fundamental concepts of Digital Communication Systems, and their performance analysis for AWGN channels.
- To understand the small scale fading channel modelling and their parameters
- To know the performance analysis of Multiple antenna wireless systems and various diversity schemes
- To understand the cellular concepts of mobile communications and multiple access techniques
- To understand and analyse the latest communication systems such as MIMO/OFDM and OSTBC schemes and Wireless Standards.

Course Outcomes (CO): Student will be able to

- Understand the basic operation and parameter metrics of digital communication and various mobile communication systems. Also understand various Wireless standards.
- Apply the concepts of various digital modulation techniques and mobile commutations to solve relative problems.
- Analyze the performance of various wireless and mobile communication systems for AWGN and wireless channels.
- Compare the performance of various wireless and mobile communication systems under different channel conditions.

UNIT - I Lecture Hrs:

Review of Digital Communication: Block diagram of digital communication, Modulation Schemes (BPSK, M-PSK, M-QAM, M-FSK), Pulse Shaping, Bandwidth efficiency, MAP – Receivers, AWGN Channel and Performance analysis of above schemes.

UNIT - II Lecture Hrs:

Wireless Channels: Fading Wireless Channel Modeling, Rayleigh/Ricean Fading Channels, RMS Delay Spread, Coherence bandwidth of a wireless channel, Doppler Spread, Jakes Model, Jakes Spectrum, BER Performance in Fading Channels.

UNIT - III Lecture Hrs:

Multiple Antenna Wireless Systems and Diversity:BER of Multiple Antenna Wireless Systems, Approximate BER, Example for BER of Wireless Communication, Deep fade in multiple antenna System, Definition of Diversity order.

UNIT - IV Lecture Hrs:

Cellular Communications: Introduction to Cellular Communications, Frequency reuse, Multiple Access Technologies, Cellular Processes - Call Setup, Handover, Introduction to CDMA, Walsh codes, PN Sequences, Multipath diversity, Rake Receiver.

UNIT - V Lecture Hrs:

MIMO/OFDM: Introduction to MIMO, MIMO Channel Capacity, SVD and Eigen-modes of the MIMO Channel, MIMO Spatial Multiplexing – BLAST, MIMO Diversity – Alamouti, OSTBC, Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, OFDM Issues. Wireless Standards: GSM, GPRS, WCDMA, WiMAX.

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(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Textbooks:
1. Fundamentals of Wireless Communications – David Tse and PramodViswanath, Cambridge University Press, 2005. 2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
Reference Books:
1. Wireless Communications: Principles and Practice, Theodore Rappaport, Prentice Hall, Second Edition.
Online Learning Resources:
1. NTPEL Videos on Wireless Communications

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42103	DESIGN OF FAULT TOLERANT SYSTEMS (21D42103)	L	T	P	C
Semester	I	PE – I	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 acquire the knowledge of design of built-in-self test.

Course Outcomes (CO): Student will be able to

- Provide broad understanding of fault diagnosis and tolerant design approach.
- Illustrate the framework of test pattern generation using semi and fully automatic approach.
- Acquire the knowledge of scan architectures.
- Acquire the knowledge of design of built-in-self test.

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-CheckingCircuits&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 – ZainalabedinNavabi, Springer International Ed.,

Reference Books:

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

Online Learning Resources:

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Course Code	21D42104	CMOS DIGITAL IC DESIGN (21D42104)	L	T	P	C
Semester	I	PE – I	3	0	0	3

Course Objectives:

- To understand the fundamental properties of digital Integrated circuits using basic MOSFET equations and to develop skills for various logic circuits using CMOS related design styles.
- The course also involves analysis of performance metrics.
- To teach fundamentals of CMOS Digital integrated circuit design such as importance of Pseudo logic, Combinational MOS logic circuits and Sequential MOS logic circuits.
- To teach the fundamentals of Dynamic logic circuits and basic semiconductor memories which are the basics for the design of high performance digital integrated circuits.

Course Outcomes (CO): Student will be able to

- Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS,
- Estimate Delay and Power of Adders circuits.
- Classify different semiconductor memories.
- Analyze, design and implement combinational and sequential MOS logic circuits.
- Analyze complex engineering problems critically in the domain of digital IC design for conducting research.
- Solve engineering problems for feasible and optimal solutions in the core area of digital ICs

UNIT - I | Lecture Hrs:

CMOS Inverter and Pseudo NMOS Logic characterization: Characterization of CMOS Inverter, Noise Margin, Inverter threshold voltage, Transient response, Pseudo NMOS logic gates, Transistor equivalence, Design of CMOS Inverter driving large capacitive loads.

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 bistable 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, Leakage currents in DRAM cell and refresh operation, SRAM operation 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. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
3. 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, AnanthaChandrakasan, BorivojeNikolic, PHI,2ndEdition.

Online Learning Resources:

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42105	FUZZY SYSTEMS AND NEURAL NETWORKS (21D42105)	L	T	P	C
Semester	I	PE – I	3	0	0	3

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.

Course Outcomes (CO): Student 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	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. KishanMehrotra, Chelkuri. K. Mohan, Sanjay Ranka, "Elements of Artificial Neural Networks", Penram International.

Reference Books:

1. S. NSivanandham, 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:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42106	CODING THEORY AND TECHNIQUES (21D42106)	L	T	P	C
Semester	I	PE – II	3	0	0	3

Course Objectives:

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

Course Outcomes (CO): Student will be able to

- Learning the measurement of information and errors.
- Obtain knowledge in designing Linear Block Codes and Cyclic codes.
- Construct tree and trellies diagrams for convolution codes
- Design the Turbo codes and 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.

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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 and Algorithms – Todd K. Moon, Wiley India, 2006. 4. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Edition, TMH, 2009
Online Learning Resources:

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42107	ADVANCED DIGITAL SIGNAL PROCESSING (21D42107)	L	T	P	C
Semester	I	PE – II	3	0	0	3

Course Objectives:

- To study about the digital signal processing algorithms and multi rate signal processing
- To study about the power spectral estimation by using barlett, welch &blackmann&tukey methods.
- To study about the effects of finite word length in fixed-point DSP systems.

Course Outcomes (CO): Student will be able to

- Get complete knowledge regarding various algorithms associated with Digital signal processing and multi rate signal processing.
- Verify the power spectral estimation by using Barlett, Welch &Blackmann&Tukey methods.
- Understand the effects of finite word length in fixed-point DSP systems by using ADC and FFT algorithms

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, Musial 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:

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42108	5G COMMUNICATIONS (21D42108)	L	T	P	C
Semester	I	PE – II	3	0	0	3

Course Objectives:

- To understand 5G Technology advances and their benefits
- To learn the key RF, PHY, MAC and air interface changes required to support 5G
- To acquire knowledge on Device-to-device communication and millimeter wave communication
- To explore implementation options for 5G

Course Outcomes (CO): Student will be able to

- Understand 5G Technology advances and their benefits
- Learn the key RF, PHY, MAC and air interface changes required to support 5G
- Acquire knowledge on Device-to-device communication and millimeter wave communication
- Explore implementation options for 5G

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), nonorthogonal 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. AfifOsseiran, 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. AmitabhaGhosh and RapeepatRatasuk "Essentials of LTE and LTE-A", CambridgeUniversity Press
3. Athanasios G. Kanatos, Konstantina S. Nikita, PanagiotisMathiopoulos, "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:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42109	ADVANCED DIGITAL SYSTEM DESIGN LAB (21D42109)	L	T	P	C
Semester	I		0	0	4	2

Course Objectives:

- To determine solution cubes of switching function using CAMP Algorithm.
- To design and implement digital systems to solve real world problems
- To synthesize logic and state machines using a PLA design and minimization and implementation of state machines using Field-Programmable Gate Arrays, CPLDs etc.
- To design a computer to be fault-tolerant for combinational circuits and sequential circuits.

Course Outcomes (CO): Student will be able to

- Identify, formulate and solve real world problems using industry standard simulators
- Verify the functionality of designed digital systems using appropriate synthesizers
- Analyze the implemented logic with CPLD/FPGA hardware kits

LIST OF EXPERIMENTS:

- The students are required to design the logic to perform the following experiments using necessary Industry standard simulator to verify the logical /functional operation, perform the analysis with appropriate synthesizer and to verify the implemented logic with different hardware modules/kits (CPLD/FPGA kits).
- Consider the suitable switching function and data to implement the required logic if required.

1. Implement QM Algorithm
2. Determination of EPCs, SPCs, SCs using CAMP Algorithm.
3. ROM, PLA design
4. PLA minimization algorithm (IISc algorithm)
5. PLA folding algorithm(COMPACT algorithm)
6. Implementation of 8:1 Mux/Demux, Full Adder, 8-bit Magnitude comparator,Encoder/decoder, Priority encoder, D-FF, 4-bit Shift registers (SISO, SIPO, PISO, bidirectional), 3-bit Synchronous Counters, Binary to Gray converter, Parity generator.
7. Implementation of Sequence generator/detectors, Synchronous FSM – Mealy and Moore machines.
8. Implementation of Arithmetic circuits like serial adder/ subtractor, parallel adder/subtractor, serial/parallel multiplier.
9. Control unit and data processor logic design
10. Digital system design using FPGA.
11. Fault simulation
12. Kohavi algorithm
13. Homing experiments
14. Distinguishing Experiments

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LAB REQUIREMENTS:

Software: Industry standard software with perpetual license consisting of required simulator, synthesizer, analyzer etc. in an appropriate integrated environment.

Hardware: Personal Computer with necessary peripherals, configuration and operating Systemand relevant VLSI (CPLD/FPGA) hardware Kits.

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Course Code	21D42110	WIRELESS AND MOBILECOMMUNICATIONS LAB (21D42110)	L	T	P	C
Semester	I		0	0	4	2

Course Objectives:

- To recapitulate the fundamental concepts of Digital Communication Systems, and their performance analysis for AWGN channels.
- To understand the small scale fading channel modeling and their parameters
- To know the performance analysis of Multiple antenna wireless systems and various diversity schemes
- To understand the cellular concepts of mobile communications and multiple access techniques
- To understand and analyze the latest communication systems such as MIMO/OFDM and OSTBC schemes and Wireless Standards.

Course Outcomes (CO): Student will be able to

- Understand the basic operation and parameter metrics of digital communication and various mobile communication systems.
- Implement different channel models and apply them as different scenarios for wireless communication systems through any one of the software platforms available.
- Implement different digital modulation schemes through simulations.
- Compare the performance of various wireless and mobile communication systems using performance metrics.
- Use of Software tools effectively in the implementation of Wireless and Mobile communication systems.

LIST OF EXPERIMENTS:

All the experiments shall be performed through simulation and all the experiments are compulsory.

1. Generate raised cosine pulse with a delay of $4T_b$. Assume a typical data rate.
2. Verify the BER performance of QPSK modulation scheme for AWGN channel.
3. Verify the BER performance of BFSK modulation scheme for AWGN channel.
4. Generation of Rayleigh Fading channel using Jakes Model taking Doppler spectrum into account.
5. Verify the BER performance of QPSK modulation scheme over Rayleigh Fading channel.
6. Implementation of Multiple Antenna Wireless System in a multipath scenario.
7. Generation of a PN code and verify its characteristics.
8. Implementation of RAKE receiver over a multipath fading channel.
9. Implementation of OFDM communication system and verify its performance over a fading channel.
10. Implementation of MIMO-OFDM communication system and verify its performance over fading channels.

Note: All the experiments may be performed using either MATLAB or any other suitable software.

References:

Online learning resources/Virtual labs:

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42201	EMBEDDED SYSTEM DESIGN (21D42201)	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To differentiate between a General purpose and an Embedded System.
- To provide knowledge on the building blocks of Embedded System.
- To understand the requirement of embedded firmware and its role in API.

Course Outcomes (CO): Student will be able to

- Expected to differentiate the design requirements between General Purpose and Embedded Systems.
- Expected to acquire the knowledge of firmware design principles.
- Expected to understand the role of Real Time Operating System in Embedded Design.
- To acquire the knowledge and experience of task level Communication in any 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, McGraw 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:

R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
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Course Code	21D42202	ADAPTIVE SIGNAL PROCESSING (21D42202)	L	T	P	C
Semester	II		3	0	0	3

UNIT – I

LMS Algorithm: Need for adaptive filtering - FIR adaptive filters – Newton's method - Steepest descent method –Convergence analysis - Performance surface – Least Mean Square (LMS) adaption algorithms – Convergence – Excess mean square error –Leaky LMS - Normalized LMS – Block LMS.

UNIT – II

Least Squares Algorithm: Recursive least squares (RLS) algorithm for adaptive filtering of stationary process- Matrix inversion – Comparison with LMS – RLS for quasi-stationary signals- Exponentially weighted RLS- Sliding window RLS.

UNIT – III

Applications of adaptive filters – Echo cancellation using LMS, and RLS algorithms – Comparison between LMS and RLS algorithms in terms of efficiency and complexity, RLS algorithm for array processing – Adaptive beam forming – Channel Equalization using RLS algorithm.

UNIT – V

Kalman Filtering: Statistical filtering for non-stationary signals – Kalman filtering- Principles - Initialization and tracking – Scalar and vector Kalman filter – Applications in signal processing – Time varying channel estimation – Radar tracking

Unit – IV

Blind Deconvolution – Overview, Channel Identifiability using Cyclostationary statistics, Subspace decomposition for Fractionally Spaced Blind Identification, Bussgang Algorithm for Blind Equalization, Extension of Bussgang Algorithm to complex Baseband Channels, Fractionally Spaced Bussgang Equalizers.

REFERENCES:

1. Simon O. Haykin, Adaptive Filter Theory, 5th Edition, Pearson Education Limited, 2014.
2. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering, and Array Processing, McGraw-Hill, 2005.
3. Bernard Widrow, Samuel D Stearns, Adaptive Signal Processing, Pearson Education; 2002.
4. Ali H. Sayed, Fundamentals of Adaptive Filtering, Wiley-IEEE Press, 2003.
5. Monson H. Hayes, Statistical Digital Signal Processing And Modeling, 1st Edition, Wiley India Pvt Ltd, 2008.
6. Michael G. Larimore, C. Richard Johnson,Theory and Design of Adaptive Filters, Pearson, 2001.

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Course Code	21D42203	LOW POWER VLSI DESIGN (21D42203)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

- To understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
- To implement Low power design approaches for system level and circuit level measures.
- To design low power adders, multipliers and memories for efficient design of systems.

Course Outcomes (CO): Student will be able to

- Understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
- Implement Low power design approaches for system level and circuit level measures.
- Design low power adders, multipliers and 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 Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend 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 – AnanthaChandrakasan, IEEE Press/Wiley International, 1998. 3. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
Online Learning Resources:

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Course Code	21D42204	SoC ARCHITECTURE (21D42204)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

- To understand the basics related to SoC architecture and different approaches related to SoC Design.
- To select an appropriate robust processor for SoC Design
- To select an appropriate memory for SoC Design.
- To realize real time case studies

Course Outcomes (CO): Student will be able to

- Understand the basics related to SoC architecture and different approaches related to SoC Design.
- Select an appropriated robust processor for SoC Design
- Select an appropriate memory for SoC Design.
- Realize real time case studies

UNIT - I Lecture Hrs:

Introduction to the System Approach: 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 Microarchitecture, 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.

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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 – PrakashRashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers
Online Learning Resources:

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42205	WIRELESS SENSOR NETWORKS (21D42205)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

- To understand the basics of Wireless sensor Networks
- To learn the Architecture of WSN
- To understand the concept of Networking in WSN

Course Outcomes (CO): Student will be able to

- Understand challenges and technologies for wireless networks
- Understand architecture and sensors
- Establishing infrastructure and simulations

UNIT – I: OVERVIEW OF WIRELESS SENSOR NETWORKS

Single-Node Architecture - Hardware Components- Network Characteristics- unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks- Types of wireless sensor networks.

UNIT – II: ARCHITECTURES

Network Architecture- Sensor Networks-Scenarios- Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts

UNIT – III: NETWORKING SENSORS

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - SMAC, - B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy-Efficient Routing, Geographic Routing.

UNIT – IV: INFRASTRUCTURE ESTABLISHMENT

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT – V: SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Textbooks:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J.Guibas, "Wireless Sensor Networks-An Information Processing Approach", Elsevier, 2007

Reference Books:

1. WaltenegusDargie , Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks Theory And Practice", By John Wiley & Sons Publications, 2011
2. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.
3. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS)

Course Code	21D42206	SOFTWARE DEFINED RADIO (21D42206)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

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

Course Outcomes (CO): Student will be able to

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

UNIT - I	Lecture Hrs:

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

UNIT - II	Lecture Hrs:

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:

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, Power amplifiers, Analog quadrature upconvertion, 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:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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Course Code	21D42207	IMAGE AND VIDEO PROCESSING (21D42207)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- To understand the quality improvement methods of Image.
- To study the basic digital image and video filter operations.
- To understand the fundamentals of Image Compression.
- To understand the Representation of video, principles and methods of motion estimation.

Course Outcomes (CO): Student will be able to

- Understand the quality improvement methods of Image.
- Study the basic digital image and video filter operations.
- Understand the fundamentals of Image Compression.
- Understand the Representation of video, principles and 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, JoemOstermann and Ya–quin Zhang. 1st Ed., PH Int. 2. Digital Image Processing – S. Jayaraman, S. Esakkirajan, T. Veera Kumar –TMH, 2009
Online Learning Resources:

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Course Code	21D42208	TRANSFORM TECHNIQUES (21D42208)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- To 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.

Course Outcomes (CO): Students 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 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:

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Course Code	21D42209	EMBEDDED SYSTEMS LAB (21D42209)	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- To familiarize with embedded systems programming concepts
- To implement different embedded communication and interfacing protocols

Course Outcomes (CO):

- Familiarize with embedded systems programming concepts
- Implement different embedded communication and interfacing protocols

LIST OF EXPERIMENTS:

1. Functional Testing of Devices

   Flashing the OS on to the device into a stable functional state by porting desktop environment with necessary packages.

2. Exporting Display on to other Systems

   Making use of available laptop/desktop displays as a display for the device using SSH client & X11 display server.

3. GPIO Programming

   Programming of available GPIO pins of the corresponding device using native programming language. Interfacing of I/O devices like LED/Switch etc. and testing the functionality.

4. Interfacing Chronos eZ430

   Chronos device is a programmable Texas Instruments watch which can be used for multiple purposes like PPT control, Mouse operations etc., Exploit the features of the device by interfacing with devices.

5. ON/OFF Control Based on Light Intensity

   Using the light sensors, monitor the surrounding light intensity & automatically turn ON/OFF the high intensity LED's by taking some pre-defined threshold light intensity value.

6. Battery Voltage Range Indicator

   Monitor the voltage level of the battery and indicating the same using multiple LED's (for ex: for 3V battery and 3 LEDs, turn on 3 LED s for 2-3V, 2 LEDs for 1-2V, 1 LED for 0.1-1V & turn off all for 0V)

7. Dice Game Simulation

   Instead of using the conventional dice, generate a random value similar to dice value and display the same using a 16X2 LCD. A possible extension could be to provide the user with option of selecting single or double dice game.

8. Displaying RSS News Feed on Display Interface

   Displaying the RSS news feed headlines on an LCD display connected to device. This can be adapted to other websites like twitter or other information websites. Python can be used to acquire data from the internet.

9. Porting Open w.r.t the Device

   Attempt to use the device while connecting to a Wi-Fi network using a USB dongle and at the same time providing a wireless access point to the dongle.

10. Hosting a website on Board

    Building and hosting a simple website(static/dynamic) on the device and make it accessible online. There is a need to install server (e.g.: Apache) and thereby host the website.

11. Webcam Server

    Interfacing the regular USB webcam with the device and turn it into fully functional IP webcam & test the functionality.

12. FM Transmission

    Transforming the device into a regular FM transmitter capable of transmitting audio at desired frequency (generally 88-108 MHz)

Software Requirements: Keil / Python
Hardware Requirements: Arduino/Raspberry Pi/Beagle board

References:

Online learning resources/Virtual labs:

Course Code	21D42210	ADAPTIVE SIGNAL PROCESSING LABORATORY (21D42210)	L	T	P	C
Semester	II		0	0	4	2

LIST OF EXPERIMENTS:

1. Generation of Wireless Channel Coefficients (either fixed or time varying channels).
2. Time invariant Channel Estimation and Equalization using LMS/NLMS algorithm
3. Time invariant Channel Estimation and Equalization using RLS algorithm
4. Echo cancellation using RLS algorithm
5. Time Varying Channel estimation using Kalman Filtering
6. Implementation Bussgang Algorithm in Blind Channel Equalization.

Note: The above experiments can be implemented in MATLAB.

References as above (as in theory)

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Course Code	21D42302	IoT AND ITS APPLICATIONS (PE – V)	L	T	P	C
Semester	III		3	0	0	3

Course Objectives:

1. To apply the Knowledge in IOT Technologies and Data management.
2. To determine the values chains Perspective of M2M to IOT.
3. To educate building blocks and characteristics of Internet of Things
4. To introduce communication protocols used in Internet of Things
5. To impart knowledge on design & develop IoT devices

Course Outcomes (CO): Student will be able to

1. Apply the Knowledge in IOT Technologies and Data management.
2. Determine the values chains Perspective of M2M to IOT.
3. Examine communication protocols used in IoT
4. Make use of python programming to implement Internet of Things
5. Design IoT applications using Raspberry Pi

UNIT - I **Lecture Hrs:**

Introduction to IoT: Introduction, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies.
Domain Specific IoTs: Home Automation, cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle

UNIT - II **Lecture Hrs:**

Fundamentals of IoT:
IoT Network Architecture and Design: Drivers Behind New Network Architectures, Comparing IoT Architectures, Simplified IoT Architecture, Core IoT Functional Stack, IoT Data Management and Compute Stack
Smart Objects: Sensors, Actuators, and Smart Objects, Sensor Networks.

UNIT - III **Lecture Hrs:**

IoT Communication Protocols:
Communications Criteria: Range, Frequency Bands, Power Consumption, Topology, Constrained Devices, Constrained-Node Networks, Data Rate and Throughput, Latency and Determinism, Overhead and Payload.
IoT Access Technologies: IEEE 802.15.4, IEEE 1901.2a, IEEE 802.11ah, LoRaWAN, NB-IoT and other LTE Variations

UNIT - IV **Lecture Hrs:**

IoT Network Layer Protocols: Need for Optimization – Constrained Nodes, Constrained Networks, IP versions Optimizing IP for IoT - From 6LoWPAN to 6Lo, Header Compression, Fragmentation, Mesh addressing
IoT Application Layer Protocols: CoAP, MQTT

UNIT - V **Lecture Hrs:**

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python; Python web application framework – Django, Designing a Restful web API.

Textbooks:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.
2. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press,2015

Reference Books:

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

Online Learning Resources: