

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.TECH IN SYSTEMS AND SIGNAL PROCESSING.  
EFFECTIVE FROM ACADEMIC YEAR 2017 - 18 ADMITTED BATCH**

**COURSE STRUCTURE AND SYLLABUS**

**I Semester**

<b>Category</b>	<b>Course Title</b>	<b>Int. marks</b>	<b>Ext. marks</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
PC-1	Adaptive Signal Processing	25	75	4	0	0	4
PC-2	Transform Techniques	25	75	4	0	0	4
PC-3	Random Processes and Time Series Analysis	25	75	4	0	0	4
PE-1	Biomedical Signal Processing Introduction to Navigational Aids Digital System Design	25	75	3	0	0	3
PE-2	VLSI Signal Processing Network Security and Cryptography Advanced Digital Signal Processing	25	75	3	0	0	3
OE-1	<b>*Open Elective – I</b>	25	75	3	0	0	3
Laboratory I	Signal Processing Lab-I	25	75	0	0	3	2
Seminar I	Seminar - I	100	0	0	0	3	2
<b>Total</b>		<b>275</b>	<b>525</b>	<b>21</b>	<b>0</b>	<b>6</b>	<b>25</b>

**II Semester**

<b>Category</b>	<b>Course Title</b>	<b>Int. marks</b>	<b>Ext. marks</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
PC-4	Detection and Estimation Theory	25	75	4	0	0	4
PC-5	Image and Video Processing	25	75	4	0	0	4
PC-6	Digital Signal Processors and Architectures	25	75	4	0	0	4
PE-3	Speech Signal Processing Spread Spectrum Communications Embedded System Design	25	75	3	0	0	3
PE4	Coding Theory and Techniques Wireless Communications and Networks System on Chip Architecture	25	75	3	0	0	3
OE-2	<b>*Open Elective – II</b>	25	75	3	0	0	3
Laboratory II	Signal Processing Lab - II	25	75	0	0	3	2
Seminar II	Seminar - II	100	0	0	0	3	2
<b>Total</b>		<b>275</b>	<b>525</b>	<b>21</b>	<b>0</b>	<b>6</b>	<b>25</b>

### III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review II	100	0	0	0	22	8
<b>Total</b>	<b>200</b>	<b>100</b>	<b>0</b>	<b>3</b>	<b>22</b>	<b>14</b>

### IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review III	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	100	0	0	0	16
<b>Total</b>	<b>100</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>24</b>

\*Open Elective subjects must be chosen from the list of open electives offered by **OTHER** departments.

# For Project review I, please refer 7.10 in R17 Academic Regulations.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. TECH. – I YEAR – II SEMESTER SYSTEMS AND SIGNAL PROCESSING**

**DETECTION AND ESTIMATION THEORY (PC - 4)**

**UNIT – I**

**Random Processes:** Discrete Linear Models, Markov Sequences and Processes, Point Processes, and Gaussian Processes.

**UNIT – II**

**Detection Theory:** Basic Detection Problem, Maximum A posteriori Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

**UNIT – III**

**Linear Minimum Mean-Square Error Filtering:** Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters.

**UNIT – IV**

**Statistics:** Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

**UNIT – V**

**Estimating the Parameters of Random Processes from Data:** Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Spectral Density Functions.

**TEXT BOOKS:**

1. K. Sam Shanmugan & A.M. Breipohl, "Random Signals: Detection, Estimation and Data Analysis", Wiley India Pvt. Ltd, 2011.
2. Lonnie C. Ludeman, "Random Processes: Filtering, Estimation and Detection", Wiley India Pvt. Ltd., 2010.

**REFERENCE BOOKS:**

1. Steven. M.Kay, "Fundamentals of Statistical Signal Processing: Volume I Estimation Theory", Prentice Hall, USA, 1998.
2. Steven. M.Kay, "Fundamentals of Statistical Signal Processing: Volume I Detection Theory", Prentice Hall, USA, 1998.
3. Srinath, Rajasekaran, Viswanathan, "Introduction to Statistical Signal Processing with Applications", 2003, PHI.
4. Louis L. Scharf, "Statistical Signal Processing: Detection, Estimation and Time Series Analysis", 1991, Addison Wesley.
5. Harry L. Van Trees, "Detection, Estimation and Modulation Theory: Part – I", 2001, John Wiley & Sons, USA.
6. Mischa Schwartz, Leonard Shaw, "Signal Processing: Discrete Spectral Analysis – Detection & Estimation", 1975, McGraw Hill.

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**IMAGE AND VIDEO PROCESSING (PC - 5)**

**UNIT – I**

**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**

**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**

**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**

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

**UNIT – V**

**2-D Motion Estimation:** Optical flow, General Methodologies, Pixel Based Motion Estimation, Block-Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

**TEXT BOOKS:**

1. Gonzalez and Woods, "Digital Image Processing", 3<sup>rd</sup> Edition, Pearson.
2. Yao Wang, Joem Ostermann and Ya-quin Zhang, "Video Processing and Communication", 1<sup>st</sup> Edition, PH Int.

**REFERENCE BOOKS:**

1. Gonzalez and Woods, "Digital Image Processing using MATLAB", 2<sup>nd</sup> Edition, McGraw Hill Education, 2010
2. Milan Sonka, Vaclav Hlavac, "Image Processing Analysis, and Machine Vision", 3<sup>rd</sup> Edition, CENGAGE, 2008
3. A Murat Tekalp, "Digital Video Processing", PERSON, 2010
4. S. Jayaraman, S. Esakkirajan, T. Veera Kumar, "Digital Image Processing", TMH, 2009

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**DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES (PC - 6)**

**UNIT - I**

**Introduction to Digital Signal Processing:** Introduction, A digital Signal – Processing system, the sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time-invariant systems, Digital filters, Decimation and interpolation.

**Architectures for Programmable DSP devices:** Basic Architectural features, DSP computational building blocks, Bus Architecture and Memory, Data addressing capabilities, Address generation UNIT, programmability and program execution, speed issues, features for external interfacing.

**UNIT - II**

**Programmable Digital Signal Processors:** Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX processors, memory space of TMS320C54XX processors, program control, TMS320C54XX instructions and programming, On-Chip peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX processors.

**UNIT - III**

**Architecture of ARM Processors:** Introduction to the architecture, Programmer's model- operation modes and states, registers, special registers, floating point registers, Behavior of the application program status register(APSR)-Integer status flags, Q status flag, GE bits, Memory system-Memory system features, memory map, stack memory, memory protection unit (MPU), Exceptions and Interrupts-what are exceptions?, nested vectored interrupt controller(NVIC), vector table, Fault handling, System control block (SCB), Debug, Reset and reset sequence.

**Technical Details of ARM Processors:** General information about Cortex-M3 and cortex M4 processors-Processor type, processor architecture, instruction set, block diagram, memory system, interrupt and exception support, Features of the cortex-M3 and Cortex-M4 Processors-Performance, code density, low power, memory system, memory protection unit, interrupt handling, OS support and system level features, Cortex-M4 specific features, Ease of use, Debug support, Scalability, Compatibility.

**UNIT - IV**

**Instruction Set:** Background to the instruction set in ARM Cortex-M Processors, Comparison of the instruction set in ARM Cortex-M Processors, understanding the assembly language syntax, Use of a suffix in instructions, Unified assembly Language (UAL), Instruction set, Cortex-M4-specific instructions, Barrel shifter, Accessing special instructions and special registers in Programming.

**UNIT - V**

**Floating Point Operations:** About Floating Point Data,Cortex-M4 Floating Point Unit (FPU)-overview, FP registers overview, CPACR register, Floating point register bank, FPSCR, FPU->FPCCR, FPU->FPCAR, FPU->FPDSCR, FPU->MVFR0, FPU->MVFR1.

**TEXTBOOKS:**

1. Avtar Singh and S. Srinivasan, "Digital Signal Processing", CENGAGE Learning, 2004.
2. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Elsevier Publications, 3rd Edition.

**REFERENCES:**

1. ARM System Developer's Guide Designing and Optimizing System Software by Andrew N. SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier Publications, 2004.

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**SPEECH SIGNAL PROCESSING (PE - 3)**

**UNIT – I**

**Fundamentals of Digital Speech Processing:** Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals.

**UNIT – II**

**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 energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

**UNIT – III**

**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 – IV**

**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: Single Microphone Approach : spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach.

**UNIT - V**

**Automatic Speech & Speaker Recognition:** Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System, Continuous digit Recognition System

**Hidden Markov Model (HMM) for Speech:** Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS,

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

**TEXT BOOKS:**

1. L. R. Rabiner and S. W. Schafer, "Digital Processing of Speech Signals", Pearson Education.
2. Douglas O'Shaughnessy, "Speech Communications: Human & Machine", 2<sup>nd</sup> Edition, Wiley India, 2000.
3. L.R Rabinar and R W Jhaung, "Digital Processing of Speech Signals", 1978, Pearson Education.

**REFERENCE BOOKS:**

1. Thomas F. Quateri, "Discrete Time Speech Signal Processing: Principles and Practice", 1<sup>st</sup> Edition, PE.
2. Ben Gold & Nelson Morgan, "Speech & Audio Signal Processing", 1<sup>st</sup> Edition, Wiley.

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**SPREAD SPECTRUM COMMUNICATIONS (PE - 3)**

**UNIT - I**

**Introduction to Spread Spectrum Systems:** Fundamental Concepts of Spread Spectrum Systems, Pseudo Noise Sequences, Direct Sequence Spread Spectrum, Frequency Hop Spread Spectrum, Hybrid Direct Sequence Frequency Hop Spread Spectrum, Code Division Multiple Access.

**Binary Shift Register Sequences for Spread Spectrum Systems:** Introduction, Definitions, Mathematical Background and Sequence Generator Fundamentals, Maximal Length Sequences, Gold Codes.

**UNIT - II**

**Code Tracking Loops:** Introduction, Optimum Tracking of Wideband Signals, Base Band Delay-Lock Tracking Loop, Tau-Dither Non-Coherent Tracking Loop, Double Dither Non-Coherent Tracking Loop.

**UNIT - III**

**Initial Synchronization of the Receiver Spreading Code:** Introduction, Problem Definition and the Optimum Synchronizer, Serial Search Synchronization Techniques, Synchronization using a Matched Filter, Synchronization by Estimated the Received Spreading Code.

**UNIT - IV**

**Cellular Code Division Multiple Access (CDMA) Principles:** Introduction, Wide Band Mobile Channel, The Cellular CDMA System, Single User Receiver in a Multi User Channel, CDMA System Capacity,

**Multi-User Detection in CDMA Cellular Radio:** Optimal Multi-User Detection, Linear Suboptimal Detectors, Interference Combat Detection Schemes, Interference Cancellation Techniques.

**UNIT - V**

**Performance of Spread Spectrum Systems in Jamming Environments:** Spread Spectrum Communication System Model, Performance of Spread Spectrum Systems without Coding.

**Performance of Spread Spectrum Systems with Forward Error Correction:** Elementary Block Coding Concepts, Optimum Decoding Rule, Calculation of Error Probability, Elementary Convolution Coding Concepts, Viterbi Algorithm, Decoding and Bit-Error Rate.

**TEXT BOOKS:**

1. Rodger E Ziemer, Roger L. Peterson and David E Borth, "Introduction to Spread Spectrum Communication- Pearson, 1st Edition, 1995.
2. Mosa Ali Abu-Rgheff, "Introduction to CDMA Wireless Communications", Elsevier Publications, 2008.

**REFERENCE BOOKS:**

1. George R. Cooper, Clare D. Mc Gillem, "Modern Communication and Spread Spectrum", McGraw Hill, 1986.
2. Andrew j. Viterbi, "CDMA: Principles of spread spectrum communication", Pearson Education, 1<sup>st</sup> Edition, 1995.
3. Kamillo Feher, "Wireless Digital Communications", PHI, 2009.
4. Andrew Richardson, "WCDMA Design Handbook", Cambridge University Press, 2005.
5. Steve Lee, "Spread Spectrum CDMA", McGraw Hill, 2002.

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**EMBEDDED SYSTEM DESIGN (PE - 3)**

**UNIT - I**

**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**

**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.

**UNIT - III**

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

**UNIT - IV**

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

**UNIT - V**

**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.

**TEXT BOOKS:**

1. Shibu K. V, "Introduction to Embedded Systems", McGraw Hill.

**REFERENCE BOOKS:**

1. Raj Kamal, "Embedded Systems", TMH.
2. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley.
3. Lyla, "Embedded Systems", Pearson, 2013
4. David E. Simon, "An Embedded Software Primer", Pearson Education.



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**CODING THEORY AND TECHNIQUES (PE - 4)**

**UNIT – I**

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

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

**UNIT - II**

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

**UNIT – III**

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

**UNIT – IV**

**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**

**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.

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

1. Bernard Sklar, "Digital Communications-Fundamental and Application", PE.
2. John G. Proakis, "Digital Communications", 5<sup>th</sup> Edition, 2008, TMH.
3. Salvatore Gravano, "Introduction to Error Control Codes", Oxford
4. Todd K.Moon, "Error Correction Coding – Mathematical Methods and Algorithms", 2006, Wiley India.
5. Ranjan Bose, "Information Theory, Coding and Cryptography", 2<sup>nd</sup> Edition, 2009, TMH.

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**WIRELESS COMMUNICATIONS AND NETWORKS (PE - 4)**

**UNIT - I**

**The Cellular Concept-System Design Fundamentals:** Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

**UNIT – II**

**Mobile Radio Propagation: Large-Scale Path Loss:** Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from perfect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

**UNIT – III**

**Mobile Radio Propagation: Small –Scale Fading and Multipath:** Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

**UNIT - IV**

**Equalization and Diversity:** Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

**UNIT - V**

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

**TEXT BOOKS:**

1. Theodore, S. Rappaport, "Wireless Communications, Principles, Practice", 2<sup>nd</sup> Edition, 2002, PHI.
2. Andrea Goldsmith, "Wireless Communications", 2005 Cambridge University Press.
3. Kaveh Pah Laven and P. Krishna Murthy, "Principles of Wireless Networks", 2002, PE
4. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson Education, 2012.

**REFERENCE BOOKS:**

1. Kamilo Feher, "Wireless Digital Communications", 1999, PHI.
2. William Stallings, "Wireless Communication and Networking", 2003, PHI.

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**SYSTEM ON CHIP ARCHITECTURE (PE - 4)**

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

**UNIT - IV**

**Interconnect Customization and Configuration:** Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance-Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

**UNIT – V**

**Application Studies / Case Studies:** SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

**TEXT BOOKS:**

1. Michael J. Flynn and Wayne Luk, "Computer System Design System-on-Chip", Wiley India Pvt. Ltd.
2. Steve Furber, "ARM System on Chip Architecture", 2<sup>nd</sup> Edition, 2000, Addison Wesley Professional.

**REFERENCE BOOKS:**

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

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**SIGNAL PROCESSING LAB – II**

**Note:**

- A. Minimum of 10 Experiments have to be conducted
- B. All Simulations are be carried out using MATLAB/DSP Processors/Labview Software & DSP Kits(or any other equivalent software)

1. Study of various addressing modes of DSP using simple programming examples
2. Generation of waveforms using recursive/filter methods
3. Sampling of input signal and display
4. Implementation of Linear and Circular Convolution for sinusoidal signals
5. Framing & windowing of speech signal.
6. Finding voiced & unvoiced detection for each frame of speech signal.
7. IIR Filter implementation using probe points
8. Implementation of FIR filters on DSP processor
9. Loop back using DSK kit
10. Real time signal enhancement using Adaptive Filter.
11. Representation of different Q-formats using GEL function
12. Verification of Finite word length effects (Overflow, Coefficient Quantization, Scaling and Saturation mode in DSP processors)
13. Image enhancement using spatial & frequency domain
14. Implementation of Image segmentation techniques
15. Extraction of frames from Video signal