M.TECH.(SSP) - COURSE STRUCTURE

I SEMESTER

Subject code	Name of the Subject	Contact hours/week		Credits	Scheme of Valuation		Total Marks
		L+T	P		Internal (CIE)	External (SEE)	
MTEC101	Advanced Digital Signal Processing	4+1		3	40	60	100
MTEC102	Digital Signal Processors	4+1		3	40	60	100
MTEC103	Linear Algebra for Signal Processing	4+1		3	40	60	100
MTEC104	Soft Computing Techniques	4+1		3	40	60	100
	Program Elective-II	4+1		3	40	60	100
MTEC1051	Array Signal Processing						
MTEC1052	Image and Video Processing						
MTEC1053	Signal Compression Techniques						
	Program Elective-II	4+1		3	40	60	100
MTEC1061	Bio-Medical Signal Processing						
MTEC1062	Multirate Signal Processing						
MTEC1063	Speech Processing						
MTEC151	Signal Processing Lab.		3	2	25	50	75
MTEC152	Technical Seminar		3	2	75		75
	Total			**22**	**340**	**410**	**750**

II SEMESTER

Subject code	Name of the Subject	Contact hours/week		Credits	Scheme of Valuation		Total Marks
		L+T	P		Internal (CIE)	External (SEE)	
MTEC201	Adaptive Signal Processing	4+1		3	40	60	100
MTEC202	Advanced Soft Computing Techniques	4+1		3	40	60	100
MTEC203	Random Processes	4+1		3	40	60	100
MTEC204	Transform Techniques	4+1		3	40	60	100
	Program Elective - III	4+1		3	40	60	100
MTEC2051	Detection and Estimation Theory						
MTEC2052	Optical Signal Processing						
MTEC2053	VLSI Architectures for Signal Processing						
	Program Elective - IV	4+1		3	40	60	100
MTEC2061	Coding Theory and Techniques						
MTEC2062	Multidimensional Signal Processing						
MTEC2063	Radar Signal Processing						
MTEC251	Soft Computing Lab.		3	2	25	50	75
MTEC252	Mini Project		3	2	75		75
	Total	24+6	6	22	290	460	750

III & IV SEMESTERS

Subject code	Name of the Subject	Contact hours/week		Credits	Scheme of Valuation		Total Marks
		L+T	P		Internal (CIE)	External (SEE)	
MTEC351	Dissertation			40	50	150	200
	Total			40	50	150	200

LBRCE EXAMINATION SECTION

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I SEMESTER

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LBRCE
EXAMINATION SECTION

MTEC101 - ADVANCED DIGITAL SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Multirate Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design and Implementation for sampling rate conversion.

UNIT – II

Spectral Density: Energy spectral density of signals, Power spectral density of signals and their Properties.

Power spectral density Estimation using Non-parametric methods: Estimation of PSD from finite data; Non-parametric methods- Periodogram properties, bias and variance analysis, Blackman-Tuckey method, Window design considerations, time-bandwidth product and resolution- variance trade-offs in window design, Modified periodogram, Averaging periodogram, Refined periodogram methods-Bartlet method, Welch method; Performance Comparison of all Non-Parametric methods.

UNIT – III

Power spectral density Estimation using Parametric methods:

Parametric method for Rational spectra- Covariance structure of ARMA process, AR signals, Yule-Walker method, Least square method, Levinson-Durbin Algorithm, MA signals, Modified Yule-Walker method, Two-stage least square method, Burg method for AR parameter estimation.

Parametric method for Line spectra-Models of sinusoidal signals in noise, Non-linear least squares method, Higher order Yule-Walker method, MUSIC and Pisayenko methods, Min-norm method, ESPIRIT method.

UNIT – IV:

Filterbank methods: Filterbank interpertation of periodogram, Slepia base-band filters, Refined filterbank method for higher resolution spectral analysis, Capon method, Introduction to higher order spectra.

UNIT – V:

Linear Prediction: Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the Lattice Forward and Backward Predictors; Solution of the Normal Equations- Levinson Durbin Algorithm, Schur Algorithm, Properties of Linear Prediction Filters.

TEXTBOOKS

1. J.G.Proakis & D.G.Manolokis, "Digital Signal Processing: Principles, Algorithms and Applications", PHI Publishers.
2. S. M.Kay, "Modern Spectral Estimation: Theory and Applications", PHI Publishers.

REFERENCES

1. R.L. Moses, Stoica, Introduction to Spectral Analysis, Prentice Hall Publishers.
2. P.P.Vaidyanathan, "Multirate Systems and Filter Banks", Pearson Education Publishers
3. Alan V Oppenheim & Ronald W Schaffer- "Discrete Time signal processing", PHI Publishers.
4. Emmanuel C.Ifeacher, Barrie. W. Jervis- "DSP- A Practical Approach", Pearson Education Publishers.
5. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, Digital Signal Processing, TMH Publishers.

MTEC102 - DIGITAL SIGNAL PROCESSORS

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Digital Signals: Review of Digital signals and operations, Z-transform, LTI Systems, Digital Filters, Discrete Time Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform.

Introduction to Digital Signal Processing Systems: A typical Digital Signal Processing System, Different types of Digital signal Processors (TMS Processors), Digital signal Processor architectures, Software developments, Hardware issues, System Considerations.

Implementation Issues: Fixed Point, Floating Point Arithmetic, Finite word length effects in DSP systems, Programming issues, Real time implementation considerations, Hardware interfacing.

Computational Accuracy in DSP Implementations: Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors.

UNIT - II

Fixed-Point Digital Signal Processors: Introduction; Architecture, Addressing modes, Instruction set, Programming issues of TMS320C2000, TMS320C54X, TMS320C55X, TMS320C62X, TMS320C64X Processors.

Floating-Point Digital Signal Processors: Introduction; Architecture, Addressing modes, Instruction set, Programming issues of TMS320C3X, TMS320C67X Processors.

UNIT-III

FIR Filtering using Digital Signal Processors: Finite-Impulse Response Filters, Design of FIR Filtering using MAT LAB, Fixed point Implementations, Floating-point Implementations, Applications.

IIR Filtering using Digital Signal Processors: Infinite-Impulse Response Filters, Design and Implementation of IIR Filters, Design of IIR Filters Using MATLAB, Fixed-Point Implementations, Floating-Point Implementations, Applications.

UNIT-IV

Fast Fourier Transforms using Digital Signal Processors: Introduction to the Discrete Fourier Transform, Fast Fourier Transform Algorithms, Analysis and Implementation Using MATLAB and C, Implementation considerations, Fixed-Point Implementations, Floating-Point Implementations, Applications.

UNIT-V

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

Interfacing Serial converters to Programmable DSP devices: Synchronous Serial Interface, Multichannel buffered serial port (McBSP), McBSP Programming, CODEC interface circuit, CODEC programming, CODEC-DSP interface example.

TEXT BOOKS

1. Sen M.Kuo and Woon-Seng S.Gan, "Digital Signal Processors Architectures, Implementations and Applications", Pearson education Publishers.
2. Avatar Singh and S. Srinivasan, Digital Signal Processing, Thomson Publications.

REFERENCES:

1. B.Venkata Ramani and M.Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, Tata MC GrawHill Publishers.
2. Phil Lapsley, Jeff Bier, Amit Shoham, Edward Lee, "DSP Processor Fundamentals, Architectures and Features" , WILEY-INDIA, 1996.
3. Jonathan Stein, Digital Signal Processing, John Wiley, 2005

MTEC103 - LINEAR ALGEBRA FOR SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Linear Equations and Matrices:

Linear Systems, Matrices, Dot Product and Matrix Multiplication, Properties of Matrix Operations, Matrix Transformation, Vectors and linear combinations, Vectors and linear equations, Elimination using matrices, Solutions of Linear Systems of Equations, the Inverse of a Matrix, LU-Factorization (Optional), Determinants.

UNIT - II

Vector Spaces and Subspaces:

Introductions to Algebraic structures, Complex Numbers, Spaces of Vectors, Properties of Vector Spaces, Subspaces, Sums and Direct Sums, Span Linear independence, basis and dimension, Homogeneous systems, Rank of the matrix and applications, The Null space of A: Solving **Ax = 0,** Ranges, The Matrix of a Linear Map,The Rank and the Row Reduced Form, The Complete Solution to **Ax = b,** Independence, Basis and Dimension, Dimensions of the Four Subspaces.

UNIT - III

Orthogonality: Definition and some properties, Orthogonal Complements, Orthonormal Sets, Fourier Expansion. Conjugate Space, Adjoint of an Operator, Self Adjoint Operators, Normal and Unitary operators, Projections and idempotent matrices, Orthogonality of the Four Subspaces. Rotations and unitary matrices, Least Squares Approximations, Gram-Schmdit Orthogonalisation Process, Shift Invariant systems and Toeplitz matrices. Operators and square matrices. Self adjoint operators and Hermitian matrices.

UNIT - IV

Eigen values and Eigen vectors: Introduction to Eigen values, Diagonalizing a Matrix, Diagonalisation of Symmetric Matrices, Applications to Differential Equations, Symmetric Matrices, Positive Definite Matrices, Invariant Subspaces on Real Vector Spaces, Similar Matrices, Singular Value Decomposition.

UNIT - V

Linear transformations and Applications:

Definition and Examples, The Idea of a Linear Transformation, The kernel and range of a Linear Transformation, The Matrix of a Linear Transformation, Diagonalisation and the Pseudo inverse, Matrices in Engineering, Fourier Series : Linear Algebra for Functions, Linear Algebra for Statistics and Probability, Complex vectors and Matrices

TEXT BOOKS

1. Gilbert Strang, "Introduction to Linear Algebra", 4th Edition, 2009.
2. Bernard Kolman, David R. Hill," Introductory Linear Algebra an Applied First Course, 8th Edition, published by Pearson Education.

REFERENCE

1. G.F.Simmons, Topology and Modern Analysis, McGraw Hill.
2. Hoffman Kenneth and Kunze Ray, Linear Algebra, Prentice Hall of India.
3. J.N.Sharma and A R Vassita by Linear algebra, Krishna prakasham Mandir, Meerut

MTEC104 - SOFT COMPUTING TECHNIQUES

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Artificial Neural Networks Fundamentals: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN-Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

UNIT - II

Single Layer Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category Training Algorithms, Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications

Multilayer Feed Forward Neural Networks: Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT - III

Associative Memories: Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, Linear Associator, Matrix Memories, Content Addressable Memory),Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms- Storage and Recall Algorithm; BAM Energy Function, Proof of BAM Stability Theorem.

Hopfield Networks: Architecture of Hopfield Network- Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis

UNIT - IV

Classical Sets & Fuzzy Sets: Introduction to classical sets– properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, Properties, fuzzy relations, cardinalities, membership functions.

Fuzzy Logic System Components: Introduction, Fuzzification, Membership Value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT - V

Features, advantages and applications of Evolutionary computation. Different types of Evolutionary Computing Techniques.

Evolutionary algorithms: Genetic algorithms: Biological background, Search space, working principle; Terminologies and operators of GA- Genes, Fitness, population, Data structures, search strategies, Representation of individuals, Encoding techniques, Selection-Roulette-wheel, Boltzmann, Tournament, Rank and Steady-state, Elitism, Crossover-single-pint, two-point, multi-point, uniform, matrix and cross over rate, Mutation- concept of

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mutation, mutation rate; Classification of GA- Parallel GA, Distributed GA, Hybrid GA, Adaptive GA, Fast messy GA, Independent sampling GA; Evolution strategies; Evolutionary programming; Genetic programming.

TEXT BOOKS

1. S.N.Sivanandam, S.N.Deepa, "Principles of Soft Computing", Wiley India Ltd, India, 2007.
2. S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic Algorithms", Springer Verlag Publishers, Germany, 2008.

REFERENCES

1. S.N.Sivanandam, S.Sumathi, S.N.Deepa, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw Hill Publications, India, 2005.
2. S.N.Sivanandam, S.Sumathi and S.N.Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer Verlag Publishers Ltd, Germany,2007.
3. Simon Haykin, "Neural Networks: A comprehensive foundation", Pearson Education, 2001.
4. James A Freeman and Davis Skapura, Neural Networks, Pearson Education Publishers, 2002.
5. D.E.Goldberg,"Genetic Algorithms in search, Optimization and machine learning", 1989.

MTEC1051 - ARRAY SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT – I
Spatial Signals: Signals in space and time, Spatial frequency, Direction vs. frequency, Wave fields, Far field and Near field signals.

UNIT - II
Sensor Arrays: Spatial sampling, Nyquist criterion. Sensor arrays. Uniform linear arrays, planar and Random arrays, Array transfer (steering) vector, Array steering vector for ULA, Broadband arrays

UNIT – III
Spatial Frequency: Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum, Spatial Domain Filtering, Beam Forming, Spatially white signal.

UNIT – IV
Direction of Arrival Estimation: Non parametric methods - Beam forming and Capon methods, Resolution of Beam forming method. Subspace methods - MUSIC, Minimum Norm and ESPRIT Techniques, Spatial Smoothing.

UNIT – V
Higher order statistics in Signal Processing: Moments, Cumulants and poly spectra, higher order Moments and LTI systems.

TEXT BOOKS
1. Dan E. Dugeon and Don H. Johnson, Array Signal Processing: Concepts and Techniques, Prentice Hall publishers.
2. Manalokis, Ingle and Kogon, Statistical and Adaptive signal processing, Artech House INC.

REFERENCES
1. Petre Stoica and Randolph L. Moses, Spectral Analysis of Signals, Prentice Hall publishers.
2. Bass J, McPheeters C, Finnigan J, Rodriguez E, Array Signal Processing, Connexions Web site. http://cnx.rice.edu/content/col10255/1.3/

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LBRCE
EXAMINATION SECTION

MTEC1052 - IMAGE AND VIDEO PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT-I: Image Fundamentals and Enchantement Methods
Introduction to 2D function, Definition of Digital Image, Sampling and Quantization of an image, Basic relationship between pixels, Spatial domain Enhancement: Point processing, Intensity Transformations Functions, Histogram Processing and its types, Smoothing Spatial Filters and Sharpening Spatial Filters in Spatial domain Enhancement: Basic of Filtering, Image Smoothing and Sharpening using Frequency Filters.

UNIT-II : Image Compression and Image Segmentation
Fundamentals of Image compression: Coding Redundancy, Spatial and Temporal Redundancy, Image Compression Models, Error-Free Compression, Lossy Compression, Detection of discontinuities, Basic Edge Detection, More Advanced Technique for Edge detection, Edge Linking and Boundary Detection, Thresholding, Region Growing, Region Splitting and Merging.

UNIT-III: Video Formation Perception and Representation
Color Perception and Specification, Light and Color, Human Perception of Color, The Trichromatic Theory of Color Mixture, Color Specification by Tristimulus Values, Color Specification by Luminance and Chrominance Attributes, Video Capture and Display, Video Cameras, Video Display, Composite versus Component Video, Gamma Correction, Analog Color Television System, Spatial and Temporal Resolution, Color Coordinates, Signal Band width, Multiplexing of Luminance, Chrominance and Audio, Analog Video Recording, Digital Video Notation, ITU-R BT.601 Digital Video, Other Video Format and Applications, Digital Video Recording, Video Quality Measure.

UNIT-IV: Fourier Analysis of Video Signals and Video Sampling
Spatial and Temporal Frequencies, Temporal Frequencies Caused by Linear Motion, Frequency Response of the Human Visual Systems, Temporal Frequency Response and Flicker Perception, Spatial Frequency Response, Spatiotemporal Frequency Response, Smooth Pursuit Eye Movement, Sampling of Video Signals, Required Sampling Rates, Sampling Video in two dimensions: Progressive versus Interlaced Scans, Sampling Video in three Dimensions, Spatial and Temporal Aliasing

UNIT-V: 2-D Motion Estimation
Optical Flow, General Methodologies, Motion Representation, Motion Estimation Criteria, Optimization Methods, Pixel Based Motion Estimation, Block- Matching Algorithm, Deformable Block-Matching Algorithms, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation,

TEXT BOOK
Rafael C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson education Publishers.

REFERENCES
1. Yao Wang, Jorn Ostermann and Ya–Qin Zhang, "Video processing and communication", Prentice Hall Publishers.
2. M. Tekalp, "Digital Video Processing", Prentice Hall Publishers.

MTEC1053 - SIGNAL COMPRESSION TECHNIQUES

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT – I

Review of Information Theory: The discrete memory less information source - Kraft inequality; optimal codes, Source coding theorem.

Compression Techniques: Lossless and Lossy Compression – Mathematical Preliminaries for Lossless Compression -Huffman Coding - Optimality of Huffman codes – Extended Huffman Coding – Adaptive Huffman Coding - Arithmetic Coding - Adaptive Arithmetic coding, Run Length Coding, Dictionary Techniques - Lempel-Ziv coding, Applications - Predictive Coding – Prediction with Partial Match – Burrows Wheeler Transform, Dynamic Markov Compression.

UNIT – II

Rate distortion theory: Rate distortion function R(D),Properties of R(D); Calculation of R(D) for the binary source and the Gaussian source, Rate distortion theorem, Converse of the Rate distortion theorem, Quantization - Uniform & Non-uniform - optimal and adaptive quantization, vector quantization and structures for VQ, Optimality conditions for VQ, Predictive Coding - Differential Encoding Schemes.

UNIT – III

Mathematical Preliminaries for Transforms:Karhunen Loeve Transform, Discrete Cosine and Sine Transforms, Discrete Walsh Hadamard Transform, Lapped transforms - Transform coding - Sub band coding -Wavelet Based Compression - Analysis/Synthesis Schemes.

UNIT – IV

Data Compression standards: Zip and Gzip, Speech Compression Standards: PCM-G.711, ADPCM G.726, SBC G.722, LD-CELP G.728, CS-ACELP (-A) G.729, MPC-MLQ, G.723.1, GSM HR VSELP, IS-54 VSELP, IS-96 QCELP, Immarsat - B APC, MELP, FS 1015, LPC10, FS1016, CELP, G721.

UNIT – V

Audio Compression standards: MPEG, Philips PASC, Sony ATRAC, Dolby AC-3,
Image Compression standards: JBIG, GIF, JPEG & JPEG derived industry standards, CALIC, SPIHT, EZW, JPEG 2000.
Video Compression Standards: MPEG, H.261, H.263 & H264.

TEXT BOOKS

1. “Introduction to Data Compression”, Khalid Sayood, Morgan Kaufmann Publishers., Second Edn., 2005.
2. “Data Compression: The Complete Reference”, David Salomon, Springer Publications, 4th Edn.,2006.
3. “Elements of Information Theory," Thomas M. Cover, Joy A. Thomas, John Wiley & Sons, Inc.,1991.

REFERENCES

1. "Rate Distortion Theory: A Mathematical Basis for Data Compression", Toby Berger, Prentice Hall,Inc., 1971.
2. "The Transform and Data Compression Handbook", K.R.Rao, P.C.Yip, CRC Press., 2001.
3. "Information Theory and Reliable Communication", R.G.Gallager, John Wiley & Sons, Inc., 1968.
4. "Multiresolution Signal Decomposition: Transforms, Subbands and Wavelets", Ali N. Akansu, Richard A. Haddad, Academic Press. 1992
5. "Wavelets and Subband Coding", Martin Vetterli, Jelena Kovacevic, Prentice Hall Inc., 1995.

LBRCE EXAMINATION SECTION

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MTEC1061 - BIOMEDICAL SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Fundamental of Digital Signals and Systems: Digital Signal, Properties of Digital signal, Representation of Digital Signals and Systems in Frequency Domain, Stationary random process, Ergodicity, Autocorrelation Function and Cross correlation Function, Power spectral density, Noise power spectral density analysis, Decimation in Time, Decimation in Frequency.

UNIT - II

ECG and EEG Signal Processing: ECG Data Acquisition, ECG Lead System, ECG Parameters and their Estimations, ECG Pattern Recognition, ECG Data Compression Techniques, The Electrophysiology origin of Brain waves, The EEG Signals and its Characteristics, EEG Modeling, Adaptive Segmentation, Transient Detection and Elimination-the case of Epileptic patients. Data Acquatisation and Classification of Sleep stages, The Markov model and Markov Chains, The Dynamics of Sleep-Wake Transitions

UNIT - III

Spectral Estimation:

The Periodogram, Blackman-Tukey Spectral Estimation, Analysis of the Doppler Signal using the Periodogram, Analysis of Heart rate variability using the Periodogram, The Cepstrum Analysis, Cepstrum Power, The Complex Cepstrum, Phase Unwrapping, Analysis of ECG Signal using Cepstrum, Analysis of Speech Signal Using Complex Cepstrum and Linear Filtering

UNIT - IV

Adaptive Systems:

Principle of Adaptive Noise Cancelling, Adaptive Noise Cancelling with LMS Algorithm and RLS Algorithm, Application of Adaptive Noise Cancelling methods to Enhance ECG Monitoring, Enhance Fetal ECG Monitoring, Adaptive Zero Tracking Methods for LMS and RLS Algorithm, Adaptive Zero Tracking of EEG Signal for Detecting Epileptic Patients, Visual Evoked Potentials for detecting Multiple Sclerosis patients.

UNIT - V

Parametric Modeling Methods: Linear Prediction and Auto Regressive Models, The Autocorrelation(Yule-Walker) methods, The Covariance method, The Cholesky Decomposition Method, Burg Method, Adaptive AR methods using LMS,RLS Methods, Applications of AR Modeling of ECG, Seizure EEG, Surface EMG,

TEXT BOOK

Miten Akay, " Biomedical Signal Processing", Academic Press Inc.

REFERENCES

1. D.C.Reddy, "Biomedical Signal Processing- Principles and Techniques", TMH.
2. Cohen.A, Biomedical Signal Processing -Vol. I Time & Frequency Analysis, CRC Press.

MTEC1062 - MULTIRATE SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT – I

Review of Single-Rate Discrete-Time Signals and Systems: Discrete-Time Signals, Discrete-Time Systems,Discrete-Time Fourier Transform, Discrete Fourier Transform The z-Transform, Structures for Discrete-Time Systems, Sampling the Continuous-Time Signal.

Basic Sampling alteration schemes: Time-Domain Representation of Down-Sampling and Up-Sampling, Frequency-Domain Characterization of Down-Sampling and Up-Sampling, Decimation and Interpolation-Identities, Cascading, Sampling-Rate Alteration Devices, Polyphase Decomposition, Multistage Systems.

UNIT – II

Filters in Multirate Systems: Spectral Characteristics of Decimators and Interpolators, Filter Specifications for Decimators and Interpolators, Computation of Aliasing Characteristics, Sampling Rate Alteration of Band pass Signals

FIR Filters for Sampling Rate Conversion Direct Implementation Structures for FIR Decimators and Interpolators, Poly-phase Implementation of Decimators and Interpolators, Memory Saving Structures for FIR Poly-phase Decimators and Interpolators, Computational Efficiency of FIR Decimators and Interpolators

UNIT – III

IIR Filters for Sampling Rate Conversion: Direct Implementation Structures for IIR Filters for Decimation and Interpolation, Computational Requirements for IIR Decimators and Interpolators, IIR Filter Structures Based on
Polyphase Decomposition.

Sampling Rate Conversion by a Fractional Factor: Sampling Rate Conversion by a Rational Factor, Spectrum of the Resampled Signal, Polyphase Implementation of Fractional Sampling Rate Converters, Rational Sampling Rate Alteration with Large Conversion Factors, Sampling Rate Alteration by an Arbitrary Factor, Fractional-Delay Filters.

UNIT – IV

Lth-Band FIR Digital Filters

Lth-Band Linear-Phase FIR Filters: Definitions and Properties, Polyphase Implementation of FIR Lth-Band Filters, Separable Linear-Phase Lth-Band FIR Filters, Minimum-Phase and Maximum-Phase Transfer Functions, Half band FIR Filters

Complementary FIR Filter Pairs

Definitions of Complementary Digital Filter Pairs, Constructing High pass FIR Filters, Analysis and Synthesis Filter Pairs, FIR Complementary Filter Pairs

UNIT – V

Multirate FIR Filter Banks: Two Channel FIR Filter bank, Alias free filter banks, Perfect reconstruction and Near Perfect reconstruction, Orthogonal Two channel FIR filter bank, Tree structured Multi-channel filter banks, Filter banks with equal pass bands, Octave Filter banks.

TEXT BOOK

1. Ljiljana Milic, Multirate filtering for Digital Signal processing- MATLAB applications, Information Science Reference, Hershey- New York, 2009.
2. P.P. Vaidyanathan, Multirate systems and filter banks, Prentice Hall PTR,1993.

REFERENCES

1. N.J. Fliege, Multirate digital signal processing, John Wiley 1994.
2. R.E. Crochiere. L. R, Multirate Digital Signal Processing, Prentice Hall Inc.1983

MTEC1063 - SPEECH PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Fundamentals and Time Domain Models: Anatomy & Physiology of Speech Organs(in-brief), The process of Speech Production, The Acoustic Theory of Speech Production, Digital models for speech signals. 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 - 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, Comparisons 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 Cestrum of Speech, Pitch Detection, Formant Estimation, the HomomorphicVocoder.

UNIT - IV

Speech enhancement: -Nature of interfering sounds, Speech enhancement techniques: Single Microphone Approach, spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multimicrophone Approach.

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.

UNIT - V Networks for Speech Recognition:

Hidden Markov Models (HMM): Speech HMMs, Training markov models, classification via HMMs, Sub-word models, Context-dependent acoustic models, comparing HMMs and DTW, Viterbi algorithm, Improving HMMs. Adapting to variability in speech, Language models.

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 - 2nd ed., IEEE Press.

REFERENCES

1. Thomas F.Quateri -Discrete Time Speech Signal Processing: principles and Practice -1 ed, PE.
2. Ben Gold & Nelson Morgan Wiley.-Speech & Audio Signal Processing-, 1 ed.

MTEC151 - SIGNAL PROCESSING LAB

Practical	:	3 Periods / Week	Internal Marks	:	25
Tutorial	:	0 Period / Week	External Marks	:	50
Credits	:	2	External Examination :		3 hrs.

List of Experiments
(Minimum 15 experiments are to be conducted)

Part 1: Linear Algebra and Random Signals

(The following experiments are to be simulated using MATLAB/SIMULINK Software)

1. Solve the system Ax=b and give least squares solution of Ax=b.
2. a)Evaluate Characteristic polynomial, eigenvalues, eigenvectors,
   b)Eigenvalues and eigenvectors of a normal matrix A
3. a) Bases for all four fundamental subspaces.
   b) Basis for the nullspace and Orthogonal complement of a subspace.
4. a)Matrix inverse by Gauss-Jordan elimination.
   b)Solution to a square, invertible system.
5. Give the relation between two random signals and derive the statistical properties of random signal.
6. Generation of discrete time independent and identically distributed random processes with different distributions like Uniform, Gaussian.
7. Generation of discrete time independent and identically distributed random processes with different distributions like Exponential, Laplacian.

Part 2: Advanced Digital Signal Processing

(The following experiments are to be simulated using MATLAB/SIMULINK Software)

8. Frequency response of a stationary signal.
9. Frequency response of a Non-stationary signal.
10. Frequency response of elliptical low pass filter and chebyshev high pass filter.
11. Frequency response of chebyshev bandpass filter and Butterworth band stop filter.
12. Implementation of decimation and interpolation in spatial domain.
13. Spectrum estimation using parametric methods
14. Spectrum estimation using nonparametric methods
15. Minimization of the spectral leakage effect.
16. Average energy calculations of Nonstationary signal.

Part 3: Experiments using Code Composer Studio Simulation Soft ware

(The following experiments are to be conducted using TMS Digital Signal Processor Kits)

17. Linear Convolution.
18. Implementation of a FIR filter.
19. Implementation of an IIR filter.
20. Calculation of FFT.

LBRCE EXAMINATION SECTION

HEAD
Department of Electronics & Communication Engineering
Lakireddy Bali Reddy College of Engineering
MYLAVARAM, Krishna Dt., Andhrapradesh.

II SEMESTER

MTEC201 - ADAPTIVE SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT – I

Introduction to Adaptive Systems: Definitions and Characteristics, Areas of Applications, Open- and Closed-Loop Adaption, Example of an Adaptive System. Adaptive Linear Combiner- Description, Input Signal and Weight Vectors, Desired Response and Error, Performance Function, Gradient and Minimum Mean-Square Error, Examples of a Performance Surface.

UNIT – II

Development of Adaptive Filter Theory: Review of Stochastic Processes and Models, Filtering Problem, Linear Optimum Filtering–Statement of the Problem, Principle of Orthogonality, Minimum Mean-Square Error, Wiener- Hopf equations, Error Performance Surface.

UNIT - III

Searching the Performance Surface: Methods of Searching the Performance Surface, Basic Ideas of Gradient Search methods, A Simple Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence, The Learning Curves, Gradient Search by Newton's Method, Newton's Method in Multidimensional Space, Gradient Search by the Method of Steepest Descent, Comparison of Learning Curves

UNIT – IV

LMS Algorithm and Applications: Structure and Operation of LMS Algorithm, LMS Adaptive Algorithm, Applications of LMS Algorithm-Canonical Model of the Complex LMS Algorithm, Adaptive deconvolution for Processing of Time -Vary, Instantaneous Frequency Measurement, Adaptive Noise cancelling Applied to a sinusoidal Interference, Adaptive Line Enchantment, Adaptive Beam forming, Comparison of the LMS with the Steepest-Descent Algorithm, Normalized Least-Mean Square Adaptive Filters, Stability of Normalized LMS Filter, Step –Size Control foe Acoustic Echo Cancellation

UNIT – V

Kalman filtering: Recursive Minimum Mean Square Estimation for Scalar Random variables, Statement of Kalman Filtering Problem ,The Innovations Process, Estimation of the State Using the Innovation Process, Filtering ,Initial conditions.

TEXT BOOKS

1. Bernard Widrow and Samuel D.Streams, Adaptive Signal Processing, Pearson education publishers.
2. Simon Haykin, Adaptive Filter Theory, Pearson education Publishers.

REFERENCES

1. Sophocles.J .Orfamadis, 'Optimum signal processing: An introduction', McGraw-Hill Publishers.
2. S.Thomas Alexander, 'Adaptive signal processing:Theory and Applications', Springer- Verlag.

MTEC202 - ADVANCED SOFT COMPUTING TECHNIQUES

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Particle swarm optimization: Basic principle, algorithm, flowchart; Variations of PSO: weighted, repulsive, stretched, comprehensive learning, combined effect PSO and clonal PSO, Comparison between PSO and GA, Applications of PSO.
Ant colony optimization: Biological Inspiration, Similarities and Differences between Real Ants and Artificial Ants, Characteristics of Ant Colony Optimization, Ant Colony Optimization Algorithms, Applications of Ant Colony Optimization.

UNIT - II

Bacterial Foraging Optimization: Forging theory, social foraging, foraging behavior of E. coli bacteria, BFO algorithm, chemotatic, swarming, reproduction and elimination and dispersal, Variations of BFO- Fuzzy BFO and Adaptive BFO.
Artificial Immune System: Overview, central and peripheral immune systems, immune network- clonal selection and its mathematical modeling, beyond clonal selection, danger theory, negative selection.

UNIT - III

Simulated Annealing: Introduction, Methodology, advantages
Learning Classifier Systems: General background, Holland's Learning Classifier System, Zeroth level Classifier System, Wilson's ZCS, Wilson's XCS.

UNIT - IV

Tabu Search: Introduction, Methodology, advantages **Harmony Search:** Introduction, Methodology, advantages

UNIT - V

Constrained Optimization: Introduction to Constrained Optimization, feasibility maintenance, Penalty function, separation of constrained violation and objective value, performance evaluation of Constrained Optimization evolutionary algorithms.
Multimodal Optimization: Problems we face, sequential niche, Fitness sharing, crowding, performance indices for Multimodal Optimization.
Multiobjective Optimization: Introduction to Multiobjective Optimization, performance based Approaches, Vector evaluated genetic algorithms, Considerations for designing Multiobjective evaluationary algorithms, classical Multiobjective evaluationary algorithms, performance performance evaluation of Multiobjective Optimization evolutionary algorithms.
Combinatorial Optimization: Introduction to Combinatorial Optimization, Knapsack problem, Traveling sales man problem, Job-scheduling problem.

TEXT BOOKS

1. S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic Algorithms", Springer Publishers.
2. Jason Brownlee, "Clever Algorithms: Nature-Inspired Programming Recipes", Lulu.com website.
3. Xinjie yu and Mitsuo Gen, "Introduction to Evolutionary algorithms", Springer Publishers.

REFERENCES

1. Dan Simon, "Evolutionary optimization algorithms", John Wiley Publications.
2. A.E.Eiben and J.E.Smith, Introduction to Evolutionary Computing, Springer Publishers.
3. E.Bonabeau, M.Dorigo and G.Theraulaz, Swarm Intelligence, Oxford University Press, New York.
4. R.C.Eberhart, Y.Shi and J.Kennedy, "Swarm Intelligence", Morgan Kaufmann Publishers.
5. D.Dasgupta, Artificial Immune Systems and their applications, Springer Publishers.
6. P.Venkataraman, Applied Optimization with MATLAB Programming, John Wiley Publications.
7. T.Baeck, D.B.Fogel, and Z.Michalewicz (eds.), Handbook on Evolutionary Computation, CRC Press.
8. Pier Luca Lanzi, Wolfgang Stolzmann, Stewart W. Wilson, "Learning Classifier Systems: From Foundations to Applications", Springer Publications.

MTEC203 - RANDOM PROCESSES

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination :		3 hrs.

UNIT – I

Random Variables and their operations: Probability Density and Probability Distribution Functions of Single and Multiple Random Variables, Expectation, Moments of Single and Multiple Random Variables, Moment generating functions, Characteristic functions of Single and Multiple Random Variables, Transformation of Single and Multiple Random Variables, Markov and Chebyshev Inequalities, Chi-square tests of hypotheses concerning distribution.

UNIT – II

Random Processes Analysis: Random Processes Analysis in the Time Domain-Continuous and Discrete Time Random Processes, Stationarity, Auto Covariance and Auto Correlation functions of Random Processes, Continuity, differentiation, Integrals of Random Processes, Normal (Gaussian) Random Process, Poisson Random process.

Random Processes Analysis in the Frequency Domain- Energy Spectral Density, Power Spectral Density, Cross Power Spectral Density of Random Processes, and their Properties.

Linear Systems with random inputs-Impulse response, Transfer function, the relation between the spectral density for the input and for the output.

UNIT- III

Markov Chains: Discrete time Markov chains, state transition probability matrix, n-step state transition probability, transition diagrams, Chapman-Kolmogorov equations, first passage probabilities, classification of states, limiting state probabilities, Continuous-time Markov chains, Gambler's ruin as a Markov chains

UNIT – IV

Series representation of Random process: Fourier series, Karhunen-Loeve expansion, Mercer's theorem, sampled band-limited processes, filtering using series representation.

UNIT – V

Queuing Theory: Elements of a Queuing System, Little's Formula, M/M/1, Queue- Delay Distribution in M/M/1 System, M/M/1 System with Finite Capacity, M/G/1 Queueing system-Residual Service Time, Mean Delay in M/G/1 Systems.

TEXT BOOKS

1. Peebles, "Probability, Random Variables and Random Signal Principles", Tata McGrawHill Publications.
2. Henry Stark, John William Woods, "Probability, Statistics, and Random Processes for Engineers", Prentice Hall PTR, 2002.

REFERENCES

1. A. Papoulis and S. U. Pillai, "Probability, Random Variables and Stochastic Processes", McGraw Hill Publications.
2. Geoffrey Grimmett, "Probability and Random Processes", Oxford University Press.
3. V. Krishnan, "Probability and Random Processes", John Wiley & Sons.
4. Albert Leon Garcia, "Probability and Random Processes for Electrical Engineering", Prentice Hall Publications.

MTEC204 - TRANSFORM TECHNIQUES

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination :		3 hrs.

UNIT - I: Review of Transforms:

Linear Spaces, Vector Spaces, Signal Spaces, Hilbert spaces for Energy signals, Basis Functions, Orthogonality and Biorthogonality ,Fourier Series, Fourier Transform, Discrete Time Fourier Transform, Discrete Fourier Transform, Window Function, Short-Time Fourier Transform (STFT),Inversion Formula, Gabor Transform, Time –Frequency Window, Properties of STFT, short comings of STFT, Discrete Short-Time Fourier Transform, Discrete Cosine Transform.

UNIT – II: Multiresolution Analysis:

Need for wavelets- Wavelet Basis- Concept of Scale and its relation with frequency, Continuous Wavelet Transform, Inverse Wavelet Transform, Time-Frequency Window, Discrete Wavelet Transform, Wavelet Series, Multiresolution Spaces, Orthogonal, Bi-orthogonal and Semi orthogonal Decomposition, Two-scale Relations, Decomposition Relations, S-pline Functions, Mapping a Function into MRA Space. Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT- Need for scaling Function-Multi resolution analysis, Tiling of time scale plane for CWT; Important Wavelets : Haar, Mexican Hat Meyer, Shannon, Daubechies.

UNIT – III: Constructions of Wavelets

Necessary Ingredients for Wavelets, Construction of Semi orthogonal Spline Wavelet, Construction of ortho normal Wavelets, Ortho normal Scaling Functions, Shannon Scaling Function, Meyer Scaling Function, Daubechies Scaling Functions, Construction of Bi-orthogonal Wavelets.

UNIT – IV : Discrete Wavelet Transform and Filter Banks

Decimation and Interpolation,Convolution Followed by Decimation, Interpolation Followed by Convolution, Signal Representation in the Approximation Subspace, Wavelet Decomposition Algorithm, Reconstruction Algorithm, Two-Channel Perfect Reconstruction Filter Bank, Spectral-Domain Analysis of A Two –Channel PR Filter Bank, Time Domain Analysis, Comments on DWT and PR Filter Banks.

UNIT – IV : Applications of Transformation Techniques

Wavelet Packets, Wavelet Packet Algorithms, Thresholding, Two Dimensional Wavelets, Two-Dimensional, Wavelet Packets, Image Compression using DCT, Wavelet Transform of an Image Sub band Coding of Speech, Wavelet De-nosing , Speckal Removal, Edge Detection and Object Isolation using Wavelets.

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.

REFERENCES

1. Soman.K.P, Ramachandran. "Insight into Wavelets from Theory to practice", Printice Hall India, First Edition, 2004.
2. Vetterli M. Kovacevic, "Wavelets and sub-band coding", PHI, 1995.
3. C. Sydney Burrus, "Introduction to Wavelets and Wavelet Transforms", PHI.
4. Stephen G. Mallat. "A Wavelet Tour of Signal Processing", Academic Press.

MTEC2051 - DETECTION AND ESTIMATION THEORY

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT-I Detection theory: binary decisions - single Observation:
Maximum likelihood decision criterion; Neymann-Pearson criterion; Probability of error criterion; Bayes risk criterion; minimax criterion; robust detection; Receiver operating characteristics. Detection with unknown signal parameters, Signal detection in the presence of noise.

UNIT–II Detection theory: Binary decisions-multiple observations
Vector observations; the general Gaussian problem; Waveform observation in additive Gaussian noise; the integrating optimum receiver; Matched filter receiver, Chernoff bound, asymptotic relative efficiency; sequential detection; nonparametric detection, sign test, rank test.

UNIT – III Estimation Theory
Methods : Maximum likelihood estimation; Bayes cost method, Bayes estimation criterion - Mean square error criterion; Uniform cost function; absolute value cost function; Linear minimum variance -Least squares method; Estimation in the presence of Gaussian noise - Linear observation; Non-linear estimation.
Properties of Estimators: Bias, Efficiency, Cramer Rao bound asymptotic properties; Sensitivity and error analysis.

UNIT – IV Parameter Estimation
Concept of sufficient statistics; Minimum Mean Squared error estimator, Maximum a Posteriori estimator, linear estimators, Maximum likelihood parameter estimator, invariance principle; estimation efficiency, Cramer-Rao lower bound, Fisher information matrix; least squares, weighted least squares, best linear unbiased estimation.

UNIT – V Estimation Models
Exponential families of distributions, Exponential families and Maximum likelihood estimation; uniformly minimum variance unbiased estimation.

TEXT BOOKS

1. Steven M.Kay, Fundamentals of statistical signal processing: Estimation Theory, Prentice Hall, 1993.
2. S.M. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, Prentice Hall 1998
3. Monsoon H. Hayes, Statistical digital signal processing and modelling, USA, Wiley, 1996.

REFERENCES

1. Dimitris G.Manolakis, Vinay K. Ingle, and Stephen M. Kogon, Statistical and adaptive signal processing, Artech House, Inc, 2005, ISBN 1580536107
2. James L. Melsa and David L. Cohn, "Decision and Estimation Theory," McGraw Hill, 1978.
3. Dimitri Kazakos, P. Papantoni Kazakos, "Detection and Estimation," Computer Science Press, 1990.
4. H.V. Poor, An Introduction to Signal Detection and Estimation, 2nd edition, Springer, 1994.
5. L.L. Scharf, Statistical Signal Processing, Detection and Estimation Theory, Addison-Wesley, 1990

MTEC2052 - OPTICAL SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Need for OSP, Fundamentals of OSP, The Fresnel Transform, Convolution and impulse response, Transform of a slit, Fourier Transforms in Optics, Transforms of Aperture functions, Inverse Fourier Transform, Resolution criteria, A Basic Optical System, Imaging and Fourier Transform conditions.

UNIT - II

Cascaded systems, scale of Fourier Transform Condition. Maximum information capacity and optimum packing density, Chirp Z transform and system Coherence.

UNIT - III

Spectrum Analysis, Spatial light Modulators, special detector arrays. Performance parameters for spectrum analyzers. Relationship between SNR and Dynamic range. The 2 D spectrum Analyzer.

UNIT - IV

Spatial Filtering, Linear Space Invariant systems, Parseval's theorem, Correlation, Input/Output Spectral Densities, Matched filtering, Inverse Filtering, Spatial Filters. Interferometers. Spatial filtering systems. Spatial Modulators. Applications of Optical Spatial Filtering, Effects of small displacements.

UNIT - V

Heterodyne systems, Temporal and spatial interference, Optimum photo detector size, Optical radio. Direct detection and Hetero dyne detection. Heterodyne spectrum Analysis. Spatial and temporal Frequencies. The CW signal and a short pulse, Photo detector geometry and bandwidth. Power spectrum analyzer using a CCD array.

TEXT BOOK

Anthony Vander Lugt, "Optical Signal Processing", John Wiley & Sons, 2005.

REFERENCES

1. D. Casasent, Optical data processing-Applications, Springer-Verlag, Berlin,1978
2. P.M. Dufffieux, The Fourier Transform and its applications to Optics, John Wiley and sons
3. J. Horner, Optical Signal Processing, Academic Press, 1988

MTEC2053 - VLSI ARCHITECTURES FOR SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination :		3 hrs.

UNIT – I

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

UNIT – II

Folding and Unfolding Folding : Introduction -Folding Transform - Register minimization Techniques – Register minimization in folded architectures – folding of Multirate systems Unfolding: Introduction – An Algorithm for Unfolding – Properties of Unfolding – critical Path, Unfolding and Retiming – Applications of Unfolding

UNIT – III

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

UNIT – IV

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

UNIT – V

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

TEXT BOOKS

1. Keshab K. Parthi , "VLSI Digital Signal Processing Systems: Design and Implementation", Wiley Inter Science Publications.
2. Kung S. Y, H. J. While House and T. Kailath "VLSI and Modern Signal processing", Prentice Hall Publications.

REFERENCES

1. Magdy A.Bayoumi, VLSI design methodologies for digital signal processing architectures, Springer Publications (Kluwer Academic Publishers).
2. Jose E. France and Yannis Tsividis, "Design of Analog-Digital VLSI Circuits for Telecommunications and Signal Processing", Prentice Hall.
3. Medisetti V.K, "VLSI Digital Signal Processing", IEEE Press, Newyork, USA.

MTEC2061 - CODING THEORY AND TECHNIQUES

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Introduction and Linear Block Codes: 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, ML Decoding Hamming Codes. Applications of Block codes for Error control in data storage system

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT – V

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

TEXT BOOKS

1. Shu Lin, Daniel J.Costello, J "Error Control Coding-: Fundamentals and Applications "Prentice Hall, Inc.
2. Tood k moon, "Error Correcting Coding Theory", Pearson publishers.

REFERENCES

1. John G Proakis, Digital Communication Systems, Pearson Education.
2. Ranjan Bose, Coding techniques,New Age Publications.

MTEC2062 - MULTIDIMENSIONAL SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT – I

Multidimensional Discrete signals and Multidimensional systems: Frequency domain characterization of multidimensional signals and systems, sampling two dimensional signals, processing continuous signals with discrete systems.

Discrete Fourier analysis of multidimensional signals: Discrete Fourier series representation of

Rectangularly periodic sequences, Multidimensional DFT, definition an properties, Calculation of DFT, Vector radix FFT, Discrete Fourier transforms for general periodically sampled signals, relationship between M dimensional and one dimensional DFT.

UNIT – II

Design and implementation of two dimensional FIR filters: Implementation, Design using windows, Optimal FIR filter design- least squares design, Design of cascaded and parallel 2 D FIR filters, Design and implementation of FIR filters using transformations

UNIT – III

Multidimensional Recursive systems: Finite order difference equations- realizing LSI systems using difference equations, recursive computability, boundary conditions, ordering the computation of output samples, Multidimensional Z Transforms, stability of 2 D recursive systems, stability theorems, Two dimensional complex cepstrum.

UNIT – IV

Design and implementation of two dimensional IIR filters: classical 2 D IIR filter implementations, Iterative implementation of 2 D IIR filters, signal flow graphs- circuit elements and their realizations, state variable realizations, Space domain Design techniques- Shank's method, Descent methods, Iterative pre filtering design method, Frequency domain design techniques, stabilization techniques.

UNIT – V

Two dimensional Inverse problems: Constrained iterative signal restoration; iterative techniques for constrained deconvolution and signal extrapolation, reconstructions from phase or magnitude, Reconstruction of signals from their projections: Projection slice theorem, Discretization of the Reconstruction problem, Fourier domain reconstruction algorithms, Convolution/ back-projection algorithms, iterative reconstruction algorithms, Fan beam algorithms, Projection of discrete signals.

TEXT BOOK

1. Multidimensional Digital Signal Processing - Dan E Dudgeon and R M Mersereau, Prentice Hall
2. Two dimensional signal and Image Processing- J S Lim, Prentice Hall.

REFERENCES

1. Digital Signal and Image Processing- Tamal Bose, John Wiley publishers.

MTEC2063 - RADAR SIGNAL PROCESSING

Lecture	:	4 Periods / Week	Internal Marks	:	40
Tutorial	:	1 Period / Week	External Marks	:	60
Credits	:	3	External Examination	:	3 hrs.

UNIT - I

Introduction– Radar Block Diagram, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar.
Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver. Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.

UNIT - II

Detection of Radar Signals in Noise: Detection Criteria – Neyman-Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer. Detectors – Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection -CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management – Schematics, Component Parts, Resources and Constraints.

UNIT - III

Waveform Selection: Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noiselike Waveforms. Waveform Design Requirements.Optimum Waveforms for Detection in Clutter, Family of Radar Waveforms.

UNIT - IV

Pulse Compression in Radar Signals: Introduction, Significance, Types. Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Sidelobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression.

UNIT - V

Phase Coding Techniques: Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar. Poly Phase Codes : Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM). Sidelobe Reduction for Phase Coded PC Signals.

TEXT BOOKS

1. Radar Handbook - M.I. Skolnik, 2nd ed., 1991, McGraw Hill.
2. Radar Design Principles : Signal Processing and The Environment - Fred E. Nathanson,2nd ed., 1999, PHI.
3. Introduction to Radar Systems - M.I. Skolnik, 3rd ed., 2001, TMH.

REFERENCES

1. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.
2. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.
3. Radar Design Principles - F.E. Nathanson, 1st ed., 1969, McGraw Hill.

MTEC251 - SOFT COMPUTING LAB

Practical	:	3 Periods / Week	Internal Marks	:	25
Tutorial	:	0 Period / Week	External Marks	:	50
Credits	:	2	External Examination	:	3 hrs.

List of Experiments

1. Implementation of AND function using Adaline with bipolar inputs and outputs.
2. Implementation of AND function using Madaline with bipolar inputs and outputs.
3. Implementation of discrete Hopfield Network and test the input pattern.
4. Implementation of Back propagation Network for a given input pattern.
5. Implementation of ART1 network for clustering input vectors with vigilance parameter.
6. Implementation of fuzzy set operations and Properties.
7. Verification of the various laws associated with fuzzy set.
8. Implementation of composition of fuzzy and crisp relations.
9. Maximizing $f(x) = x^2$ using genetic algorithm, where x ranges from 0 to 31. Perform 5 iterations.
10. Maximizing sin(x) using genetic algorithm, where the range of x is $0<x<3.14$

LBRCE EXAMINATION SECTION

HEAD
Department of Electronics & Communication Engineering
Lakireddy Bali Reddy College of Engineering
MYLAVARAM, Krishna Dt., Andhrapradesh