**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**

| Category | Course Title | Int. marks | Ext. marks | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 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<br>Introduction to Navigational Aids<br>Digital System Design | 25 | 75 | **3** | 0 | 0 | 3 |
| PE-2 | VLSI Signal Processing<br>Network Security and Cryptography<br>Advanced Digital Signal Processing | 25 | 75 | **3** | 0 | 0 | 3 |
| OE-1 | ***Open Elective – I** | 25 | 75 | 3 | 0 | 0 | 3 |
| Laboratory I | Signal Processing Lab-I | 25 | 75 | 0 | 0 | 3 | 2 |
| Seminar I | Seminar | 100 | 0 | 0 | 0 | 3 | 2 |
| **Total** | | **275** | **525** | **21** | **0** | **6** | **25** |

**II Semester**

| Category | Course Title | Int. marks | Ext. marks | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 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<br>Spread Spectrum Communications<br>Embedded System Design | 25 | 75 | **3** | 0 | 0 | 3 |
| PE4 | Coding Theory and Techniques<br>Wireless Communications & Networks<br>System on Chip Architecture | 25 | 75 | **3** | 0 | 0 | 3 |
| OE-2 | ***Open Elective – II** | 25 | 75 | 3 | 0 | 0 | 3 |
| Laboratory II | Signal Processing Lab - II | 25 | 75 | 0 | 0 | 3 | 2 |
| Seminar II | Seminar | 100 | 0 | 0 | 0 | 3 | 2 |
| **Total** | | **275** | **525** | **21** | **0** | **6** | **25** |

**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 |
| **Total** | **200** | **100** | 0 | **3** | 22 | **14** |

**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 |
| **Total** | **100** | **100** | **0** | **0** | **24** | **24** |

***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 – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**ADAPTIVE SIGNAL PROCESSING (PC-1)**

**UNIT –I**

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

**UNIT –II**

**Development of Adaptive Filter Theory & Searching the Performance surface:**
Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonally - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error, Estimation of phase shift between two narrow band signals using Orthogonal Decomposer.

**UNIT –III**

**Steepest Descent Algorithms:** Searching the performance surface – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of convergence - Learning Curves Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

**UNIT –IV**

**LMS Algorithm & Applications:** Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm. **Applications:** Adaptive BFSK, BPSK, ASK demodulators and delay estimation. Adaptive Beam forming, concept of IQ channels, Adaptive filter implementation of Hilbert Transform. Introduction to MUSIC

**UNIT –V**

**State Estimators**: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Example estimation of state from observations of noisy observed narrow band signals. Target tracking using only DOA.

**TEXT BOOKS:**


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


**REFERENCE BOOKS:**


1. Kaluri V. Rangarao, Ranjan K. Mallik, "Digital Signal Processing: A Practitioner's Approach", ISBN: 978-0-470-01769-2, 210 pages, November 2006, John Wiley (UK)
2. Sophocles. J. Orfamadis, "Optimum signal processing: An introduction", 2nd Edition, 1988, McGraw-Hill, Newyork
3. S. Thomas Alexander, "Adaptive signal processing-Theory and Applications", 1986, Springer –Verlag.
4. Candy, "Signal analysis", McGraw Hill Int. Student Edition
5. James V. Candy, "Signal Processing: A Modern Approach", McGraw-Hill, International Edition, 1988.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**TRANSFORM TECHNIQUES (PC-2)**

**UNIT -I**

**Fourier analysis:** Vector space, Hilbert spaces, Fourier basis, FT- Limitations of Fourier Analysis, Need for time-frequency analysis, DFT, 2D-DFT: Definition, Properties and Applications, IDFT, Hilbert Transform, STFT.

**UNIT -II**

**Transforms:** Walsh, Hadamard, Haar and Slant Transforms, DCT, DST, KLT,– definition, properties and applications

**UNIT -III**

**Continuous Wavelet Transform (CWT):** 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- Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat, Meyer, Shannon, Daubechies.

**UNIT -IV**

**Multi Rate Analysis and DWT:** Need for Scaling function – Multi Resolution Analysis, Two-Channel Filter Banks, Perfect Reconstruction Condition, Relationship between Filter Banks and Wavelet Basis, DWT, Structure of DWT Filter Banks, Daubechies Wavelet Function, Applications of DWT.

**UNIT -V**

**Special Topics:** Wavelet Packet Transform, Multidimensional Wavelets, Bi-orthogonal basis- B-Splines, Lifting Scheme of Wavelet Generation, Multi Wavelets

**TEXT BOOKS:**


1. Raghuveer M. Rao and Ajit S. Bopardikar, “Wavelet Transforms-Introduction theory and applications”, Pearson Education, Asia, New Delhi, 2003.
2. Soman. K. P, Ramachandran. K.I, “Insight into Wavelets from Theory to practice”, Prentice Hall India, First Edition, 2004.


**REFERENCE BOOKS:**


1. Jaideva C Goswami, Andrew K Chan, “Fundamentals of Wavelets- Theory, Algorithms and Applications”, John Wiley & Sons, Inc, Singapore, 1999.
2. Vetterli M. Kovacevic, “Wavelets and sub-band coding”, PJI, 1995.
3. C. Sydney Burrus, “Introduction to Wavelets and Wavelet Transforms”, PHI, 1st Edition, 1997.
4. Stephen G. Mallat,. “A Wavelet Tour of Signal Processing”, Academic Press, 2nd Edition
5. S. Jayaraman, S. Esakkirajan, T.Veera Kumar, “Digital Image Processing”, TMH,2009

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**RANDOM PROCESSES AND TIME SERIES ANALYSIS (PC-3)**

**UNIT -I**

**Stationary Random Processes from a Probability Point of View:** Probability Density and Probability Distribution Functions of a Random Variable, Expected Value of Random Variable, Markov and Chebyshev Inequalities, Computer Methods for Generating Random Variables, Multidimensional Random variables, Chi-square tests of hypotheses concerning distribution.

**UNIT -II**

**Random Processes Analyzed in the Time Domain**: Continuous and Discrete Time, Stationarity, Auto Covariance and Auto Correlation functions, Continuity, differentiation, Integrals of Random Processes.

Some special cases: The Poisson process, the Normal (Gaussian) Process.

**UNIT -III**

**Random Processes Analyzed in the Frequency Domain**: The Fourier Transform, Spectral Density, The Cross Power Spectral Density.

**Linear Systems with random input:** Impulse response, Transfer function, the relation between the spectral density for the input and for the output

**UNIT -IV**

**Markov Chains:** Markov Processes: Discrete time Markov chains, state transition probability matrix, n-step state transition probability, transition diagrams, classification of states, limiting state probabilities, Continuous-time Markov chains, Gambler's ruin as a Markov chains

**UNIT -V**

**Basic 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 Queuing system- Residual Service Time, Mean Delay in M/G/1 Systems.

**TEXT BOOKS:**


1. Peebles, P. Z, "Probability, Random Variables, and Random Signal Principles", 1993 3rd Edition, New York, McGraw-Hill
2. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, 2009
3. Alberto Leon-Garcia, "Probability and Random Processes for Electrical Engineering", 2nd Edition, Pearson


**REFERENCE BOOKS:**


1. Athanasios Papoulis, S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", TMH, 2008
2. Henry Stark, John W. Woods, "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson
3. Roy D. Yates, David J. Goodman, "Probability and Stochastic Processes – A Friendly Introduction for Electrical and Computer Engineers", John Wiley & Sons.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**BIOMEDICAL SIGNAL PROCESSING (PE-1)**

**UNIT -I**

**Random Processes:** Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth and noise figure of systems.

**UNIT -II**

**Data Compression Techniques:** Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Huffman coding, vector quantization, DICOM Standards

**UNIT -III**

**Cardio logical Signal Processing**: Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia Detection Algorithms, Automated ECG Analysis, ECG Pattern Recognition.
Adaptive Noise Cancelling: Principles of Adaptive Noise Cancelling, Adaptive Noise Cancelling with the LMS Adaptation Algorithm, Noise Cancelling Method to Enhance ECG Monitoring, Fetal ECG Monitoring.

**UNIT -IV**

**Signal Averaging, Polishing** – Mean and trend removal, Prony's method, Prony's Method based on the Least Squares Estimate, Linear prediction, Yule – Walker (Y –W) equations, Analysis of Evoked Potentials.

**UNIT -V**

**Neurological Signal Processing**: Modeling of EEG Signals, Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive (A.R.) modelling of seizure EEG. Sleep Stage analysis, Inverse Filtering, Least squares and polynomial modelling.

**TEXT BOOKS:**


1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", 4th Edition, 2009, TMH.
2. D. C. Reddy, "Biomedical Signal Processing- Principles and Techniques", 2005, TMH.


**REFERENCE BOOKS:**


1. Weitkunat R, "Digital Bio Dignal Processing", 1991, Elsevier.
2. Akay M , "Biomedical Signal Processing", IEEE Press.
3. Cohen.A, "Biomedical Signal Processing -Vol. I Time & Frequency Analysis", 1986, CRC Press.
4. Willis J. Tompkins, "Biomedical Digital Signal Processing: C-Language Experiments and Laboratory Experiments", PHI.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**INTRODUCTION TO NAVIGATIONAL AIDS (PE-1)**

**UNIT –I**

**Navigational Systems:** Review of Navigational Systems: Aircraft navigational system. Geometry of the earth.Navigation equation. Navigation errors. Radio navigation system types and Performance parameters. ILS System.

**UNIT –II**

**Inertial Navigation**: Inertial navigation system. Sensing instruments: Accelerometer. Gyro- copes, Analytic and Gimbaled platforms.

**UNIT –III**

**Global Positioning System (GPS) for Navigation:** Overview of GPS, Reference systems. Satellite orbits, Signal structure, Geometric dilution of precision (GDOP), or Precision dilution of recision (PDOP), Satellite ephemeris, Satellite clock, Ionospheric group delay.Tropospheric group delay, Multipath errors and Receiver measurement errors.

**UNIT –IV**

**Differential GPS and WAAS:** Standard and precise positioning service local area DGPS and Wide area DGPS errors. Wide Area Augmentation System (WAAS) architecture.Link budget and Data Capacity, Ranging function, Precision approach and error estimates.

**UNIT –V**

**GPS Navigational Application:** General applications of GPS, DGPS, Marine. Air and Land Navigation, Surveying, Mapping and Geographical information systems, Military and Space.

**TEXT BOOKS:**


1. Myron Kavton and Walter Friend, R, “Avionics Navigation Systems”, Wiley,1997
2. Parkinson. BW. Spilker, “Global Positioning System Theory and Applications”, Progress in Astronautics, Vol. I and II, 1996.


**REFERENCE BOOKS:**


1. Hoffman. B., Wellenhof. H. Lichtenegger and J. Collins, “GPS Theory and Practice”, Springer Verlang Wien New York, 1992.
2. Elliot D. Kaplan, “Understanding GPS Principles and Applications”, Artech House. Inc., 1996.
3. Lieck Alfred, “GPS Satellite Surveying”, John Wiley, 1990.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**DIGITAL SYSTEM DESIGN (PE-1)**

**UNIT -I**

**Minimization and Transformation of Sequential Machines:** The Finite State Model – Capabilities and limitations of FSM – State equivalence and machine minimization – Simplification of incompletely specified machines. Fundamental mode model – Flow table – State reduction – Minimal closed covers – Races, Cycles and Hazards.

**UNIT -II**

**Digital Design:** Digital Design Using ROMs, PALs and PLAs, BCD Adder, 32 – bit adder, State graphs for control circuits, Scoreboard and Controller, A shift and add multiplier, Array multiplier, Keypad Scanner, Binary divider.

**UNIT -III**

**SM Charts:** State machine charts, Derivation of SM Charts, Realization of SM Chart, Implementation of Binary Multiplier, dice game controller.

**UNIT -IV**

**Fault Modeling & Test Pattern Generation:** Logic Fault model – Fault detection & Redundancy-Fault equivalence and fault location –Fault dominance – Single stuck at fault model – Multiple stuck at fault models –Bridging fault model. Fault diagnosis of combinational circuits by conventional methods – Path sensitization techniques, Boolean Difference method – Kohavi algorithm – Test algorithms – D algorithm, PODEM, Random testing, Transition count testing, Signature analysis and test bridging faults.

**UNIT - V**

**Fault Diagnosis in Sequential Circuits:** Circuit Test Approach, Transition Check Approach – State identification and fault detection experiment, Machine identification, Design of fault detection experiment

**TEXT BOOKS:**


1. Charles H. Roth, “Fundamentals of Logic Design”, 5th Edition, Cengage Learning.
2. Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, “Digital Systems Testing and Testable Design”, John Wiley & Sons Inc.
3. N. N. Biswas, “Logic Design Theory”, PHI


**REFERENCE BOOKS:**


1. Z. Kohavi , “Switching and Finite Automata Theory”, 2nd Edition, 2001, TMH
2. Morris Mano, M.D. Ciletti, “Digital Design”, 4th Edition, PHI.
3. Samuel C. Lee , “Digital Circuits and Logic Design”, PHI

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**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**VLSI SIGNAL PROCESSING (PE-2)**

**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 – Winograd algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

**UNIT -V**

**Low Power Design:** Scaling Vs Power Consumption –Power Analysis, Power Reduction techniques – Power Estimation Approaches.

**Programmable DSP:** Evaluation of Programmable Digital Signal Processors, DSP Processors for Mobile and Wireless Communications, Processors for Multimedia Signal Processing

**TEXT BOOKS:**


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


**REFERENCE BOOKS:**


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

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**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**NETWORK SECURITY AND CRYPTOGRAPHY (PE-2)**

**UNIT- I**

**Introduction:** Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.

**Modern Techniques:** Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Block Cipher Design Principles.

**UNIT- II**

**Encryption:** Triple DES, International Data Encryption algorithm, Blowfish, RC5, Characteristics of Advanced Symmetric block ciphers.

**Conventional Encryption:** Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

**UNIT - III**

**Public Key Cryptography:** Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptograpy.

**Number Theory:** Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.

**UNIT- IV**

**Message Authentication and Hash Functions:** Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.

**Hash and Mac Algorithms:** MD File, Message digest Algorithm, Secure Hash Algorithm.

Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards. **Authentication Applications:** Kerberos, Electronic Mail Security: Pretty Good Privacy, S/MIME.

**UNIT – V**

**IP Security:** Overview, Architecture, Authentication, Encapsulating Security Payload, Key Management. Web Security: Web Security requirements, secure sockets layer and Transport layer security, Secure Electronic Transaction. **Intruders, Viruses and Worms:** Intruders, Viruses and Related threats.

**Fire Walls:** Fire wall Design Principles, Trusted systems.

**TEXT BOOKS:**


1. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education.
2. William Stallings, "Network Security Essentials (Applications and Standards)", Pearson Education.


**REFERENCE BOOKS:**


1. Eric Maiwald, "Fundamentals of Network Security", Dreamtech press
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security - Private Communication in a Public World" Pearson/PHI.

3. Whitman, “Principles of Information Security”, Thomson.
4. Robert Bragg, Mark Rhodes, “Network Security: The complete reference”, TMH
5. Buchmann, “Introduction to Cryptography”, Springer.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**ADVANCED DIGITAL SIGNAL PROCESSING (PE-2)**

**UNIT –I**

**Review of DFT, FFT, IIR Filters and FIR Filters:** Introduction to filter structures (IIR & FIR).Implementation of Digital Filters, specifically 2nd Order Narrow Band Filter and 1st Order All Pass Filter. Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Backward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

**UNIT -II**

**Non-Parametric Methods:** Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all Non-Parametric methods

**UNIT - III**

**Parametric Methods:** Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

**UNIT –IV**

**Multi Rate Signal Processing:** Introduction, 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 & Implementation for sampling rate conversion. Examples of up-sampling using an All Pass Filter.

**UNIT –V**

**Applications of Multi Rate Signal Processing:** Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Subband Coding of Speech Signals, Quadrature Mirror Filters, Transmultiplexers, Over Sampling A/D and D/A Conversion.

**TEXT BOOKS:**


1. J.G. Proakis& D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4th Edition, PHI.
2. Alan V Oppenheim & Ronald W Schaffer, “Discrete Time signal processing”, PHI.
3. Emmanuel C. Ifeacher, Barrie. W. Jervis, “DSP – A Practical Approach”, 2nd Edition, Pearson Education.


**REFERENCE BOOKS:**


1. S. M .Kay, “Modern spectral Estimation: Theory & Application”, 1988, PHI.
2. P.P. Vaidyanathan, “Multi Rate Systems and Filter Banks”, Pearson Education.
3. Kaluri V. Rangarao, Ranjan K. Mallik, “Digital Signal Processing: A Practitioner's Approach”, ISBN: 978-0-470-01769-2, 210 pages, November 2006 John Wiley.
4. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, “Digital Signal Processing”, 2000,TMH

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**M. TECH. – I YEAR – I SEMESTER**
**SYSTEMS AND SIGNAL PROCESSING**

**SIGNAL PROCESSING LAB - I**

**Note:**

A. Minimum of 10 Experiments have to be conducted
B. All Experiments may be Simulated using MATLAB (or any other equivalent software) and to be verified theoretically.

1. Basic Operations on Signals, Generation of Various Signals and finding its FFT.
2. Program to verify Decimation and Interpolation of a given Sequences.
3. Program to Convert CD data into DVD data
4. Generation of Dual Tone Multiple Frequency (DTMF) Signals
5. Plot the Periodogram of a Noisy Signal and estimate PSD using Periodogram and Modified Periodogram methods
6. Estimation of Power Spectrum using Bartlett and Welch methods
7. Verification of Autocorrelation Theorem
8. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation
9. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal
10. Design of LPC filter using Levinson-Durbin Algorithm
11. Computation of Reflection Coefficients using Schur Algorithm
12. To study Finite Length Effects using Simulink
13. ECG signal compression.
14. Design and verification of Matched filter
15. Adaptive Noise Cancellation using Simulink
16. Design and Simulation of Notch Filter to remove 60Hz Hum/any unwanted frequency component of given Signal (Speech/ECG)