ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

REGULATIONS - 2013

M.E. DIGITAL SIGNAL PROCESSING

CURRICULUM I TO IV SEMESTERS (FULL TIME)

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA7159	Applied Mathematics for Signal Processing Engineers	3	1	0	4
2.	DS7101	DSP Processor Architecture and Programming	3	0	0	3
3.	AP7101	Advanced Digital Signal Processing	3	1	0	4
4.	DS7102	Video Compression Techniques	3	0	0	3
5.	CU7102	Advanced Digital Communication Techniques	3	0	0	3
6.		Elective - I	3	0	0	3
PRACTICAL						
7.	DS7111	Digital Signal Processing Laboratory I	0	0	3	2
		TOTAL	**18**	**2**	**3**	**22**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	DS7201	Advanced Digital Image Processing	3	0	0	3
2.	DS7202	Radar Signal Processing	3	0	0	3
3.	VL7101	VLSI Signal Processing	3	0	0	3
4.	CP7103	Multicore Architectures	3	0	0	3
5.		Elective II	3	0	0	3
6.		Elective III	3	0	0	3
PRACTICAL						
7.	DS7211	Digital Signal Processing Laboratory II	0	0	3	2
		TOTAL	**18**	**0**	**3**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	DS7301	Speech and Audio Signal Processing	3	0	0	3
2.		Elective IV	3	0	0	3
3.		Elective V	3	0	0	3
PRACTICAL						
1.	DS7311	Project Work (Phase I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	DS7411	Project Work (Phase II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL NO.OF CREDITS:69

LIST OF ELECTIVES

ELECTIVE - I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CU7009	Neural Network and Applications	3	0	0	3
2.	IF7301	Soft Computing	3	0	0	3
3.	CP7030	Robotics	3	0	0	3
4.	AP7102	Advanced Digital Logic System Design	3	0	0	3

ELECTIVE - II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	DS7001	Optical Signal Processing	3	0	0	3
2.	DS7002	Bio Signal Processing	3	0	0	3
3.	BM7201	Applied Medical Image Processing	3	0	0	3
4.	DS7003	Array Signal Processing	3	0	0	3

ELECTIVE - III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
		ELECTIVES III				
1.	DS7004	Wireless Sensor Networks	3	0	0	3
2.	DS7005	Cryptographic Techniques	3	0	0	3
3.	DS7006	Adaptive Signal Processing	3	0	0	3
4.	DS7007	Underwater Acoustics Signal Processing	3	0	0	3

ELECTIVE - IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	DS7008	Embedded System Design	3	0	0	3
2.	DS7009	Real Time Operating System Design	3	0	0	3
3.	DS7010	Microcontroller System Design and Analysis	3	0	0	3
4.	DS7011	Digital Signal Compression	3	0	0	3
5.	MU7011	Video Compression	3	0	0	3

ELECTIVE - V

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	MU7102	Multimedia Communication Networks	3	0	0	3
2.	CP7204	Advanced Operating systems	3	0	0	3
3.	DS7012	Design and Analysis of Algorithms	3	0	0	3
4.	DS7013	Digital Modulation and Coding	3	0	0	3

MA7159 APPLIED MATHEMATICS FOR SIGNAL PROCESSING ENGINEERS **L T P C**
3 1 0 4

OBJECTIVES:

- To develop the ability to use the concepts of Linear algebra and Special functions for solving problems related to Networks.
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- To expose the students to solve ordinary differential equations by various techniques.

OUTCOMES:

- To achieve an understanding of the basic concepts of algebraic equations and method of solving them.
- To familiarize the students with special functions and solve problems associated with engineering applications.

UNIT I LINEAR ALGEBRA (9+3)

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

UNIT II SPECIAL FUNCTIONS (9+3)

Bessel's equation – Bessel function – Recurrence relations - Generating function and orthogonal property for Bessel functions of first kind – Fourier-Bessel expansion.

UNIT IV LINEAR PROGRAMMING (9+3)

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT IV ALGEBRAIC EQUATIONS (9+3)

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, inverse power method, Faddeev – Leverrier Method.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

TOTAL: 45+15=60 PERIODS

BOOKS FOR STUDY:

1. Richard Bronson, Gabriel B.Costa, "Linear Algebra", Academic Press, Second Edition, 2007.
2. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning, Seventh Edition, 2011.
3. Grimaldi R.P. and Ramana B.V., "Discrete and Combinatorial Mathematics", Pearson Education, Reprinted in 2006. (5^{th} Edition).
4. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.

REFERENCES:

1. Richard Bronson, "Matrix Operation", Schaum's outline series, Tata McGraw Hill, Second Edition, 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson/Prentice Hall, Third Edition, 2004.
3. Erwin Kreyszig. "Advanced Engineering Mathematics", John Wiley & Sons, Ninth Edition, 2011.
4. Taha H.A., "Operations Research: An introduction", Pearson Education, Asia, New Delhi, Ninth Edition, 2012.

DS7101 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING **L T P C**
3 0 0 3

OBJECTIVES:

The objective of this course is to provide in-depth knowledge on

- Digital Signal Processor basics
- Third generation DSP Architecture and programming skills
- Advanced DSP architectures and some applications.

OUTCOMES:

Students should be able to:

- Become Digital Signal Processor specialized engineer
- DSP based System Developer

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT II TMS320C5X PROCESSOR 9

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III TMS320C6X PROCESSOR 9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

UNIT IV ADSP PROCESSORS 9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

UNIT V ADVANCED PROCESSORS 9

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

TOTAL: 45 PERIODS

REFERENCES:

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications" – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, cengage Learning India Private Limited, Delhi 2012
3. User guides Texas Instrumentation, Analog Devices, Motorola.
4. Rulph Chassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, A JOHN WILEY & SONS, INC., PUBLICATION, 2005

AP7101 ADVANCED DIGITAL SIGNAL PROCESSING **L T P C**
3 1 0 4

OBJECTIVES:

The purpose of this course is to provide in-depth treatment on methods and techniques in discrete-time signal transforms, digital filter design, optimal filtering

- Power spectrum estimation, multi-rate digital signal processing
- DSP architectures which are of importance in the areas of signal processing, control and communications.

OUTCOMES:
Students should be able to:
- To design adaptive filters for a given application
- To design multirate DSP systems.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9
Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem, special types of random process – Signal modeling-Least Squares method, Pade approximation, Prony's method, iterative Prefiltering, Finite Data records, Stochastic Models.

UNIT II SPECTRUM ESTIMATION 9
Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method.

UNIT III LINEAR ESTIMATION AND PREDICTION 9
Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter - Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT IV ADAPTIVE FILTERS 9
FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS - Sliding window RLS - Simplified IIR LMS Adaptive filter.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9
Mathematical description of change of sampling rate - Interpolation and Decimation - Continuous time model - Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

L +T= 45+15=60 PERIODS

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000.
3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi, 2005.
4. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.
5. S. Kay," Modern spectrum Estimation theory and application", Prentice Hall, Englehood Cliffs, NJ1988.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

DS7102 VIDEO COMPRESSION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:
- To understand the basics of Video representation in space and transform domains
- To understand intraframe coding Techniques
- To understand interframe compression
- To know the basics of Video Compression standards

OUTCOMES:

- To be able to design Video Compression schemes
- To be able to implement the state-of the art Video Standards

UNIT I DIGITAL VIDEO REPRESENTATION 9

Video Frames and Fields- Colour Spaces- Spatial and Temporal sampling-Quantization – MSE-Uniform Scalar Quanitization- Non-Uniform Scalar Quantization- Transform Representation – 2D_DFT- DCT- 2D Wavelet Transform

UNIT II STILL IMAGE COMPRESSION TECHNIQUES 9

Spatial Redundancy Reduction- Predictive Coding - Transform Coding Techniques-Variable Length Coding_ Huffman Coding – Arithmetic Coding –Run Length Coding -Still Image Compression-JPEG

UNIT III VIDEO COMPRESSION 9

Inter_frame Coding- I, P,B and D frames-Motion estimation – Motion estimation with Half Pixel Precision-Bidirectional Motion estimation- MPEG2-Scalability

UNIT IV LOW BIT RATE VIDEO CODING 9

Coding for Video Conferencing – Overview of H.261 – Coding in H.263- Coding of Motion Vectors

UNIT V CONTENT BASED VIDEO CODING 9

Video Object Plane-encoding of VOPs-Segmenation-shape Coding- Texture Coding-MPEG-4 – Basics of content description, search and delivery in MPEG7

TOTAL: 45 PERIODS

REFERENCES

1. Mohammed Ghanbari, Standard Codecs: Image compression to Advanced Video Coding, Telecommunication Series, IET, 2008
2. Peter Symes, Digital Video Compression, McGraw Hill, 2004
3. Iain E.G. Richardson, H.264 and MPEG-4, Video Compression: Video Coding for Next generation Multimedia, John Wiley, 2003.

CU7102 ADVANCED DIGITAL COMMUNICATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of signal-space analysis and digital transmission.
- To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
- To understand Orthogonal Frequency Division Multiplexing.
- To understand the different block coded and convolutional coded digital communication systems.
- To understand the different Equalizers.

UNIT I COHERENT AND NON-COHERENT COMMUNICATION 9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK--BER Performance Analysis. Carrier Synchronization- Bit synchronization.

UNIT II EQUALIZATION TECHNIQUES 9

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals-Equalization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

UNIT III BLOCK CODED DIGITAL COMMUNICATION 9

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hammning; Golay; Cyclic; BCH ; Reed – Solomon codes - Space time block codes

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION 9

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

UNIT V OFDM 9

Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; OFDM signal processing; Peak Power Problem: PAP reduction schemes- Clipping, Filtering, Coding and Scrambling.-

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Develop the ability to understand the concepts of signal space analysis coherent and non-coherent receivers.
- Comprehend the generation of OFDM signals and the processing of the signals.
- Possess knowledge on different block codes and convolutional codes.
- Conceptually appreciate different Equalization techniques.

REFERENCES:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995.
2. Simon Haykin, Digital communications, John Wiley and sons, 1998
3. Bernard Sklar., 'Digital Communications', second edition, Pearson Education,2001.
4. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001
5. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002.
6. Stephen G. Wilson., 'Digital Modulation and Coding', First Indian Reprint ,Pearson Education, 2003.
7. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication,2001.

DS7111 DIGITAL SIGNAL PROCESSING LABORATORY I

L	T	P	C
0	0	3	2

Using Digital Signal Processing Starter Kit

1. Sine wave Generation Using Eight Points with DIP Switch Control
2. Sine wave Generation with Two Sliders for Amplitude and Frequency Control
3. Square, Ramp Generation Using a Lookup Table
4. Loop Program with Stereo Input and Stereo Output
5. Program to generate Echo with controls for different effects
6. Pseudorandom noise sequence generation program
7. Implementation of Four Different Filters: Low pass, High pass, Band pass, and Band stop
8. FIR Implementation Using C Calling an ASM Function with a Circular Buffer
9. IIR Filter Implementation Using Second-Order Stages in Cascade

TOTAL: 45 PERIODS

DS7201 ADVANCED DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
- To understand the image segmentation and representation techniques.
- To understand how image are analyzed to extract features of interest.
- To introduce the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets.

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT II SEGMENTATION 9

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods

UNIT III FEATURE EXTRACTION 9

First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION 9

Registration- Preprocessing, Feature selection-points, lines, regions and templates Feature correspondence-Point pattern matching, Line matching, region matching Template matching .Transformation functions-Similarity transformationand Affine Transformation. Resampling- Nearest Neighbour and Cubic Splines

Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusiondiscrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION 9

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- To understand image formation and the role human visual system plays in perception of gray and color image data.
- To apply image processing techniques in both the spatial and frequency (Fourier) domains.
- To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
- To conduct independent study and analysis of feature extraction techniques.
- To understand the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets and to apply image processing algorithms in practical applications.

TEXT BOOKS:

1. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.
2. Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press, 2008.
3. Ardeshir Goshtasby, “2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications”, John Wiley and Sons, 2005.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing’, Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, , Fundamentals of Digital Image Processing’, Pearson Education, Inc., 2002.
3. Rick S.Blum, Zheng Liu,“ Multisensor image fusion and its Applications“, Taylor & Francis, 2006.

DS7202 RADAR SIGNAL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the Radar Signal acquisition and sampling in multiple domains
- To provide clear instruction in radar DSP basics
- To equip the skills needed in both design and analysis of common radar algorithms
- To understand the basics of synthetic aperture imaging and adaptive array processing
- To illustrate how theoretical results are derived and applied in practice

UNIT I INTRODUCTION TO RADAR SYSTEMS 9

History and application of radar, basic radar function, elements of pulsed radar,review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing

UNIT II SIGNAL MODELS 9

Components of a radar signal, amplitude models,types of clutters,noise model and signal-to-noise ratio, jamming, frequency models: the doppler shift, spatial models,spectral model

UNIT III SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS 9

Domains and criteria for sampling radar signals, Sampling in the fast time dimension,Sampling in slow time: selecting the pulse repetition interval,sampling the doppler spectrum,Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.

UNIT IV RADAR WAVEFORMS 9

Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range sidelobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse compression waveforms, COSTAS Frequency Codes.

UNIT V DOPPLER PROCESSING 9

Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing

TOTAL: 45 PERIODS

REFERENCES:
1. Fundamentals of Radar Signal Processing, Mark A. Richards McGraw-Hill, New York, 2005
2. Principles of Radar and Sonar Signal Processing, Francois Le Chevalier, Artech House.
3. Radar systems, Peak Detection and Tracking, Michael O Kolawole, 2010, Elseveir
4. Introduction To Radar Systems 3/E, Skolnik, McGraw Hill.
5. Radar Principles, Peyton Z. Peebles, 2009 Wiley India
6. Radar Design Principles-Signal Processing and the environment, Fred E. Nathanson, PHI

VL7101 VLSI SIGNAL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES
- To understand the various VLSI architectures for digital signal processing.
- To know the techniques of critical path and algorithmic strength reduction in the filter structures.
- To study the performance parameters, viz. area, speed and power.

OUTCOMES
- To be able to design architectures for DSP algorithms.
- To be able to optimize design in terms of area, speed and power.
- To be able to incorporate pipeline based architectures in the design.
- To be able to carry out HDL simulation of various DSP algorithms.

UNIT I INTRODUCTION 6
Overview of DSP – FPGA Technology – DSP Technology requirements – Design Implementation.

UNIT II METHODS OF CRITICAL PATH REDUCTION 12
Binary Adders – Binary Multipliers – Multiply-Accumulator (MAC) and sum of product (SOP) – Pipelining and parallel processing – retiming – unfolding – systolic architecture design.

UNIT III ALGORITHMIC STRENGTH REDUCTION METHODS AND RECURSIVE FILTER DESIGN 9
Fast convolution-pipelined and parallel processing of recursive and adaptive filters – fast IIR filters design.

UNIT IV DESIGN OF PIPELINED DIGITAL FILTERS 9
Designing FIR filters – Digital lattice filter structures – bit level arithmetic architecture – redundant arithmetic – scaling and round-off noise.

UNIT V SYNCHRONOUS ASYNCHRONOUS PIPELINING AND PROGRAMMABLE DSP 9
Numeric strength reduction – synchronous – wave and asynchronous pipelines – low power design – programmable DSPs – DSP architectural features/alternatives for high performance and low power.

TOTAL: 45 PERIODS

REFERENCES:
1. Keshab K.Parhi, “VLSI Digital Signal Processing Systems, Design and Implementation”, John Wiley, Indian Reprint, 2007.
2. U. Meyer – Baese, "Digital Signal Processing with Field Programmable Arrays", Springer, Second Edition, Indian Reprint, 2007.
3. S.Y.Kuang, H.J. White house, T. Kailath, “VLSI and Modern Signal Processing”, Prentice Hall, 1995.

CP7103 MULTICORE ARCHITECTURES L T P C
3 0 0 3

OBJECTIVES

- To understand the recent trends in the field of Computer Architecture and identify performance related parameters
- To appreciate the need for parallel processing
- To expose the students to the problems related to multiprocessing
- To understand the different types of multicore architectures
- To expose the students to warehouse-scale and embedded architectures

UNIT I FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS 9

Classes of Computers – Trends in Technology, Power, Energy and Cost – Dependability – Measuring, Reporting and Summarizing Performance – Quantitative Principles of Computer Design – Classes of Parallelism - ILP, DLP, TLP and RLP - Multithreading - SMT and CMP Architectures – Limitations of Single Core Processors - The Multicore era – Case Studies of Multicore Architectures.

UNIT II DLP IN VECTOR, SIMD AND GPU ARCHITECTURES 9

Vector Architecture - SIMD Instruction Set Extensions for Multimedia – Graphics Processing Units - Detecting and Enhancing Loop Level Parallelism - Case Studies.

UNIT III TLP AND MULTIPROCESSORS 9

Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues - Performance Issues – Synchronization Issues – Models of Memory Consistency - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

UNIT IV RLP AND DLP IN WAREHOUSE-SCALE ARCHITECTURES 9

Programming Models and Workloads for Warehouse-Scale Computers – Architectures for Warehouse-Scale Computing – Physical Infrastructure and Costs – Cloud Computing – Case Studies.

UNIT V ARCHITECTURES FOR EMBEDDED SYSTEMS 9

Features and Requirements of Embedded Systems – Signal Processing and Embedded Applications – The Digital Signal Processor – Embedded Multiprocessors - Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Identify the limitations of ILP and the need for multicore architectures
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism
- Critically analyze the different types of inter connection networks
- Discuss the architecture of GPUs, warehouse-scale computers and embedded processors

REFERENCES:

1. John L. Hennessey and David A. Patterson, " Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier, 5^{th} edition, 2012.
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill Education, 2003
3. Richard Y. Kain, "Advanced Computer Architecture a Systems Design Approach", Prentice Hall, 2011.
4. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture : A Hardware/ Software Approach" , Morgan Kaufmann / Elsevier, 1997.

DS7211 DIGITAL SIGNAL PROCESSING LABORATORY II **L T P C**
0 0 3 2

USING SIMULINK-DSP STARTER KIT

1. MATLAB–DSK Interface Using RTDX
2. MATLAB–DSK Interface Using RTDX for FIR Filter Implementation
3. Adaptive Filter for Sinusoidal Noise Cancellation
4. Adaptive Predictor for Cancellation of Narrowband Interference Added to a Desired Wideband Signal
5. DSK Interface Using RTDX with MATLAB Functions for FFT and Plotting
6. mini-project based on the Matlab/Simulink-DSK

TOTAL : 45 PERIODS

DS7301 SPEECH AND AUDIO SIGNAL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES:

1. To study the basic concepts of speech and audio.
2. To study the analysis of various M-band filter banks for audio coding
3. To learn various transform coders for audio coding.
4. To study the speech processing methods in time and frequency domain

UNIT I MECHANICS OF SPEECH AND AUDIO 9

Introduction - Review Of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features.
Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Nonsimultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

UNIT II TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS 9

Introduction -Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters- Tree-Structured QMF and CQF M-band Banks - Cosine Modulated “Pseudo QMF” M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banksand the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre-echo Control Strategies.

UNIT III AUDIO CODING AND TRANSFORM CODERS 9

LosslessAudioCoding-LossyAudioCoding- ISO-MPEG-1A,2A,2A Advaned , 4A AudioCoding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization.

UNIT IV TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING 9

Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCRand energy
Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods

HOMOMORPHIC SPEECH ANALYSIS:

Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.

UNIT V LINEAR PREDICTIVE ANALYSIS OF SPEECH 9

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

TOTAL : 45 PERIODS

REFERENCES:

1. Digital Audio Signal Processing, Second Edition, Udo Zölzer**,** A John Wiley& sons Ltd Publicatioons
2. Applications of Digital Signal Processing to Audio And Acoustics
   Mark Kahrs, Karlheinz Brandenburg, KLUWER ACADEMIC PUBLISHERS NEW YORK, BOSTON, DORDRECHT, L ONDON , MOSCOW
3. Digital Processing of Speech signals – L.R.Rabiner and R.W.Schaffer - Prentice Hall --1978

CU7009 NEURAL NETWORK AND APPLICATIONS

L	T	P	C
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UNIT I BASIC LEARNING ALGORITHMS 9

Biological Neuron – Artificial Neural Model - Types of activation functions – Architecture: Feedforward and Feedback – Learning Process: Error Correction Learning –Memory Based Learning – Hebbian Learning – Competitive Learning - Boltzman Learning – Supervised and Unsupervised Learning – Learning Tasks: Pattern Space – Weight Space – Pattern Association – Pattern Recognition – Function Approximation – Control – Filtering - Beamforming – Memory – Adaptation - Statistical Learning Theory – Single Layer Perceptron – Perceptron Learning Algorithm – Perceptron Convergence Theorem – Least Mean Square Learning Algorithm – Multilayer Perceptron – Back Propagation Algorithm – XOR problem – Limitations of Back Propagation Algorithm.

UNIT II RADIAL-BASIS FUNCTION NETWORKS AND SUPPORT VECTOR MACHINES RADIAL BASIS FUNCTION NETWORKS 9

Cover's Theorem on the Separability of Patterns - Exact Interpolator – Regularization Theory – Generalized Radial Basis Function Networks - Learning in Radial Basis Function Networks Applications: XOR Problem – Image Classification.

SUPPORT VECTOR MACHINES

Optimal Hyperplane for Linearly Separable Patterns and Nonseparable Patterns – Support Vector Machine for Pattern Recognition – XOR Problem - -insensitive Loss Function –Support Vector Machines for Nonlinear Regression

UNIT III COMMITTEE MACHINES 9

Ensemble Averaging - Boosting – Associative Gaussian Mixture Model – Hierarchical Mixture of Experts Model(HME) – Model Selection using a Standard Decision Tree – A Priori and PostprioriProbabilities – Maximum Likelihood Estimation – Learning Strategies for the HME Model - EMAlgorithm – Applications of EM Algorithm to HME Model

NEURODYNAMICS SYSTEMS

Dynamical Systems – Attractors and Stability – Non-linear Dynamical Systems- Lyapunov Stability – Neurodynamical Systems – The Cohen-Grossberg Ttheorem.

UNIT IV ATTRACTOR NEURAL NETWORKS: 9

Associative Learning – Attractor Neural Network Associative Memory – Linear Associative Memory – Hopfield Network – Content Addressable Memory – Strange Attractors and Chaos- Error Performance of Hopfield Networks - Applications of Hopfield Networks – Simulated Annealing – Boltzmann Machine – Bidirectional Associative Memory – BAM Stability Analysis – Error Correction in BAMs - Memory Annihilation of Structured Maps in BAMS – Continuous BAMs – Adaptive BAMs – Applications

ADAPTIVE RESONANCE THEORY:

Noise-Saturation Dilemma - Solving Noise-Saturation Dilemma – Recurrent On-center – Off surround Networks – Building Blocks of Adaptive Resonance – Substrate of Resonance Structural Details of Resonance Model – Adaptive Resonance Theory – Applications

UNIT V SELF ORGANISING MAPS 9

Self-organizing Map – Maximal Eigenvector Filtering – Sanger's Rule – Generalized Learning Law – Competitive Learning - Vector Quantization – Mexican Hat Networks – Self -organizing Feature Maps – Applications

PULSED NEURON MODELS:

Spiking Neuron Model – Integrate-and-Fire Neurons – Conductance Based Models – Computing with Spiking Neurons.

TOTAL: 45 PERIODS

REFERENCES:

1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004.
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2ed., Addison Wesley Longman (Singapore) Private Limited, Delhi, 2001.
3. Martin T.Hagan, Howard B. Demuth, and Mark Beale, "Neural Network Design", Thomson Learning, New Delhi, 2003.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education (Singapore) Private Limited, Delhi, 2003.

IF7301	**SOFT COMPUTING**	**L T P C**
		3 0 0 3

OBJECTIVES

- To learn the key aspects of Soft computing and Neural networks.
- To know about the components and building block hypothesis of Genetic algorithm.
- To understand the features of neural network and its applications
- To study the fuzzy logic components
- To gain insight onto Neuro Fuzzy modeling and control.
- To gain knowledge in machine learning through Support vector machines.

UNIT I INTRODUCTION TO SOFT COMPUTING 9

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II GENETIC ALGORITHMS 9

Introduction, Building block hypothesis, working principle, Basic operators and Terminologies like individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, GA optimization problems, JSPP (Job Shop Scheduling Problem), TSP (Travelling Salesman Problem),Differences & similarities between GA & other traditional methods, Applications of GA.

UNIT III NEURAL NETWORKS 9

Machine Learning using Neural Network, Adaptive Networks – Feed Forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance Architectures – Advances in Neural Networks.

UNIT IV FUZZY LOGIC 9

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making

UNIT V NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control – Case Studies.

TOTAL : 45 PERIODS

OUTCOMES

- Implement machine learning through Neural networks.
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Write Genetic Algorithm to solve the optimization problem

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
2. Kwang H.Lee, “First course on Fuzzy Theory and Applications”, Springer–Verlag Berlin Heidelberg, 2005.
3. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1995.
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.
5. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, 2007.
6. Mitsuo Gen and Runwei Cheng,”Genetic Algorithms and Engineering Optimization”, Wiley Publishers 2000.
7. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998.
8. S.N.Sivanandam, S.N.Deepa, “Introduction to Genetic Algorithms”, Springer, 2007.
9. Eiben and Smith “Introduction to Evolutionary Computing” Springer
10. E. Sanchez, T. Shibata, and L. A. Zadeh, Eds., "Genetic Algorithms and Fuzzy Logic Systems: Soft Computing Perspectives, Advances in Fuzzy Systems - Applications and Theory", Vol. 7, River Edge, World Scientific, 1997.

CP7030 ROBOTICS L T P C

3 0 0 3

OBJECTIVES

- To understand robot locomotion and mobile robot kinematics
- To understand perception in robotics
- To understand mobile robot localization
- To understand mobile robot mapping
- To understand simultaneous localization and mapping (SLAM)
- To understand robot planning and navigation

UNIT I LOCOMOTION AND KINEMATICS 9

Introduction to Robotics – key issues in robot locomotion – legged robots – wheeled mobile robots – aerial mobile robots – introduction to kinematics – kinematics models and constraints – robot maneuverability

UNIT II ROBOT PERCEPTION 9

Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data

UNIT III MOBILE ROBOT LOCALIZATION 9

Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments

UNIT IV MOBILE ROBOT MAPPING 9

Autonomous map building – occupancy grip mapping – MAP occupancy mapping – SLAM – extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fastSLAM algorithm

UNIT V PLANNING AND NAVIGATION 9

Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms

TOTAL : 45 PERIODS

OUTCOMES

Upon Completion of the course, the students will be able to

- Explain robot locomotion
- Apply kinematics models and constraints
- Implement vision algorithms for robotics
- Implement robot localization techniques
- Implement robot mapping techniques
- Implement SLAM algorithms
- Explain planning and navigation in robotics

REFERENCES:

1. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to autonomous mobile robots”, Second Edition, MIT Press, 2011.
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005.
3. Howie Choset et al., “Principles of Robot Motion: Theory, Algorithms, and Implementations”, A Bradford Book, 2005.
4. Gregory Dudek andMichael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010.
5. Maja J. Mataric, “The Robotics Primer”, MIT Press, 2007.

AP7102 ADVANCED DIGITAL LOGIC SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To analyze synchronous and asynchronous sequential circuits
- To realize and design hazard free circuits
- To familiarize the practical issues of sequential circuit design
- To gain knowledge about different fault diagnosis and testing methods
- To estimate the performance of digital systems
- To know about timing analysis of memory and PLD

UNIT I SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Clocked Synchronous Sequential Networks (CSSN) - Modeling of CSSN – State Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – ASM Chart – ASM Realization, Design of Arithmetic circuits for Fast adder- Array Multiplier.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Design of Hazard free circuits - Data Synchronizers – Designing Vending Machine Controller – Mixed Operating Mode Asynchronous Circuits. Practical issues such as clock skew, synchronous and asynchronous inputs and switch bouncing.

UNIT III FAULT DIAGNOSIS & TESTING 9

Fault diagnosis: Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm. Design for testability: Test Generation – Masking Cycle – DFT Schemes. Circuit testing fault model, specific and random faults, testing of sequential circuits, Built in Self Test, Built in Logic Block observer (BILBO), signature analysis.

UNIT IV PERFORMANCE ESTIMATION 9

Estimating digital system reliability, transmission lines, reflections and terminations, system integrity, network issues for digital systems, formal verifications of digital system: model-checking, binary decision diagram, theorem proving, circuit equivalence.

UNIT V TIMING ANALYSIS 9

ROM timings, Static RAM timing, Synchronous Static RAM and it's timing, Dynamic RAM timing, Complex Programmable Logic Devices, Logic Analyzer Basic Architecture, Internal structure, Data display, Setup and Control, Clocking and Sampling.

TOTAL:45 PERIODS

REFERENCES:

1. Charles H.Roth Jr "Fundamentals of Logic Design", Thomson Learning 2004.
2. Nripendra N Biswas "Logic Design Theory" Prentice Hall of India, 2001.
3. Parag K.Lala "An introduction to Logic Circuit Testing" Morgan and claypool publishers, 2009.
4. Stephen D Brown, "Fundamentals of digital logic", TMH publication, 2007.
5. Balabanian, "Digital Logic Design Principles", Wiley publication, 2007.
6. Stalling, "Computer Organization & Architecture", Pearson Education India, 2008.
7. J.F.Wakerly, "Digital Design", Pearson Education India, 2012.
8. J.F.Wakerly, "Digital Design principles and practices", PHI publications, 2005.
9. Charles J. Sipil, Microcomputer Handbook McCrindle- Collins Publications 1977.

DS7001 OPTICAL SIGNAL PROCESSING L T P C

3 0 0 3

UNIT I ANALYSIS OF TWO DIMENSIONAL SIGNALS AND SYSTEMS 9

Review of one-dimensional fourier analysis, analysis of two-dimensional signals and systems, fourier analysis in two dimensions, localization, linear systems and fourier analysis, two dimensional sampling theory.

UNIT II FOUNDATIONS OF SCALAR DIFFRACTION THEORY 9

Kirchoff and rayleigh-sommerfield formulations, comparison of kirchoff and Rayleigh sommerfield theories, huygens-fresnel principle, non-monochromatic waves, diffraction at boundaries, angular spectrum of plane waves fresnel and fraunhofer diffraction Fresnel approximation, fraunhofer approximation, examples of fraunhofer diffraction patterns, examples of fresnel diffraction calculations.

UNIT III WAVE OPTICS ANALYSIS OF COHERENT OPTICAL SYSTEMS 9

Thin lens as phase transformation, fourier transforming properties of lenses, image formation monochromatic illumination, analysis of complex coherent optical systems.

UNIT IV TRANSFER FUNCTIONS AND FREQUENCY ANALYSIS OF OPTICAL IMAGING SYSTEMS 9

Generalized treatment of imaging systems, amplitude transfer function, frequency response for coherent and incoherent imaging, aberrations and their effect on frequency response, comparison of coherent and incoherent imaging, resolution beyond classical diffraction limit.

UNIT V WAVEFRONT MODULATION 9

Photographic film, liquid crystals and other modulators, diffractive optical elements, analog optical information processing, incoherent image processing systems, coherent optical image processing systems. Holography- wavefront reconstruction problem, gabor and leith, upatnieks holograms, image locations and magnification, different types of holograms- thick holograms, recording materials, computer-generated holograms, degradation of holographic images, holography with spatially incoherent light, applications.

TOTAL: 45 PERIODS

REFERENCES:

1. Joseph W. Goodman, “Introduction to Fourier Optics”, 3rd edition, Mc Graw Hill
2. D. Casasent, “Optical Data Processing, Applications”, Springer, Verlag, Berlin, 1978
3. H.J. Caulfield ,“Handbook of holography”, Academic Press New York 1979
4. P.M. Dufffieux, “The Fourier Transform and its applications to Optics”, John Wiley and sons 1988

DS7002 BIO SIGNAL PROCESSING

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UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminate function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA

TOTAL: 45 PERIODS

REFERNCES:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Rangaraj M. Rangayyan, 'Biomedical Signal Analysis-A case study approach', Wiley-Interscience/IEEE Press, 2002
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, 'Digital Signal processing- A Practical Approach' Pearson education Ltd., 2002
5. Raghuveer M. Rao and Ajith S.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000.

BM7201 APPLIED MEDICAL IMAGE PROCESSING

L	T	P	C
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OBJECTIVES:

- To understand the fundamentals of medical image processing techniques.
- To develop computational methods and algorithms to analyze and quantify biomedical data

UNIT I IMAGE FUNDAMENTALS AND PRE-PROCESSING 9

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms. Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations,

UNIT II BASICS OF MEDICAL IMAGE SOURCES 9

Radiology- The electromagnetic spectrum-Computed Tomography-Magnetic Resonance Tomography –ultrasound-nuclear medicine and molecular imaging-other imaging techniques-radiation protection and dosimetry.

UNIT III MEDICAL IMAGE REPRESENTATION 9

Pixels and voxels – algebraic image operations - gray scale and color representation- depth-color and look up tables - image file formats- DICOM- other formats- Analyze 7.5, NifTI and Interfile, Image quality and the signal to noise ratio- MATLAB based simple operations.

UNIT IV MEDICAL IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will be able to apply image processing concepts for medical images.
- Will be able to analyze Morphology, Segmentation techniques and implement these in images.
- Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy.

REFERENCES:

1. Wolfgang Birkfellner, 'Applied Medical Image Processing – A Basic course', CRC Press, 2011.
2. Atam P.Dhawan, 'Medical Image Analysis', Wiley Interscience Publication, NJ, USA 2003.
3. R.C.Gonzalez and R.E.Woods, 'Digital Image Processing', Second Edition, Pearson Education, 2002.
4. Anil. K. Jain, 'Fundamentals of Digital Image Processing', Pearson education, Indian Reprint 2003.
5. Alfred Horowitz, 'MRI Physics for Radiologists – A Visual Approach', Second edition Springer Verlag Network, 1991.
6. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing",CRC – Taylor and Francis,New York,2006
7. John L.Semmlow,"Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004
8. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006.

DS7003	**ARRAY SIGNAL PROCESSING**	**L T P C**
		3 0 0 3

UNIT I INTRODUCTION 9

Antenna parameters, Basic Antenna elements, Array Fundamentals- Element pattern, directive gain, Directivity, Power Gain, Polarization, array pattern, array gain, array taper efficiency, Pencil beam array, linear array synthesis-schelknoff 's polynomial array, binomial array, chebyshev array, Microstrip patch array, Noise in communication.

UNIT II SPATIAL SIGNALS AND SENSOR ARRAYS 9

Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and Near field signals. 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 9

Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering, sectorization, switched beam, phased antenna array, adaptive antenna array and adaptive signal processing application, Beam Forming. Spatially white signal. Introduction to microphone array signal processing

UNIT IV DIRECTION OF ARRIVAL ESTIMATION 9

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 APPLICATIONS OF ARRAY SIGNAL PROCESSING 9

RADAR, Sonar, Seismic, Acoustics, Wireless Communications and networks and Radio Astronomy signal processing applications

TOTAL : 45 PERIODS

REFERENCES:
1. Dan E. Dugeon and Don H. Johnson. Array Signal Processing: Concepts and Techniques. Prentice Hall. 1993.
2. Petre Stoica and Randolph L. Moses, Spectral Analysis of Signals. Prentice Hall. 2005
3. Simon Haykins and K. J. Ray Liu, Handbook of Array Signal Processing and Sensor Networks, Wiley.
4. Bass J, McPheeters C, Finnigan J, Rodriguez E. Array Signal Processing, February 2005.

DS7004 WIRELESS SENSOR NETWORKS **L T P C**
3 0 0 3

UNIT I INTRODUCTION 9

Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture – Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks.

UNIT II PHYSICAL LAYER 9

Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management .

UNIT III DATA LINK LAYER 9

MAC protocols – fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols - SMAC, BMAC, Traffic-adaptive medium access protocol (TRAMA), Link Layer protocols – fundamentals task and requirements, error control, framing, link management.

UNIT IV NETWORK LAYER 9

Gossiping and agent-based uni-cast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques.

UNIT V CASE STUDY 9

Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Operating System Design Issues, Introduction to TinyOS – NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, Emulator TOSSIM.

TOTAL:45 PERIODS

REFERENCES:
1. Kazem Sohraby, Daniel Minoli and Taieb Znati, “ Wireless Sensor Networks Technology-Protocols and Applications”, John Wiley & Sons, 2007.
2. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks: an information processing approach”, Else vier publication, 2004.
3. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, “Wireless Sensor Networks”, Springer publication, 2004.
4. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John wiley publication, Jan 2006.

5. K.Akkaya and M.Younis, " A Survey of routing protocols in wireless sensor networks", Elsevier Adhoc Network Journal, Vol.3, no.3,pp. 325-349, 2005.
6. Philip Levis, " TinyOS Programming", 2006 – www.tinyos.net.
7. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.
8. Jamal N. Al-karaki, Ahmed E. Kamal, "Routing Techniques in Wireless sensor networks: A survey", IEEE wireless communication, December 2004, 6 – 28.

DS7005 CRYPTOGRAPHIC TECHNIQUES **L T P C 3 0 0 3**

UNIT I SYMMETRIC CIPHERS 9

Overview – classical Encryption Techniques – Block Ciphers and the Data Encryption standard – Introduction to Finite Fields – Advanced Encryption standard – Contemporary Symmetric Ciphers – Confidentiality using Symmetric Encryption.

UNIT II PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS 9

Introduction to Number Theory – Public-Key Cryptography and RSA – Key Management – Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Message Authentication and Hash Functions – Hash Algorithms – Digital Signatures and Authentication Protocols.

UNIT III NETWORK SECURITY PRACTICE 9

Authentication Applications – Kerberos – X.509 Authentication Service – Electronic mail Security – Pretty Good Privacy – S/MIME – IP Security architecture – Authentication Header – Encapsulating Security Payload – Key Management.

UNIT IV SYSTEM SECURITY 9

Intruders – Intrusion Detection – Password Management – Malicious Software – Firewalls – Firewall Design Principles – Trusted Systems.

UNIT V WIRELESS SECURITY 9

Introduction to Wireless LAN Security Standards – Wireless LAN Security Factors and Issues.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. William Stallings, "Cryptography And Network Security – Principles And Practices", Pearson Education, 3rd Edition, 2003.

REFERENCES:

1. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill, 2003.
2. Bruce Schneier, "Applied Cryptography", John Wiley and Sons Inc, 2001.
3. Stewart S. Miller, "Wi-Fi Security", McGraw Hill , 2003.
4. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security In Computing", 3rd Edition,Pearson Education, 2003.
5. Mao, "Modern Cryptography: Theory and Practice" , First Edition, Pearson Education, 2003.

DS7006 **ADAPTIVE SIGNAL PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- This course is intended to impart to the students the principles of
- Adaptive signal processing,
- Different algorithms used for design of Adaptive Filters,
- Performance evaluation of systems
- Modeling systems like multipath communication channel
- Synthesis of filters

UNIT I INTRODUCTION 9

Introduction to Adaptive Processing General properties, filtering, prediction and smoothing, applications in Communications: Equalisation, Echo cancellation, Noise cancellation.

UNIT II ORTHOGONALIZED ADAPTIVE FILTERS 9

Optimal Signal Processing Principles of orthogonality, minimum square error, Wiener Hopf equations, state space model, innovations process, Kalman filter equations. Linear Adaptive Equalization Gradient search and steepest descent adaptation algorithms, effect of eigen value spread on stability and rate of convergence

UNIT III LEAST MEAN SQUARES ADAPTIVE FILTER 9

stochastic gradient descent using Least Mean Squares (LMS) algorithms, transient and steady state properties including convergence rate and mis-adjustment, least square estimation, normal equations, Recursive Least Squares (RLS) algorithms, relationship between RCS and Kalman filters.

UNIT IV KALMAN FILTER THEORY 9

Kalman Filter theory; Introduction; recursive minimum mean square estimation for scalar random variables; statement of the kalman filtering problem: the innovations process; Estimation of state using the innovations process

UNIT V FAST RECURSIVE ALGORITHMS AND APPLICATIONS 9

Introduction to Fast Recursive Algorithms for Equalisation Adaptive linear prediction, lattice filtering for RLS. Other Applications Echo cancellation in wowire systems, Noise cancellation.

TOTAL: 45 PERIODS

REFERENCES:

1. Adaptive Signal Processing, B. Widrow, S. Stearns, Prentice-Hall, 1985
2. Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing, D. Manolakis, V. Ingle, S. Kogan, McGraw Hill, 1999
3. Adaptive Signal Processing, L. Sibul, Ed., IEEE Press, 1987
4. Adaptive Filters: Structures, Algorithms and Applications, M. Honig, D. Messerschmitt, Kluwer, 1984.
5. Fundamentals of Adaptive Filtering, Ali H. Sayed, John Wiley, 2003.
6. Mohinder S. Grewal, Angus P. Andrews, Kalman Filtering: Theory and Practice Using MATLAB, John Wiley & Sons. 2008.

DS7007 UNDERWATER ACOUSTICS SIGNAL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the characteristics of Underwater Channel
- To understand the principles of SONAR
- To understand the challenges in underwater signal processing

OUTCOMES:

- To be able to design underwater signal processing systems
- To be able to analyze the performance of underwater signal processing systems

UNIT I UNDERWATER ACOUSTIC CHANNEL 9

Underwater Channel Characterization – Sound Transmission Losses-Acoustic Characteristics of surface layer-Ambient Noise in the ocean- Correlation properties of Ambient Noise

UNIT II SONAR 9

Basics of SONAR- correlation and ambiguities-Wideband Synthetic Aperture SONAR processing-Discrete Spatial arrays-Beam stearing- Target Angle Estimation –Array Shading:

UNIT III TARGET DETECTION 9

Passive Acoustic signatures of Ships and Submarines-Target strength for Active Systems-Hypothesis testing- receiver operating Characteristics-estimation of signal Parameters

UNIT IV STATISTICAL PROCESSING & ADAPTIVE SPATIAL FILTERING 9

Monostatic Sounding of Single point Targets-Target strength estimation from Echo ensemble-Optimum Filter for Maximum SNR-High Resolution Beam Forming –

UNIT V UNDERWATER ACOUSTIC COMMUNICATION 9

Underwater Bio Telemetry System -system Design principle-Speech Coding and Decoding-Transmission and Detection of speech

TOTAL: 45 PERIODS

REFERENCES:

1.William S. Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002
2.Robert S.H. Istepanian and Milica Stojan, Underwater Acoustic Digital signal processing & communication system, Kluwer academic Publisher, 2002

DS7008 EMBEDDED SYSTEM DESIGN **L T P C**
3 0 0 3

UNIT I EMBEDDED DESIGN LIFE CYCLE 9

Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Selection Processes – Microprocessor Vs Micro Controller – Performance tools – Bench marking – RTOS Micro Controller – Performance tools – Bench marking – RTOS availability – Tool chain availability – Other issues in selection processes.

UNIT II PARTITIONING DECISION 9

Hardware / Software duality – coding Hardware – ASIC revolution – Managing the Risk – Co-verification – execution environment – memory organization – System startup – Hardware manipulation – memory mapped access – speed and code density.

UNIT III INTERRUPT SERVICE ROUTINES 9

Watch dog timers – Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyser – Caches – Computer optimization – Statistical profiling

UNIT IV IN CIRCUIT EMULATORS **9**

Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.

UNIT V TESTING **9**

Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.

‘ **TOTAL : 45 PERIODS**

REFERENCES:

1. Arnold S. Berger – “Embedded System Design”, CMP books, USA 2002.
2. Sriram Iyer, “Embedded Real time System Programming”
3. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.

DS7009 REAL TIME OPERATING SYSTEM DESIGN **L T P C**
3 0 0 3

UNIT I REVIEW OF OPERATING SYSTEMS **9**

Basic Principles – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Operating System structures.

UNIT II DISTRIBUTED OPERATING SYSTEMS **9**

Topology – Network types – Communication – RPC – Client server model – Distributed file system – Design strategies.

UNIT III REAL TIME MODELS AND LANGUAGES **9**

Event Based – Process Based and Graph based Models – Petrinet Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV REAL TIME KERNEL **9**

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and study of various RTOS like QNX – VX works – PSOS – C Executive – Case studies.

UNIT V RTOS APPLICATION DOMAINS **9**

RTOS for Image Processing – Embedded RTOS for voice over IP – RTOS for fault Tolerant Applications – RTOS for Control Systems.

TOTAL: 45 PERIODS

REFERENCES:

1. Herma K., “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, 1997.
2. Charles Crowley, “Operating Systems-A Design Oriented approach” McGraw Hill 1997.
3. C.M. Krishna, Kang, G.Shin, “Real Time Systems”, McGraw Hill, 1997.
4. Raymond J.A.Bhur, Donald L.Bailey, “An Introduction to Real Time Systems”, PHI 1999.

DS7010 MICROCONTROLLER SYSTEM DESIGN AND ANALYSIS **L T P C**
3 0 0 3

UNIT I 8051 ARCHITECTURE 9
Basic organization – 8051 CPU structure – Register file – Interrupts – Timers – Port circuits – Instruction set – Timing diagram – Addressing modes – Simple Program and Applications.

UNIT II 8051 PROGRAMMING 9
Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming Interrupt Programming – RTOS for 8051 – RTOSLite – FullRTOS –Task creation and run – LCD digital clock/thermometer using FullRTOS

UNIT III PIC MICROCONTROLLER 9
Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MP-LAB.

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER 9
Timers – Interrupts, I/O ports- I^2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

UNIT V SYSTEM DESIGN – CASE STUDY 9
Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling AC appliances –Measurement of frequency – Stand alone Data Acquisition System.

TOTAL : 45 PERIODS

REFERENCES:

1. John B.Peatman, “Design with Micro controllers”, McGraw Hill international Limited, Singapore, 1989.
2. Michael Slater, “Microprocessor based design A comprehensive guide to effective Hardware design” Prentice Hall, New Jersey, 1989.
3. Ayala, Kenneth, “The 8051 Microcontroller” Upper Saddle River, New Jersey Prentice Hall, 2000.
4. Muhammad Ali Mazidi, Janice Gillispie mazidi. “The 8051 Microcontroller and Embedded systems”, Person Education, 2004.
5. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education 2008
6. John Iovine, ‘PIC Microcontroller Project Book ’, McGraw Hill 2000
7. Myke Predko, “Programming and customizing the 8051 microcontroller”, Tata McGraw Hill 2001.

DS7011 DIGITAL SIGNAL COMPRESSION **L T P C**
3 0 0 3

UNIT I INTRODUCTION OF COMPRESSION TECHNIQUES 9
Compression techniques, Modeling & Coding, Distortion criteria, Differental Entropy, Rate Distortion Theory, Vector Spaces, Information theory, Models for sources, Coding – uniquely decodable codes, Prefix codes, Kraft McMilan Inequality.

UNIT II QUANTIZATION 9
Quantization problem, Uniform Quantizer, Adaptive Quantization, Non-uniform Quantization; Entropy coded Quantization, Vector Quantization, LBG algorithm, Tree structured VQ, Structured VQ, Variations of VQ – Gain shape VQ, Mean removed VQ, Classified VQ, Multisage VQ, Adaptive VQ, Trellis coded quantization, Differential Encoding, Basic algorithm, Prediction in DPCM, Adaptive DPCM, Delta Modulation, Speech coding – G.726, Image coding.

UNIT III TRANSFORM CODING 9

Transforms – KLT, DCT, DST, DWHT; Quantization and coding of transform coefficients, Application to Image compression – JPEG, Application to audio compression, Sub-Band Coding: Filters, Sub-band coding algorithm, Design of filter banks, Perfect reconstruction using two channel filter banks, M-band QMF filter banks, Poly-phase decomposition, Bit allocation, Speech coding – G.722, Audio coding – MPEG audio, Image compression.

UNIT IV WAVELET BASED COMPRESSION 9

Wavelets, Multiresolution analysis & scaling function, Implementation using filters, Image compression – EZW, SPIHT,JPEG 2000. Analysis / Synthesis Schemes: Speech compression – LPV-10, CELP, MELP, Image Compression – Fractal compression.

UNIT V LOSSLESS CODING 9

Huffman coding, Adaptive Huffman coding, Golomb codes, Rice codes, Trunstall codes, Applications of Huffman coding, Arithmetic coding, Algorithm, implementation, Applications of Arithmetic coding, Dictionary techniques – LZ77, LZ78, Applications of LZ78-JBIG, JBIG2, Predictive coding – Prediction with partial match, Burrows Wheeler Transform, Applications – CALIC, JPEG-LS, Facsimile coding – T.4, T.6

TOTAL: 45 PERIODS

REFERENCES:

1. K. Sayood, Introduction to Data Compression, Harcourt India Pvt. Ltd. & Morgan Kaufmann Publishers, 1996.
2. N. Jayant and P. Noll, Digital Coding of Waveforms: Principles and Applications to Speech and Video, Prentice Hall, USA, 1984.
3. D. Salomon, Data Compression: The Complete Reference, Springer, 2000. Z. Li and M.S. Drew, Fundamentals of Multimedia, Pearson Education (Asia) Pte. Ltd., 2004.
4. Ralt Steinmetz and Klara Nahrstedt, Multimedia: Computing, Communication & Applications, Pearson Education Publications, 2004.
5. Rafael C. Gonzaleze & Richard E. Woods, Digital Image Processing Prentice Hall Publications.

MU7011 VIDEO COMPRESSION L T P C
3 0 0 3

OBJECTIVES :

- To introduce principles and current technologies of multimedia systems.
- To study the issues in effectively representing, processing and transmitting multimedia data including text, graphics, sound and music, image and video.
- To study the Image, video and audio standards such as JPEG, MPEG, H.26x, Dolby Digital and AAC will be reviewed.
- To study the applications such as video conferencing, multimedia data indexing and retrieval will also be introduced.

UNIT I INTRODUCTION 9

Overview of image compression - important information theory concepts - entropy definition and interpretation - Shannon-Fanon coding - Huffman coding - Adaptive Huffman coding - Lempel-Ziv codec- QM codec, context-based QM coder - examples of lossless compression

UNIT II QUANTIZATION 9

Scalar quantization, optimal scalar quantizer, commander- Vector quantization- Audio and speech compression- JPEG & JPEG-2000 still image compression- Video coding standards (A) MPEG-1, MPEG-2

UNIT III VIDEO PROCESSING 9

Video coding standards H.264/AVC and HEVC- Video coding techniques - motion estimation, rate control algorithms, pre & post processing- Video delivery/streaming over wired and wireless networks

UNIT IV ADVANCED VIDEO CODING TECHNIQUES 9

Mobile multimedia computing- Multimedia content management and protection- Future directions – Multi-view video coding, depth coding and others

UNIT V CONTENT MANAGEMENT 9

Video Compression-Motion Compensation, H.261 standard – FMM-14 Multimedia Applications Content-based retrieval in digital libraries – FMM

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able

- To know principles and current technologies of multimedia systems
- To know issues in effectively representing, processing, and retrieving multimedia data
- To know the areas by implementing some components of a multimedia streaming system
- To know the latest web technologies and some advanced topics in current multimedia research

REFERENCES:

1. Handbook of Image and Video processing - Al Bovik (Alan C Bovik), Academic Press, Second Edition, 2005.
2. Digital Image Sequence Processing, Compression, and Analysis - Todd R. Reed, CRC Press, 2004.
3. H.264 and MPEG-4 Video Compression: Video Coding for Next Generation Multimedia - Iain E.G. Richardson, Wiley, 2003
4. Digital Video Processing - A. Murat Tekalp, Prentice Hall, 1995
5. Andy Beach, “Real World Video Compression” Pearson Education, 2010.
6. Peter D. Symes ,” Video Compression Demystified” McGraw-Hill, 2001.
7. Yun Q. Shi, Huifang Sun,” Image and Video Compression for Multimedia Engineering Fundamentals, Algorithms, and Standards” 2nd Edition 2008.

MU7102 MULTIMEDIA COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the Multimedia Communication Models
- To analyze the Guaranteed Service Model
- To study the Multimedia Transport in Wireless Networks
- To solve the Security issues in multimedia networks
- To explore real-time multimedia network applications

UNIT I MULTIMEDIA COMMUNICATION MODELS 9

Architecture of Internet Multimedia Communication- Protocol Stack-Requirements and Design challenges of multimedia communications- Multimedia distribution models-Unicasting, Broadcasting and Multicasting.

UNIT II GUARANTEED SERVICE MODEL 9

Multicast routing-PIM- Best effort service model and its limitations- QoS and its metrics-Queuing techniques-WFQ and its variants-RED-QoS aware routing -Call Admission Control-RSVP- Policing and Traffic Shaping algorithms- QoS architectures.

UNIT III MULTIMEDIA TRANSPORT 9
End to end solutions-Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video Streaming-Interactive and non Interactive Multimedia- RTSP- RTP/RTCP – SIP-H.263.

UNIT IV MULTIMEDIA OVER WIRELESS NETWORKS 9
End to end QoS Provisioning-QoS enhancements-Call Admission Control-QoS Management-Multimedia support in 3G & 4G networks- Location Based Multimedia Service System.

UNIT V MULTIMEDIA NETWORK SECURITY AND APPLICATIONS 9
Security threats in Multimedia Communication- Digital Rights Management Architecture-DRM for Mobile Multimedia- Architectures, Requirements and Design Challenges of real time Multimedia Network Applications- Case Study-VoIP- Video Conferencing- Military Surveillance- Interactive TV-Video on Demand- Smart Phone.

TOTAL 45 PERIODS

OUTCOMES:
At the end of the course, the students will be able to
- deploy the right multimedia communication models
- apply QoS to multimedia network applications with efficient routing techniques
- solve the security threats in the multimedia networks
- develop the real-time multimedia network applications

REFERENCES:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Introduction to Multimedia Communications Applications, Middleware, Networking", John Wiley and Sons, 2006.
2. Jean Warland, Pravin Vareya, "High Performance Networks", Morgan Kauffman Publishers, 2002.
3. William Stallings, "High Speed Networks and Internets Performance and Quality of Service", 2^{nd} Edition, Pearson Education, 2002.
4. Aura Ganz, Zvi Ganz, Kitti Wongthawaravat, 'Multimedia Wireless Networks Technologies, Standards and QoS', Prentice Hall, 2003.
5. Mahbub Hassan and Raj Jain, "High Performance TCP/IP Networking", Pearson Education, 2004
6. Shiguo Lian, "Multimedia Communication Security Recent Advances", Nova Science Publishers, 2008.

CP7204 ADVANCED OPERATING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:
- To learn the fundamentals of Operating Systems
- To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
- To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols
- To know the components and management aspects of Real time, Mobile operating systems

UNIT I FUNDAMENTALS OF OPERATING SYSTEMS 9
Overview – Synchronization Mechanisms – Processes and Threads - Process Scheduling – Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques.

UNIT II DISTRIBUTED OPERATING SYSTEMS 9
Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9

Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol – Security and Protection.

UNIT IV REAL TIME AND MOBILE OPERATING SYSTEMS 9

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –Micro Kernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File system.

UNIT V CASE STUDIES 9

Linux System: Design Principles - Kernel Modules - Process Management Scheduling - Memory Management - Input-Output Management - File System - Interprocess Communication. iOS and Android: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

OUTCOMES:

Upon Completion of the course, the students should be able to:

1. Discuss the various synchronization, scheduling and memory management issues
2. Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
3. Discuss the various resource management techniques for distributed systems
4. Identify the different features of real time and mobile operating systems
5. Install and use available open source kernel
6. Modify existing open source kernels in terms of functionality or features used

REFERENCES:

1. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, “Operating System Concepts”, Seventh Edition, John Wiley & Sons, 2004.
3. Daniel P Bovet and Marco Cesati, “Understanding the Linux kernel”, 3rd edition, O’Reilly, 2005.
4. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2006.
5. Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, Fourth Edition, Payload media, 2011.

DS7012 DESIGN AND ANALYSIS OF ALGORITHMS

L	T	P	C
3	1	0	4

UNIT I INTRODUCTION 10

Fundamentals of algorithmic problem solving – Important problem types – Fundamentals of the analysis of algorithm efficiency – analysis frame work – Asymptotic notations – Mathematical analysis for recursive and non-recursive algorithms.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD 12

Divide and conquer methodology – Merge sort – Quick sort – Binary search – Binary tree traversal – Multiplication of large integers – Strassen’s matrix multiplication – Greedy method – Prim’s algorithm – Kruskal’s algorithm – Dijkstra’s algorithm.

UNIT III DYNAMIC PROGRAMMING 12

Computing a binomial coefficient – Warshall’s and Floyd’ algorithm – Optimal binary search tree – Knapsack problem – Memory functions.

UNIT IV BACKTRACKING AND BRANCH AND BOUND 14

Backtracking – N-Queens problem – Hamiltonian circuit problem – Subset sum problem – Branch and bound – Assignment problem – Knapsack problem – Traveling salesman problem.

UNIT V NP-HARD AND NP-COMPLETE PROBLEMS 12

P & NP problems – NP-complete problems – Approximation algorithms for NP-hard problems – Traveling salesman problem – Knapsack problem.

L : 45 T : 15 TOTAL : 60 PERIODS

REFERENCES:

1. Anany Levitin "Introduction to the Design and Analysis of Algorithms" Pearson Education 2003.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, "Introduction to algorithms" Prentice Hall 1990.

DS7013 DIGITAL MODULATION AND CODING

L	T	P	C
3	0	0	3

UNIT I BAND PASS DATA TRANSMISSION 9

Geometric representation of signals; Coherent detection of signals in noise. Correlation receiver and matched filter receiver.

UNIT II DIGITAL MODULATION 9

Probability of error and receiver implementation of BPSK, BFSK, QPSK, MSK, Mary PSK and Mary FSK.

UNIT III DEMODULATION OF SIGNALS 9

Union bound approximation for the probability of error. Detection of signals with unknown phase Spectra of digitally modulated signals. Carrier and clock recovery methods.

UNIT IV ERROR CONTROL CODES 9

Error control coding: Linear block codes: Generator and parity check matrices. Syndrome calculation. Error detection and error correction using block codes. Conventional codes: Generator and transfer function matrices.

UNIT V CONVENTIONAL CODES 9

State and trellis diagrams. Maximum likelihood decoding of conventional codes: The Viterbi algorithm. Trellis coded modulation.

TOTAL: 45 PERIODS

REFERENCES:

1. Stephen G. Wilson, Digital Modulation and Coding, Prentice Hall, 1996.
2. M. K. Simon S. M. Winedi and N. C. Lindsey " DIGITAL COMMUNICATION TECHNIQUES'' Signalling and detection preatice wall India, New Delhi 195
3. Simon Waykin Digital Communication Johnwiley and sons 1998.
4. John G. Prakis "Digital Communication 4th Edition McGRAW HILL Publication 2012..
5. Theodooc S. Rappaport " Wireless Communication 2nd Edition "Pearson Education 2002.