MTDC 13 ADVANCED DIGITAL SIGNAL PROCESSING

Instruction	3 Periods per week
Duration of University Examination	3 Hrs
University Examination	100 Marks
Sessional	50 Marks

UNIT-I

Multirate Digital Signal Processing: Decimation, Interpolation, time domain and frequency domain characterization of sampling rate alteration devices, Fractional sampling rate conversion, Direct-form FIR structures, poly phase filter structures, Time-variant filter structures, multistage implementation of sampling rate conversion, design of phase shifters,

Interfacing of digital system: Interfacing with different sampling rates, Implementation of digital filter banks, sub band coding of speech signals, quadrature mirror filters, Trans multiplexers, oversampling ADCs and DACs.

UNIT-II

Optimal Linear Filters: Representation of stationary random process, rational power spectra, filter parameters and auto correlation sequence.

Forward and Backward Predictors: Reflection co-efficients, AR process and Linear Prediction, Solution of normal Equations, Levinson & Durbin Algorithm, Properties of Linear Prediction error filters, AR and ARMA lattice Ladder structures.

UNIT-III

Wavelet Transforms: Introduction to Short Time Fourier Transform (STFT), Definition of Wavelet Transform and its importance in multiresolution analysis, Wavelet basis function, Mother Wavelet.

Power Spectrum Estimation: Cross correlation and Auto correlation of discrete time signals, power spectral density, periodogram, use of DFT in power spectrum estimation.

Non parametric methods for Power Spectrum Estimation: Bartlett method, Welch method, Blackman & Tukey method.

UNIT-IV

Parametric methods for Power Spectrum Estimation: estimation Autoregressive (AR) moving average(MA) and Auto regressive - Moving average (ARMA) models, Yule-Walker method, Burg method Unconstrained least squares methods.

Sequential Data algorithms for Power Spectrum Estimation: Capon's minimum variance, Pisarenko's harmonic decomposition method and Eigen decomposition method, MUSIC and ESPIRIT algorithms.

Reference Text Books:

1. John G. Proakis D. G. Monolakis, *Digital Signal Processing: Principles, Algorithms & Applications*, PHI, New Delhi.
2. S. K. Mitra, *Digital Signal processing: A computer based approach*, Tata Mc Graw - Hill, New Delhi
3. Marple, Jr. SL., *Digital Spectral Analysis with Applications*, PHI, PPR, Englewood Cliffs, New Jersey.
4. P. P. Vaidyanatham, *Multirate filter banks*, PHI, New Delhi.

MTDC 16(d) LOW POWER VLSI DESIGN
(Elective-I)

Instruction	3 Periods per week
Duration of University Examination	3 Hrs
University Examination	100 Marks
Sessional	50 Marks

UNIT-I

Introduction and need of low power design sources of power dissipation and design strategies for low power. Physics of power dissipation in CMOS-low power VLSI design limits. Power estimation at circuit level – modeling of signals, signal probability calculations, statistical techniques, input vector compaction, circuit reliability. Synthesis for low power – behaviour level transforms, logic and circuit level optimization.

UNIT-II

Design styles and testing – low voltage CMOS circuit design styles, leakage current in deep submission transitions and design issues, minimization of short channel effects (SCE) and hot carrier effects. Testing of deep sub micron ICs with elevated intrinsic leakage.

UNIT-III

Low power architectures – MOS static RAM cells, banked organization SRAMS, reducing voltage swing on bit lines, write lines, driver circuits and sense amplifier circuits, Energy computing and recovery techniques – energy dissipation using an RC model, energy recovery circuit design, design with partially reversible logic and supply clock generation.

UNIT-IV

Software design for low power – dedicated hardware Vs Software implementation, power dissipation, Estimation and optimization. Automated power code generation and co design for low power.

Reference Text Books:

1. Kaushik Roy, Sharad Prasad, " Low power CMOS VLSI circuit Design", John Wiley & Sons, 2000
2. A.P. Chandrakasan, R.W.Broderson,"Low power design", IEEE Press, 1998.
3. J.B.Kuo, J.H.Juo, "Low voltage VLSI circuits" John Wiley & Sons.

MTDC 26(b) WIRELESS & MOBILE COMMUNICATIONS
(Elective-III)

Instruction	3 Periods per week
Duration of University Examination	3 Hrs
University Examination	100 Marks
Sessional	50 Marks

UNIT-I

Basic cellular mobile communication system- the cellular concept- System design fundamentals-Frequency reuse- Channel assignment strategies, Handoff strategies, power control, Interference and system capacity, improving coverage and capacity in cellular systems.

UNIT II

Mobile radio propagation-Large scale path loss-Introduction to radio wave, free space propagation model, Three basic propagation mechanisms, Reflection, ground reflection (two ray) model, Diffraction, Scattering,
Practical link budget design using path loss models, Out door propagation models, Indoor propagation models, Signal penetration into buildings.

UNIT III

Mobile radio propagation-Small scale fading and multi path, Small scale multipath propagation, Impulse response model of a multipath channel, Small scale multipath measurements, parameters of mobile multipath channels, **Types of small scale fading,** Rayligh and Ricean distributions, Statistical models for multipath fading channels.

UNIT IV

Multiple access techniques for wireless communications-FDMA, TDMA, Spread spectrum multiple access (SDMA), Packet radio, CSMA, Reservation Protocols.
Wireless systems and standards – Evaluation of wireless systems, study of AMPS, IS-54, IS-136, GSM, IS-95, CDMA-2000, WCDMA, Introduction to Fourth generation systems.

Reference Text Books:

1. Theodore S. Rappaport, Wireless communications principles and practice PHI, 2nd Edition, 2002.
2. V.K. Garg, IS-95 CDMA& CDMA 2000, Pearson Education, 2002
3. William Stallings, Wireless communications & Networks, Pearson Education-2002
4. William C.Y Lee, Mobile Cellular Tele communications, McGraw-Hill, 2nd Edition, 1995.

Image Processing and Computer Vision

(Syllabus for Pre Ph.D Course)

Unit-1

Image representation: Gray scale and colour Images, Image Sampling and Quantization. 2D Orthogonal Transforms: DFT, WHT, Haar Transform, KLT, DCT. Image Enhancement: Filters in Spatial and Frequency domain, Histogram based Processing. Homomorphic Filtering, Edge detection – non parametric and Model based approaches, LOG filters.

Unit-2

Image Restoration: Degradation Models, PSF, Restoration in the presence of Noise Only-Spatial filtering, Inverse Filtering, Minimum Mean Square Error (Weiner) Filtering Geometric Mean Filter, maximum entropy -based methods.

Unit-3

Image Segmentation: Pixel Classification, Bi-Level Thresholding, Multilevel Thresholding, P-Tile method, Adaptive thresholding, Region Growing, Mean shift Segmentation, Active Contour models – snakes, Evaluation issues in segmentation. Fundamental Concepts of Image Compression, Compression Models, Information theoretic perspective, Fundamental Coding Theorem, Lossless Compression: Huffman Coding-Arithmetic Coding; Lossy compression: Transform Coding, Image Compression Standards.

Unit-4

Object Recognition: Patterns and Patterns Classes, recognition based on decision-theoretic methods, matching, optimum statistical classifiers, Neural Networks. Image Understanding: Image Understanding control stategies, RANSAC, Point Distribution Models, Active Appearance Models. 3D Vision, geometry: 3D Vision tasks, Basics of Projective geometry, A single perspective camera, scene reconstruction from multiple views.

Reference Books:

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, Third Edition, Pearson.
2. A.K. Jain Fundamentals of digital Image Processing, Prentice Hall of India, 1989.
3. Sonka, Hlavac, Boyle, Digital Image Processing and Computer Vision, CENGAGE Learning, 2008.
4. A. Bovik, Handbook of Image & Video Processing, Academic Press,2000.

SYLLABUS FOR Pre Ph.D. Course
BIOMEDICAL INSTRUMENTATION & IMAGING TECHNIQUES

UNIT- I (9)

Introduction: The human body an overview, generalized medical instrumentation system, medical measurement constraints

Origin of Bio-Potentials: Electrical activity of cells, volume conductor fields, functional organization of the peripheral nervous system, electroneurogram (ENG), electromyogram (EMG), electroretinogram (ERG), electrodes for biophysical sensing surface electrodes, microelectrodes.

UNIT- II (9)

Electrocardiography: Physiology of heart and circulatory system, electro conduction system of the heart, ECG waveform, standard lead system, block diagram of electrocardiograph, ECG preamplifier, isolation amplifier, chopper stabilized amplifier problems frequently encountered in ECG design, common mode and other interference reduction circuits, physiological signals input guarding, abnormal ECG waveforms

Blood Pressure Measurement: Sphygmomanometer, ultrasonic method, systolic, diastolic and mean detector circuits, practical problems in pressure monitoring

UNIT- III (9)

Electro encephalography: Anatomy and function of brain, EEG10-20 electrode system, EEG amplitude and frequency bands, EEG recording modes, EEG diagnostic uses and sleep patterns

Respiratory Measurements: Mechanics of breathing, respiratory system measurements, impedance pneumograph, spirometer, pulse oximetry, blood glucose sensors

UNIT- IV (9)

Biomedical Imaging Techniques: X-Ray, ultrasonic imaging, CTscan, MRIscan

Biomedical Wearable Devices (*Block diagram approach):* Introduction, wearable health monitors, design considerations for wireless implanted devices, examples of wireless implanted devices-pacemakers and implanted cardioverter defibrillator, combining data from multiple sensors, continuous glucose monitors

Electrical Safety: Physiological effects of electricity, macro shock hazards, micro shock hazards, protection

TextBooks:

[1] JohnG. Webster, *Medical Instrumentation: Application and Design*, 3rd edn., Wiley India Edition, 2008. (Chapters1,4,5,6,7,8,9,14).

[2] JosephJ. Carrand John M.Brown, *Introduction to Biomedical Equipment Technology*, 4th edn., Pearson Education, 2000. (Chapters1,2,6,7,8,9,10,13)

ReferenceBooks:

[1] Andrew G.Webb, *Principles of Biomedical Instrumentation*, Cambridge University Press,2018.

[2] Cromwell Leslie, Weibell FredJ., and Pfeiffer EricA., *Biomedical Instrumentation and Measurements*, 2nd edn., PHI Learning, 1990.

[3] Mandeep Singh, *Introduction to Biomedical Instrumentation*, PHI Learning, 2010.

[4] R.S Khandpur and Raghbir Khandpur, *Biomedical Instrumentation*, TMH, Professional.

VLSI TECHNOLOGY AND DESIGN

Course Objectives

1) Students from other engineering background to get familiarize with large scale integration technology.
2) To expose fabrication methods, layout and design rules.
3) Learn methods to improve Digital VLSI system's performance.
4) To know about VLSI Design constraints.
5) Visualize CMOS Digital Chip Design.

Course Outcomes

1) Review of FET fundamentals for VLSI design.
2) To acquire knowledge about stick diagrams and layouts.
3) Enable to design the subsystems based on VLSI concepts.

UNIT-I

Review of Microelectronics and Introduction to MOS Technologies-
MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS & BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage VT, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT- II

Layout Design and Tools
Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools.
Logic Gates & Layouts
Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT-III

Combinational Logic Networks
Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

UNIT-IV

Sequential Systems
Memory cells and Arrays, Clocking disciplines, Design Power optimization, Design validation and testing.
Floor Planning
Floorplanning methods, Global Interconnect, FloorPlan Design, Off-chip connections.

TEXTBOOKS

1. Essentials of VLSI Circuits and Systems, K.E shraghian Eshraghian. D,A.Pucknell, 2005, PHI.
2. Modern VLSI Design–Wayne Wolf, 3rdEd.,1997, Pearson Education.

REFERENCES

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective–Ming-BO Lin, CRC Press, 2011.
2. Principals of CMOS VLSI Design–N.H.E Weste, K. Eshraghian, 2ndEd.,Addison Wesley.