BRANCH-ELECTRONICS AND TELECOMMUNICATION ENGINEERING

2nd Semester

***Specialization:** VLSI & Embedded System Design/ VLSI & Embedded System/ VLSI Design & Embedded System*

Second Semester							
	Theory				Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 Embedded System Design	4-0	4	100	50	-	-	-
Specialization Core-2 VLSI Fabrication Technology	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Low Power Digital VLSI Design 2.Introduction to Nanoelectronics 3.Microsystems – Principle, Design and Application 4.VLSI Physical Design	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2. Adaptive Signal Processing. 3. RF and Mixed-Signal Integrated Circuits 4. ASIC & SoC Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3.Bio-MEMS and Nanotechnology 4.Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

BRANCH-ELECTRONICS AND TELECOMMUNICATION ENGINEERING

2nd Semester

Specialization: Electronics and Communication Engineering/ Electronics and Telecommunication Engineering/ Communication Engineering/ Communication Systems

Second Semester							
	Theory				Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 Telecommunication Network and Optical Switching	4-0	4	100	50	-	-	-
Specialization Core-2 Satellite Communication System	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Fiber-Optics Components and Device 2.Digital Image Processing 3.Radar System Engineering 4.Wireless Sensor Network	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Industrial Telematics 2. Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuit Design 4. Embedded System Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Antenna Design & Measurement 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

BRANCH-ELECTRONICS AND TELECOMMUNICATION ENGINEERING

2nd Semester

Specialization: Signal Processing and Engineering

Second Semester							
Theory					**Practical**		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 DSP Algorithm and Architectures	4-0	4	100	50	-	-	-
Specialization Core-2 Digital Image and Video Processing	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Array Signal Processing 2.Multirate Signal Processing 3. Biomedical instrumentation & Signal Processing 4. Speech and Audio Signal Processing	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2.Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuits 4. Embedded System Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Bio-MEMS and Nanotechnology 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

BRANCH-ELECTRONICS AND TELECOMMUNICATION ENGINEERING

2nd Semester

Specialization: Wireless Communication Technology

Second Semester							
	Theory				Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 MIMO Wireless Communication System	4-0	4	100	50	-	-	-
Specialization Core-2 Ultra Wide Band Communication system	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Wireless Communication Management 2.Spread Spectrum Communication Technique 3.VLSI for Wireless Communication 4.Satellite Communication System	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2. Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuits 4. Embedded System Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Antenna Design & Measurement 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

BRANCH-ELECTRONICS AND TELECOMMUNICATION ENGINEERING

2nd Semester

Specialization: Signal Processing and Communication

Second Semester							
	Theory				Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 Detection and Estimation Theory	4-0	4	100	50	-	-	-
Specialization Core-2 Digital Image and Video Processing	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Fiber-Optics Components and Device 2.Radar and Sonar Signal Processing 3.Biomedical Instrumentation and Signal Processing 4.Digital Filter Design	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2. Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuits 4.VLSI Digital Signal Processing	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Antenna Design & Measurement 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

DETAILED SYLLABUS OF SECOND SEMISTER M.TECH 2016-17 ADDMISSION BATCH

2nd Semester

BRANCH-Electronics and Telecommunication Engineering

Specialization: Electronics and Communication Engineering/ Electronics and Telecommunication Engineering/ Communication Engineering/ Communication Systems

Second Semester							
Theory					Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 Telecommunication Network and Optical Switching	4-0	4	100	50	-	-	-
Specialization Core-2 Satellite Communication System	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Fiber-Optics Components and Device 2.Digital Image Processing 3.Radar System Engineering 4.Wireless Sensor Network	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Industrial Telematics 2. Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuits 4. Embedded System Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Antenna Design & Measurement 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

2nd Semester

TELECOMMUNICATION NETWORK AND OPTICAL SWITCHING

MODULE – I **(8 hours)**

Introduction Evolution, simple telephone communication, basis of switching system, telecommunication networks.

Electronic space division switching Stored program control, centralized and distributed SPC, software architecture, application software, enhanced software, two and three stage networks.

MODULE – II **(10 hours)**

Time Division Switching Basic time division space switching, basic time division time switching, time multiplexed space and time switching, combination switching, three-stage combination switching.

Traffic Engineering Network traffic load and parameters, Grade of service, modeling switching systems, incoming traffic, blocking models and loss estimates.

MODULE – III **(12 hours)**

OPTICAL NETWORK ARCHITECTURES Introduction to Optical Networks; Layered Architecture-Spectrum partitioning, Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays.

OPTICAL SWITCHING Free-space optical switching – multistage optical interconnection networks-back plane optical interconnects, optical memory for switching – logic functionality – nonlinear fiber couplers, photonic switch architectures based on TDM, WDM, OCX, ATM.

MODULE – IV **(8 hours)**

OPTICAL INTERNET NETWORKS Optical Circuit switching- Optical Burst switching- Optical packet switching – Unbuffered Networks, Buffering Startegies- MPLS in WDM Networks -Types MPLS Nodes – Multi protocol lambda switching – MPLS and Optical TE similarities – IP, MPLS and Optical control planes –LSP routing.

Textbooks:

1.Thiagarajan Viswanathan, Telecommunication Switching Systems and Networks by, PHI Learning Pvt. Ltd., New Delhi.

2.Alberto Leon-Gracia and IndraWidjaja, Communication Networks, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

3. Thomas E. Stern, Georgios Ellinas, Krishna Bala, “Multiwavelength Optical Networks – Architecture, Design and control “, Cambridge University Press, 2nd Edition, 2009.

4. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks : A Practical Perspective”, Harcourt Asia Pte Ltd., Second Edition 2006.

5. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks : Concept, Design and Algorithms”, Prentice Hall of India, Ist Edition, 2002.

6. Uyless Black, “ Optical Network: Third Generation Transport System”,Pearson Education, Ist edition,2002.

2nd Semester

SATELLITE COMMUNICATION SYSTEM

Module: 1 **(8 Hours)**

Satellite Communication Technology Satellite orbits, Satellite constellation and ISL, orbital parameters, look angle determination, launching procedures. Spacecraft subsystems - Attitude and orbit control, power, TT & C, communication and antennas.

Module: 2 **(8 Hours)**

Earth station design - Digital transmitter and receiver, antenna and beam steering techniques. Link Design Digital satellite link analysis and design for FSS and BSS - link budget and Eb/No calculations.

Module: 3 **(6 Hours)**

Performance impairments - Noise, interference, propagation effects and frequency considerations. Intermodulation and back off - SPADE system.

Module: 4 **(10 Hours)**

Access Techniques FDMA concept- TDMA concept - Frame and burst structure - Frame acquisition and synchronization - Satellite Switched TDMA system. CDMA concepts - DS and FH System acquisition and Tracking. Audio broadcasting via satellite – World Space Services throughTeledesic, LEO system and Glob star.

Textbooks:

1. Tri T. Ha, Digital Satellite Communication Systems Engineering, McGraw Hill, 1990.

2. Wilbur L. Pritchard, Henri G. Suyderhoud, and Robert A. Nelson, Satellite Communication System Engineering, 2nd Edn., Pearson Education, New delhi. Recommended Reading:

3. Pratt and Bostain, Satellite Communication, John Wiley and Sons, 1986.

4. M. Richharia, Mobile Satellite Communications – Principles and Trends, Pearson Education, 2003.

5. Robert.M.Gagliardi, Satellite Communication, CBS Publishers

2nd Semester

FIBRE-OPTICS COMPONENTS AND DEVICE

MODULE – I **(8 hours)**

Fibre-Optic Light Sources and Detectors Brief description on the principle of optical sources,Internal Quantum efficiency of LED,Modulationcapability,Power-Bandwidth product, Laser diodes, Laser diode modes, Threshold conditions, Resonant frequencies, Laser diode structures, Single mode lasers, modulation of laser diodes.

MODULE – II **(8 hours)**

Brief description on the principle of optical detectors, photodetector noise, Noise sources, Signal-to-Noise ratio, Detector response time, Depletion layer photocurrent, Response time, Avalanche multiplication noise.

MODULE – III **(11 hours)**

Optical Fibre Connection Joint loss, Multi mode fibre joints, Singe mode fibre joints, Fibre splices, Fusion splices, Mechanical splices, Multiple splices, Fibre connectors, Cylindrical ferrule connectors, Biconical ferrule connectors, Double eccentric connectors, Duplex fibre connectors, Expanded beam connectors, Fibre couplers, Three port couplers, Four port couplers, Star couplers, WDM couplers.

MODULE – IV **(12 hours)**

Optical Amplification and Integrated Optics Optical amplifiers, Semiconductor laser amplifiers, Fibre amplifiers, Rare earth doped fibre amplifiers, Raman fibre amplifiers, Brillouin fibre amplifiers, Integrated optics, Integrated optical devices, Beam splitters, Directional couplers, switches, Modulators, Periodic structures for filters and injection lasers, Opto-electronic integration, Optical bistability and digital optics, Optical computation.

Textbooks:

1. G. Keiser, Optical Fibre Communications, Mc-Graw-Hill.

2. J.M.Senior, Optical Fibre Communications Principles and Practice, PHI.

2nd Semester

DIGITAL IMAGE PROCESSING

MODULE – I

Digital Image Fundamentals, Image Transforms: Fourier, Hadamard, Walsh, Discrete cosine and HotellingTransforms.Image Enhancement: Histogram modification, Histogram equalisation, Smoothing, Filtering, Sharpening, Homomorphic filtering.

MODULE – II

Image restoration, Segmentation: Pixel classification, Bi-level thresholding, Multi-level thresholding, P-tile method, Adaptive thresholding, Spectral & spatial classification, Edge detection, Hough transform, Region growing.

MODULE – III

Matching and Registration: Image modeling, Stereo mapping, Landmark matching, Rectification in geometric transformations, Match measurement, Matching of binary pattern, Distortion tolerant matching.

MODULE – IV

Digital geometry and its applications: Neighborhood, Path, Connectedness, Holes and Surroundness, Borders, Distances, Medial Axis Transform (MAT), Shrinking and Expanding, Thinning. Introduction to Mathematical morphology and its application, Morphological Operations, Dilation, Erosion, Opening, Closing, Smoothing, Extraction of connected components, Thinning.

Textbooks:

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, Pearson Prentice Hall, 2007.
2. B. Chanda, D.D. Majumder, Digital Image Processing and Analysis, Prentice Hall, 2007.

Reference Book:

1. W.K. Pratt, Digital Image Processing (Fourth Edition), John Wiley & Sons, Inc., 2007
2. A.K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1988.

2nd Semester

RADAR SYSTEM ENGINEERING

Module – I **(10 hours)**

The radar equation in terms of the key radar parameters and target-radar cross section. False alarm, minimum detectable signal, Receiver noise and the SNR. Probabilities of detection and False alarm, integration of radar pulses, radar cross section of targets; complex targets, transmitted power, prf, antenna parameters, beam shape, cosecant-squared antenna pattern.

Module – II **(8hours)**

Basic ideas on system losses MTI and pulse doppler radar, delay line canceller, doppler effect on blind speeds in MTI, staggered prf. doppler filter banks, digital MTI processing, Limitations to MTI performance MTI from a moving platform (AMTI), pulse doppler radar, FM-CW radar for range and velocity determination, SLAR & SAR.

Tracking with radar, monopulse tracking, amplitude comparison monopulse, phase comparison monopulse, conical scan and sequential lobing, Glint (example from a simple target model) tracking in range.

Module – III **(10 hours)**

Target acquisition, servo system tracking in doppler, track with scan (limited sector scan), Automatic tracking with surveillance Radars. Functions of the radar antenna, antenna radiation pattern, effective aperture and aperture illumination, side lobe radiation, reflector antennas, grain antenna, Electronically steered phased-array antennas, Beam steering and array-feed networks, change of beam width with steering angle, phase shifters, diode phase shifters, ferrite phase shifters

Module – IV **(8 hours)**

Frequency-scan arrays, bandwidth limitation, transmission lines for frequency scan. Radiators and architectures for phased arrays, effect of errors on radiation patens, errors in arrays, adaptive antennas array. General ideas on radar transmitters (RF power sources) and super heterodyne radar receiver, radar displays, scan converter, displexer and receiver protectors.

Text book:

1. Introduction to Radar system (3rd Edition); Merrill L. Skolnik Tata McGraw Hill publishing Ltd.

2nd Semester

Reference books

1. Ridenour, L. N. Radar System Engineering, MIT radiation laboratory series, Vol. I & II, New York: Mc Graw Hill 1047.

2. Krous, J. D. Antennas, 2nd Edition. Mc Graw Hill, 1988

3. Nathanson, F. E. Radar Design Principle, 2nd Edition, Mc Graw Hill, 1991 (N.Y.)

4. Barton, D. K. Modern Radar System Analysis, Norwood, MA: Ar.Tech House, 1988

5. Hansen, R. C. Phased Array Antennas N.Y. John Willey, 1998 (Chap. 5)

2nd Semester

WIRELESS SENSOR NETWORK

Module – I

Introduction to wireless sensor network: Application and Motivation, Network Performance objective, Development of Wireless Sensor Network.

Module – II

Canonical Problem Localization and Tracking: Tracking Multiple Objects, State space decomposition, Data association, Sensor Models, Performance Comparison and Metrics; Networking Sensors: The S MAC Protocol,IEEE 802.15.4 Standard and ZigBee , Routing in sensor network.

Module – III

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Clocks and Communication Delays, Sensor Tasking and Control.Sensor Network Databases: Sensor Database Challenges, Querying The Physical Environment, Query Interfaces.

Module – IV

Cougar sensor database and abstract data types, Probabilistic queries, High level Database Organization, In Network Aggregation, Query propagation and aggregation, TinyDB query processing, Query processing scheduling and optimization, Data Centric Storage. Special topics in wireless sensor networks.

Text books:

1. F. Zhao and L. Guibas, Wireless Sensor Network: Information Processing Approach, Elsevier.
2. E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols: CRC Press.

Reference books:

1. A. Hac, Wireless Sensor Network Designs, John Wiley & Sons

2nd Semester

INDUSTRIAL TELEMATICS

MODULE – I **(11 hours)**

Ethernet and Wireless Network Technologies: Approaches to Enforce Real-Time Behavior in Ethernet, Switched Ethernet in Automation Networking, Wireless LAN Technology for the Factory Floor: Challenges and Approaches, Wireless Local and Wireless Personal Area Network Technologies for Industrial Development.

MODULE – II **(11 hours)**

Linking Factory Floor with the Internet and Wireless Fieldbuses: Linking Factory Floor and the Internet, Extending EIA-709 Control Networks across IP Channels, Interconnection of Wireline and Wireless Fieldbuses. Network Security and Safety Technologies in Industrial Networks: Security Topics and Solutions for Automation Networks, PROFIsafe: Safety Technology with PROFIBUS.

MODULE – III **(6 hours)**

Applications of Networks and Other Technologies: Automotive Communication Technologies, Design of Automotive X-by-Wire Systems, FlexRay Communication Technology, The LIN Standard, Volcano: Enabling Correctness by Design, Networks In Building Automation, The Use of Network Hierarchies in Building Telemetry and Control Applications, EIB: European Installation Bus.

MODULE – IV **(10 hours)**

Fundamentals of LonWorks/EIA-709 Networks: ANSI/EIA-709 Protocol Standard (LonTalk), Manufacturing Message Specification In Industrial Automation, The Standard Message Specification for Industrial Automation Systems: ISO 9506 (MMS), Virtual Factory Communication System Using ISO 9506 and Its Application to Networked Factory Machine, Motion Control, The SERCOS interface™, Train Communication Network, The IEC/IEEE Train Communication Network, Smart Transducer Interface, A Smart Transducer Interface Standard for Sensors and Actuators, Energy Systems, Applying IEC 61375 (Train Communication Network) to Data Communication in Electrical Substations, SEMI, SEMI Interface and Communication Standards: An Overview and Case Study.

2nd Semester

Textbooks:

1. Richard Zurawski, The Industrial Communication Technology Handbook (Industrial Information Technology), Taylor and Francis, (CRC Press), ISA – The Instrumentation, Systems, and Automation Society, 2005, ISBN-10: 0849330777, ISBN-13: 978-0849330773.

Recommended Reading:

1. Richard Zurawski, Integration Technologies for Industrial Automated Systems (Industrial Information Technology), Taylor and Francis, (CRC Press), ISA – The Instrumentation, Systems, and Automation Society, 2006, ISBN-10: 0849392624, ISBN-13: 978-0849392627.

2. Richard Zurawski, The Industrial Information Technology Handbook (Industrial Electronics), Taylor and Francis, (CRC Press), ISA – The Instrumentation, Systems, and Automation Society, 2004, ISBN-10: 0849319854, ISBN-13: 978- 0849319853

2nd Semester

STATISTICAL SIGNAL PROCESSING

Module – 1 **(9 hrs)**

Discrete Random Process: Random Process- Ensemble Average, Gaussian Process, Stationary Process, The Autocorrelation and Autocovariance Matrix, Ergodicity, White Noise, The Power Spectrom, Filtering Random Process, Special Types of Random Process-ARMV Process, AR Process, MA Process, Harmonic Process. [Read Hayes Chapter 3.3.1 – 3.3.8, 3.4, 3.6.1 – 3.6.4] Signal Modeling: Introduction, Stochastic Models- ARMA Models, AR Models, MA Models, Application: Power Spectrum Estimation. [Read Hayes Chapter 4.1, 4.7.1 – 4.7.4]

Module – 2 **(8 hrs)**

Winer Filtering: Introduction, The FIR Wiener Filter- Filtering, Linear Prediction, Noise Cancellation, IIR Wiener Filter- Noncausal IIR Wiener Filter, The Causal IIR Wiener Filter, Causal Wiener Filtering, Causal Linear Prediction, Wiener Deconvolution, Discrete Kalman Filter. [Read Hayes Chapter 7.1, 7.2.1 – 7.2.3, 7.3.1 – 7.3.5, 7.4)

Module – 3 **(10 hrs)**

Spectrum Estimation: Introduction, Nonparametric Method- The Periodogram, Performance of Periodogram. Parametric Methods- AR Spectrum Estimation, MA Spectrum Estimation, ARMA Spectrum Estimation. Frequency EstimationEigendecomposition of the Autocorrelation Matrix, MUSIC. [Read Hayes Chapter 8.1, 8.2.1, 8.2.2, 8.5.1 – 8.5.3, 8.6.1, 8.6.3]

Module – 4 **(11 hrs)**

Adaptive Filtering: Introduction, FIR Adaptive Filters- The Steepest Descent Adaptive Filter, The LMS Algorithm, Convergence of LMS Algorithm, NLMS, Noise Cancellation, LMS Based Adaptive Filter, Channel Equalization, Adaptive Recursive Filter, RLSExponentially Weighted RLS, Sliding Window RLS. [Read Hayes Chapter 9.1, 9.2.1 – 9.2.6, 9.2.9, 9.3, 9.4]

Text Book

1. Monson H. Hayes, Statistical Digital Signal Processing &Modeling, John Wiley & Sons

Reference Books

1. Steven M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hal

2nd Semester

RF AND MIXED-SIGNAL INTEGRATED CIRCUITS

MODULE – I **(13 hours)**

Introduction: Overview of wireless principles, Characteristics of passive IC components – resistors, Capacitors, Inductors, Transformers, Interconnect at RF and high frequencies, Skin effect. Bandwidth Estimation Techniques: Method of open-circuit time constants, Method of short-circuit time constants, Rise time, Delay and Bandwidth. High-frequency Amplifier Design: Zeros as bandwidth enhancers, Shunt-series amplifier, Bandwidth enhancement with fT doublers, Tuned amplifiers, Neutralization and unilateralization, Cascaded amplifiers, AM-PM conversion.

MODULE – II **(13 hours)**

Voltage Reference: Review of diode behavior, Diodes and Bipolar Transistors in CMOS technology, Supply-independent bias circuits, Bandgap voltage reference, Constant-gm bias. Noise: Thermal noise, Short noise, Flicker noise, Popcorn noise, Classical two-port noise theory, Examples of noise calculations. Low-Noise Amplifier (LNA) Design: Derivation of intrinsic MOSFET two-port noise parameters, LNA topologies – Power match Vs. Noise match, Power-constrained noise optimization, Design Example, Linearity and large signal performance, Spurious-free dynamic range.

MODULE – III **(8hours)**

Mixers: Mixer fundamentals, Non-linear systems as linear mixers, Multiplier-based mixers, Sub-sampling mixers, Diode-ring mixers. RF Power Amplifiers: Classes of power amplifiers, RF power amplifier design example, Power amplifier characteristics and Design consideration.

MODULE – IV **(8 hours)**

Phase-Locked Loops (PLL): Introduction to PLL, Linearized PLL models, Some noise properties of PLLs, Phase detectors, Sequential phase detectors, Loop filters and charge pumps, PLL design examples. Oscillators and Synthesizers: Problems with purely linear oscillators, Describing functions, Resonators, Tuned oscillators, Negative resistance oscillators, Frequency synthesis.

Textbooks:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd Edn., Cambridge University Press, 2004.
2. 1. E.N. Farag and M.I. Elmasry, Mixed Signal VLSI Wireless Design: Circuits & Systems, Kluwer, 1999.

2nd Semester

EMBEDDED SYSTEM DESIGN

MODULE I

Introduction to Embedded Computing: Terms and scope, Application areas, Growing importance of embedded systems. Specifications: Requirements, Models of computation, State Charts: Modelling of hierarchy, Timers, Edge labels and State Charts semantics, Evaluation and extensions, General language characteristics: Synchronous and asynchronous languages, Process concepts, Synchronization and communication, Specifying timing, Using non-standard I/O devices, SDL, Petri nets: Introduction, Condition/event nets, Place/transition nets, Predicate/transition nets, Evaluation, Message Sequence Charts, UML, Process networks: Task graphs, Asynchronous message passing, Synchronous message passing.

MODULE II

Embedded System Hardware: Introduction, Input: Sensors, Sample-and-hold circuits, A/D-converters, Communication: Requirements, Electrical robustness, Guaranteeing real-time behaviour, Examples, Processing units: Application-Specific Circuits (ASICs), Processors, Reconfigurable Logic, Memories, Output: D/A-converters, Actuators.Standard Software: Embedded Operating Systems, Middleware, and Scheduling: Prediction of execution times, Scheduling in real-time systems: Classification of scheduling algorithms, Aperiodic scheduling, Periodic scheduling, Resource access protocols, Embedded operating systems: General requirements, Real-time operating systems, Middleware: Real-time data bases, Access to remote objects

MODULE III

Implementing Embedded Systems: Hardware/Software Co-design, COOL, Actual design flows and tools: SpecC methodology, IMEC tool flow, The COSYMA design flow, Ptolemy II, The OCTOPUS design flow.Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, Different Phases of EDLC.Overview of PIC and AVR Family of Microcontrollers and ARM Processors .Introduction to PIC and AVR Family of Microcontrollers and ARM Processors

MODULE IV

Basic Features of VHDL: Major Language Constructs, Lexical Description, VHDL Source File, Data Types, Data Objects, Language Statements, Advanced Features of VHDL.Basic VHDL Modelling Techniques: Modelling Delay in VHDL, The VHDL Scheduling Algorithm, Modelling Combinational and

2nd Semester

Sequential Logic.HDL-Based Design Techniques: Design of Combinational Logic Circuits, Design of Sequential Logic Circuits; Modelling for Synthesis: Behavioral Model Development, The Semantics of Simulation and Synthesis, Modelling Sequential Behaviour, Modelling Combinational Circuits for Synthesis, Inferred Latches and Don't Cares, Tristate Circuits

Textbooks:

1. Peter Marwedel, Embedded System Design, Springer, 2006 http://ls12-www.cs.unidortmund.de/~marwedel/kluwer-es-book/

Reference Book:

1. Wayne Wolf, Computers as Components, Morgan Kaufmann, 2001 http://www.ee.princeton.edu/~wolf/embedded-book

2. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software CoDesign, Morgan Kaufmann, Systems-on-Silicon Series Embedded

3. Frank Vahid and Tony D. Givargis, System Design: A Unified Hardware/Software Introduction, Addison Wesley, 2002.

4. Michael Barr, Programming Embedded Systems in C and C++, O'Reilly, 1999.

5. David E. Simon, An Embedded Software Primer, Addison Wesley, 1999.

6. Jack Ganssle, The Art of Designing Embedded Systems, Newnes, 2000.

7. K. Short, Embedded Microprocessor System Design, Prentice Hall, 1998. C. Baron, J. Geffroy and G. Motet, Embedded System Applications, Kluwer, 1997.

2nd Semester

DATA ENCRYPTION AND SECURITY

Module I **(14 Hours)**

Introduction: Security Goals, Attacks, Services and Mechanism, Techniques Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers Modern Symmetric-Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers Data Encryption Standard (DES):Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES, Differential Cryptanalysis, Linear Cryptanalysis of DES

Module II **(12 Hours)**

Advanced Encryption Standard (AES): Introduction, Transformations, Key Expansion, Cipher, Analysis of AES .Message Integrity and Message Authentication: Message integrity, Random Oracle Model, Message authentication. Cryptographic Hash Functions: Introduction, SHA – 512, Whirlpool

Module III **(8 Hours)**

Entity Authentication: Introduction, Passwords, Challenge – response, Zero – knowledge .Key Management: Symmetric – key Distribution, Kerberos, Symmetric – key agreement, Public – key distribution .Security at application layer: E-mail, PGP, S/MIME

Module IV **(8 Hours)**

Security at the Transport layer: SSL architecture, Four protocols, SSL message format, Transport layer security .Security at the network layer: Two modes, two security protocols, security association, security policy, Internet key exchange .

Textbooks:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.2007, ISBN-10 0-07-066046-8:

References

1. Elements of Information Theory, By T.M. Cover &Joy.A.Thomas, 2ndedition, Wiley-Interscience, ISBN-10 0-471-24195-4

2. Cryptography & Network Security: AtulKahate, TMH. 2ndEdition, ISBN-10: 0-07-064823-9

2nd Semester

NETWORK ARCHITECTURE AND DESIGN

Module-I **(10 Hours)**

Introduction: overview of analysis, architecture, and design processes, System description, Service description, service characteristics, performance characteristics, Network supportability. Network Architecture: Component architecture, Reference architecture, Architectural models, System and network architectures.

Module: II **(8 Hours)**

Addressing and routing Architecture: Addressing mechanisms, Routing mechanisms, Addressing strategies, Routing strategies, Architectural considerations.Network Management Architecture: Defining network management, Network management mechanisms, Architectural consideration.

Module: III **(8 Hours)**

Performance Architecture: Goals for performance, Performance mechanisms, Architectural consideration. Security and Privacy Architecture: Security and privacy administration, Security and privacy mechanisms, Architectural consideration.

Module: IV **(14 Hours)**

Designing a Network: LAN specifics, Network type, Ethernet fundamentals .Network operating systems, Hardware considerations, considering the client, choosing a protocol, connectivity devices, WAN technologies, Remote connectivity, Internet connectivity, securing the network.

Text Books:

1. Network Analysis, Architecture and Design, By James D. McCabe, Morgan Kauffmann publishers, 3rdedition, 2003

2. Network Architecture and Design, By J. F. DiMarzio, Sams Publishing, 2001, ISBN : 0-672-32082-7.

2nd Semester

ANTENNA DESIGN & MEASUREMENT

MODULE-I

Antenna parameters and array fundamental: Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization

Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays.

MODULE-II

Antenna Synthesis: Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods Dolph Chebyshev linear array, Taylor line source method.

MODULE-III

Method of Moments : Introduction to method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of antenna and scatter characteristics. CEM for Antennas: Finite Difference Time Domain Method Geometrical Optics Wedge diffraction theory, ray fixed coordinate system, uniform theory of wedge diffraction, E - Plane analysis of Horn antennas. Cylindrical parabolic antenna, radiation by a slot on a finite ground plane, radiation by a monopole on a finite ground plane, equivalent current concepts, multiple diffraction formulation, by curved surfaces, physical optics, method of stationary phase, Physical theory of diffraction, cylindrical parabolic reflector antennas.

MODULE-IV

Measurements of Antenna and design considerations:

Design consideration of different types of antennas: Aperture Antenna: Techniques for evaluating Gain, Reflector Antenna: - Parabolic reflector antenna principles, Axial-symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice, Microwave and optical Metamaterials, Nano antenna, Optical rectenna Antenna, Fractal Antenna, Smart Antenna, Antenna for Space and Medical Applications

2nd Semester

Text Books:

1. Antenna Theory: Analysis and Design, 3rd Edition by Constantine A. Balanis (Author)
2. Antenna Theory by J. D Kraus, TMH Publication.
3. Antenna Theory and Design 2nd Editionby Warren L. Stutzman (Author), Gary A. Thiele (Author)
4. Antennas 3rd Edition by John D. Kraus (Author), Ronald J. Marhefka (Author)

Recommended Books:

1. .Practical Antenna Handbook 4th Edition by Joseph Carr (Author)
2. Cai**,** Wenshan, Shalaev**,** Vladimir, Optical Metamaterials, Fundamentals and Applications (Springer series)

2nd Semester

Wireless and Mobile Communication

Module-I

Evolution of mobile radio communication fundamentals, General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling.

Module-II

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.

Module-III

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

Module-IV

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text Book:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson Publications, Second Edition.
2. Upena Dalal, “Wireless Communication and Networks”, Oxford Press Publications.
3. T L Singal ,“Wireless Communications ”, McGraw Hill Publications.

Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
2. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

2nd Semester

BRANCH-Electronics and Telecommunication Engineering

Specialization: Signal Processing and Communication

Second Semester							
	Theory				Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 Detection and Estimation Theory	4-0	4	100	50	-	-	-
Specialization Core-2 Digital Image and Video Processing	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Fiber-Optics Components and Device 2.Radar and Sonar Signal Processing 3.Biomedical Instrumentation and Signal Processing 4.Digital Filter Design	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2. Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuits 4.VLSI Digital Signal Processing	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Antenna Design & Measurement 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

2nd Semester

DETECTION AND ESTIMATION THEORY

Module 1:

Fundamentals of Detection Theory Hypothesis Testing: Bayes‟ Detection, MAP Detection, ML Detection, Minimum Probability of Error Criterion, Min-Max Criterion, Neyman-Pearson Criterion, Multiple Hypothesis, Composite Hypothesis Testing: Generalized likelihood ratio test (GLRT), Receiver Operating Characteristic Curves.

Module 2:

Unbiased Estimation, Minimum variance unbiased(MVU) estimators, Finding MVU Estimators, Cramer-Rao Lower Bound, Linear Modeling-Examples, Sufficient Statistics, Use of Sufficient Statistics to find the MVU Estimator

Module 3:

Fundamentals of Estimation Theory Role of Estimation in Signal Processing,
Estimation Techniques Deterministic Parameter Estimation: Least Squares Estimation-Batch Processing, Recursive Least Squares Estimation, Best Linear Unbiased Estimation,

Module 4:

Likelihood and Maximum Likelihood Estimation Random Parameter Estimation: Bayesian Philosophy, Selection of a Prior PDF, Bayesian linear model, Minimum Mean Square Error Estimator, Maximum a Posteriori Estimation State Estimation: Prediction, Single and Multistage Predictors, Filtering, TheKalman Filter

References:

1. M D Srinath, P K Rajasekaran, R Viswanathan, Introduction to Statistical Signal Processing with Applications, “Pearson”

2. Steven M. Kay, “Statistical Signal Processing: Vol. 1: Estimation Theory, Vol. 2: Detection Theory," Prentice Hall Inc., 1998.

3. Jerry M. Mendel, “Lessons in Estimation Theory for Signal Processing, Communication and Control," Prentice Hall Inc., 1995

4. Ralph D. Hippenstiel, “Detection Theory- Applications and Digital Signal Processing”, CRC Press, 2002.

5. Bernard C. Levy, “Principles of Signal Detection and Parameter Estimation”, Springer, New York, 2008.

6. Harry L. Van Trees, “Detection, Estimation and Modulation Theory, Part 1 and 2," John Wiley & Sons Inc. 1968.

7. Neel A. Macmillan and C. Douglas Creelman, “Detection Theory: A User's Guide (Sec. Edn.)” Lawrence Erlbaum Associates Publishers, USA, 2004.

8. Monson H. Hayes, “Statistical Digital Signal Processing and Modelling," John Wiley & Sons Inc., 1996.

2nd Semester

DIGITAL IMAGE AND VIDEO PROCESSING

Module I **(10 Hrs)**

Image representation: Gray scale and colour Images, image sampling and quantization. Two dimensional orthogonal transforms: DFT, WHT, Haar transform, KLT, DCT. Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Edge detection - non parametric and model based approaches, LOG filters, localisation problem.

Module II **(10 Hrs)**

Image Restoration: Degradation Models, PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.

Image Segmentation: Pixel classification, Bi-level thresholding, Multi-level thresholding, P-tile method, Adaptive thresholding, Spectral & spatial classification, Edge detection, Hough transform, Region growing.

Module III **(8 Hrs)**

Image compression: Fundamental concepts of image compression - Compression models - Information theoretic perspective - Fundamental coding theorem - Lossless Compression: Huffman Coding- Arithmetic coding - Bit plane coding - Run length coding - Lossy compression: Transform coding - Image compression standards.

Module IV: **(10 Hrs)**

Video Processing: Representation of Digital Video, Spatio-temporal sampling; Motion Estimation; Video Filtering; Video Compression, Video coding standards.

Texts/References

1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.

2nd Semester

2. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education. II Ed.,2002

3. W. K. Pratt, Digital image processing, Prentice Hall, 1989

4. A. Rosenfold and A. C. Kak, Digital image processing, Vols. 1 and 2, Prentice Hall, 1986.

5. H. C. Andrew and B. R. Hunt, Digital image restoration, Prentice Hall, 1977

6. R. Jain, R. Kasturi and B.G. Schunck, Machine Vision, McGraw-Hill International Edition, 1995

7. A. M. Tekalp, Digital Video Processing , Prentice-Hall, 1995

8. A. Bovik, Handbook of Image & Video Processing, Academic Press, 2000

2nd Semester

FIBER-OPTICS COMPONENTS AND DEVICE

MODULE – I

Fibre-Optic Light Sources and Detectors Brief description on the principle of optical sources, Internal Quantum efficiency of LED, Modulation capability, Power-Bandwidth product, Laser diodes, Laser diode modes, Threshold conditions, Resonant frequencies, Laser diode structures, Single mode lasers, modulation of laser diodes.

MODULE – II

Brief description on the principle of optical detectors, photodetector noise, Noise sources, Signal-to-Noise ratio, Detector response time, Depletion layer photocurrent, Response time, Avalanche multiplication noise.

Optical Fibre Connection Joint loss, Multi mode fibre joints, Singe mode fibre joints, Fibre splices,Fusion splices, Mechanical splices, Multiple splices, Fibre connectors

MODULE – III

,Cylindrical ferrule connectors, Biconical ferrule connectors, Double eccentricconnectors, Duplex fibre connectors, Expanded beam connectors, Fibre couplers, Three port couplers, Four port couplers, Star couplers, WDMcouplers.

Optical Amplification and Integrated Optics ptical amplifiers, Semiconductor laser amplifiers, Fibre amplifiers, Rare earthdoped fibre amplifiers, Raman fibre amplifiers, Brillouin fibre amplifiers

MODULE – IV

Integrated optics, Integrated optical devices, Beam splitters, Directional couplers, switches, Modulators, Periodic structures for filters and injectionlasers, Opto-electronic integration, Optical bistability and digital optics, Optical omputation.

Textbooks:

1. G. Kei ser, Optical Fibre Communications, Mc-Graw-Hill.

2. J.M.Senior, Optical Fibre Communications Principles and Practice, PHI.

2nd Semester

RADAR AND SONAR SIGNAL PROCESSING

Module I:

Introduction to Radar Systems Introduction: History and applications of radar, basic radar functions, elements of pulsed radar, review of selected signal processing concepts and operations. A preview of basic radar signal processing.

Signal Models: Components of a radar signal, amplitude models, clutter, noise model and signal to noise ratio, jamming, frequency models, spatial models, spectral model.

Module II:

Sampling and Quantization of Pulsed Radar Signals: Domains and criteria for sampling radar signals. Sampling in the fast time domain, sampling in slow time domain, sampling the Doppler spectrum. Sampling in the spatial and angle dimensions, quantization.

Module III:

Doppler Processing & Detection Alternate forms of Doppler spectrum, Moving Target Indication (MIT), pulse Doppler processing, pulse pair processing, clutter mapping and the moving target detector. Radar detection as hypothesis testing, Threshold detection in coherent systems, Threshold detection of radar signals, binary integration.

Module IV:

Overview of sonar systems Sonar Basics: Propagation of sound in the ocean, noise in the ocean. Analysis of Sonar Signals: The sonar equation, signal/noise considerations, Generation of underwater sound, Nonlinear effect of depth Detection of Sonar signals: Threshold concept, Various types of detector, Typical problems in detection of sonar signals, Adaptive digital filters, Digital Doppler nullification

Text Books:

1. Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw-Hill, 2005.

2. Fred E.Nathanson, "Radar Design Principles", 2nd Edition, Prentice-Hall of India, New Delhi, 2004.

3. Fracois Le Chevalier, "Principles of Radar and Sonar Signal Processing", ARTECH House, 2002.

Reference Books:

1. Byron Edde, “Radar Principles, Technology, Applications”, Prentice-Hall of India

2. Peyton Z.Peebles, “Radar Principles”,Jr. John-Wiley & Sons Inc., 2004.

3. Roger J.Sullivan, “Radar Foundations for Imaging and Advanced Concepts”, Prentice-Hall of India, New Delhi-2004.

4. R.Urick: Principles of under water sound, McGraw Hill, 1983

5. A.D.Waite: Sonar for Practicing Engineers, 2002.

2nd Semester

BIOMEDICAL INSTRUMENTATION & SIGNAL PROCESSING

MODULE – I **(10 hours)**

Introduction: Cell structure, basic cell function, origin of bio-potentials, electric activity of cells. Biotransducers: Physiological parameters and suitable transducers for its measurements, operating principles and specifications for the transducers to measure parameters like blood flow, blood pressure, electrode sensor, temperature, displacement transducers.

MODULE – II **(10 hours)**

Cardiovascular system: Heart structure, cardiac cycle, ECG (electrocardiogram) theory (B.D.), PCG (phonocardiogram). EEG, X-Ray, Sonography, CT-Scan,The nature of biomedical signals. Analog signal processing of Biosignals: Amplifiers, Transient Protection, Interference Reduction, Movement Artifact Circuits, Active filters, Rate Measurement. Averaging and Integrator Circuits, Transient Protection circuits.

MODULE – III **(8 hours)**

Time-frequency representations: Introduction, Short-time Fourier transform, spectrogram, wavelet signal decomposition. Biomedical applications: Fourier, Laplace and z-transforms, autocorrelation, crosscorrelation, power spectral density.

MODULE – IV **(8 hours)**

Noise: Different sources of noise, Noise removal and signal compensation. Software based medical signal detection and pattern recognition.

TextBooks:

1. R S Kandpur, Handbook of Biomedical Instrumentation, 2nd Edn, TMH Publication, 2003

2. E. N. Bruce, Biomedical Signal Processing and Signal Modelling, John Wiley, 2001.

References

1. Wills J. Tompkins, Biomedical Digital Signal Processing, PHI.

2. M. Akay, Time Frequency and Wavelets in Biomedical Signal Processing, IEEE Press, 1998.

3. Cromwell, Biomedical Instrumentation and Measurements, 2nd Edn, Pearson Education.

2nd Semester

DIGITAL FILTER DESIGN

MODULE – I

Transforms: Discrete-time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT), Modified DCT (MDCT).

MODULE – II

Discrete Time systems: linear and circular convolution, overlap add, overlap save, stability triangle, allpass filters, group delay, minimum phase systems.

MODULE – III

FIR filter design: windowing, remez exchange algorithm for optimal design. IIR filter design: bilinear transformation, spectral transformations, optimal filter design. Filter implementation: coefficient quantisation, lattice filters.

MODULE – IV

Multirate signal processing: sample rate conversion, polyphase filters, Farrow filters. Subband processing, STFT processing, MDCT-based processing.

Textbooks

1. "Digital Signal Processing" by Sanjit K. Mitra, 4th edition, McGraw Hill, 2011. ISBN 0071289461.

Reference books

1. “Multirate Signal Processing” by Fred Harris, Prentice Hall, ISBN:0137009054 2. C.S. Lindquist, Adaptive & Digital Signal Processing, Steward & Sons, CA, 1989.

2nd Semester

ADVANCED TECHNIQUES IN DSP

MODULE – I

Multi-rate Digital Signal Processing: Decimation by a factor D, interpolation by a factor 1, sampling rate conversion by a national factor I/D.

MODULE – II

Sampling rate conversion of band pass signals. Implementation of low pass filter and digital filter banks. ; lattice filters, Linear prediction, forward and backward linear prediction, FIR wiener filter.

MODULE – III

Power spectrum estimation, non-parametric method Barlett, Parametric method. ; Yule-Walker MA and ARMA models. Higher order statistics and its applications.

MODULE – IV

DSP transforms: Discrete Hartely transform, Discrete consine transform, Discrete Wavelet transform, Stransform. DSP techniques for bioinformatics., recent topics

Text Book

1. J.G. Proakis, D.G. Manolakis, Digital Signal Processing, PHI, New Delhi, 1995.

2. S.J. Orfanidis, Optimum Signal Processing, Mac Millan Publishing Co., USA, 1985.

Reference Book

1. C.K. Chui, An Introduction to Wavelets,Academic Press, USA, 1992.

2. Guoan Bi and Y. Zeng, Transforms and Fast Algorithms for signal analysis and representations, Springer, NY, USA, 2003.

2nd Semester

STATISTICAL SIGNAL PROCESSING

Module – 1 **(9 hrs)**

Discrete Random Process: Random Process- Ensemble Average, Gaussian Process, Stationary Process, The Autocorrelation and Autocovariance Matrix, Ergodicity, White Noise, The Power Spectrom, Filtering Random Process, Special Types of Random Process-ARMV Process, AR Process, MA Process, Harmonic Process. [Read Hayes Chapter 3.3.1 – 3.3.8, 3.4, 3.6.1 – 3.6.4] Signal Modeling: Introduction, Stochastic Models- ARMA Models, AR Models, MA Models, Application: Power Spectrum Estimation. [Read Hayes Chapter 4.1, 4.7.1 – 4.7.4]

Module – 2 **(8 hrs)**

Winer Filtering: Introduction, The FIR Wiener Filter- Filtering, Linear Prediction, Noise Cancellation, IIR Wiener Filter- Noncausal IIR Wiener Filter, The Causal IIR Wiener Filter, Causal Wiener Filtering, Causal Linear Prediction, Wiener Deconvolution, Discrete Kalman Filter. [Read Hayes Chapter 7.1, 7.2.1 – 7.2.3, 7.3.1 – 7.3.5, 7.4)

Module – 3 **(10 hrs)**

Spectrum Estimation: Introduction, Nonparametric Method- The Periodogram, Performance of Periodogram. Parametric Methods- AR Spectrum Estimation, MA Spectrum Estimation, ARMA Spectrum Estimation. Frequency EstimationEigendecomposition of the Autocorrelation Matrix, MUSIC. [Read Hayes Chapter 8.1, 8.2.1, 8.2.2, 8.5.1 – 8.5.3, 8.6.1, 8.6.3]

Module – 4 **(11 hrs)**

Adaptive Filtering: Introduction, FIR Adaptive Filters- The Steepest Descent Adaptive Filter, The LMS Algorithm, Convergence of LMS Algorithm, NLMS, Noise Cancellation, LMS Based Adaptive Filter, Channel Equalization, Adaptive Recursive Filter, RLSExponentially Weighted RLS, Sliding Window RLS. [Read Hayes Chapter 9.1, 9.2.1 – 9.2.6, 9.2.9, 9.3, 9.4]

Text Book

1. Monson H. Hayes, Statistical Digital Signal Processing & Modeling, John Wiley & Sons

Reference Books

1. Steven M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall.

2nd Semester

RF AND MIXED-SIGNAL INTEGRATED CIRCUITS

MODULE – I **(13 hours)**

Introduction: Overview of wireless principles, Characteristics of passive IC components – resistors, Capacitors, Inductors, Transformers, Interconnect at RF and high frequencies, Skin effect. Bandwidth Estimation Techniques: Method of open-circuit time constants, Method of short-circuit time constants, Rise time, Delay and Bandwidth. High-frequency Amplifier Design: Zeros as bandwidth enhancers, Shunt-series amplifier, Bandwidth enhancement with fT doublers, Tuned amplifiers, Neutralization and unilateralization, Cascaded amplifiers, AM-PM conversion.

MODULE – II **(13 hours)**

Voltage Reference: Review of diode behavior, Diodes and Bipolar Transistors in CMOS technology, Supply-independent bias circuits, Bandgap voltage reference, Constant-gm bias. Noise: Thermal noise, Short noise, Flicker noise, Popcorn noise, Classical two-port noise theory, Examples of noise calculations. Low-Noise Amplifier (LNA) Design: Derivation of intrinsic MOSFET two-port noise parameters, LNA topologies – Power match Vs. Noise match, Power-constrained noise optimization, Design Example, Linearity and large signal performance, Spurious-free dynamic range.

MODULE – III **(8hours)**

Mixers: Mixer fundamentals, Non-linear systems as linear mixers, Multiplier-based mixers, Sub-sampling mixers, Diode-ring mixers.RF Power Amplifiers: Classes of power amplifiers, RF power amplifier design example, Power amplifier characteristics and Design consideration.

MODULE – IV **(8 hours)**

Phase-Locked Loops (PLL): Introduction to PLL, Linearized PLL models, Some noise properties of PLLs, Phase detectors, Sequential phase detectors, Loop filters and charge pumps, PLL design examples. Oscillators and Synthesizers: Problems with purely linear oscillators, Describing functions, Resonators, Tuned oscillators, Negative resistance oscillators, Frequency synthesis.

2nd Semester

Textbooks:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd Edn., Cambridge University Press, 2004.

Recommended Reading:

1. E.N. Farag and M.I. Elmasry, Mixed Signal VLSI Wireless Design: Circuits & Systems, Kluwer, 1999.

2nd Semester

VLSI DIGITAL SIGNAL PROCESSING

MODULE – I

Introduction to DSP System: Typical DSP algorithms, DSP application demands and scaled CMOS technology, Representation of DSP algorithms.Iteration Bound: Data-flow graph representations, Loop bound and iterartion bound, Algorithms for computing iteration bound, Iteration bound of multirate data-flow graphs. Pipelining and Parallel Processing: Pipelining of FIR digital filters, Parallel processing, Pipelining and parallel processing for low power.

MODULE – II

Retiming: Definitions and properties, Solving systems of inequalities, Retiming techniques. Unfolding: An algorithm for unfolding, Properties of unfolding, Critical path, unfolding and retiming, Applications of unfolding.

MODULE – III

Folding: Folding transformation, Register minimization techniques, Register minimization in folding architectures, Folding of multirate systems.Systolic Architecture Design: Systolic array design methodology, FIR systolic arrays, Selection of scheduling vector, Matrix-matrix multiplication and 2D systolic array design, Systolic design for space representations containing delays.

MODULE – IV

Bit-Level Arithmetic Architecture: Parallel multipliers, Interleaved floor-plan and bit-plane-based digital filters, Bit-serial multipliers, Bit-serial filter design and implementation, Canonic signed digit arithmetic, Distributed arithmetic. Programmable Digital Signal Processors: Evolution of programmable digital signal processors, Important features of DSP processors, DSP processors for mobile and wireless communications, Processors for multimedia signal processing.

2nd Semester

Textbooks:

1. K. K. Parhi, VLSI Digital Signal Processing Systems, Design and Implementation, Wiley India Pvt. Ltd., New Delhi

Recommended Reading:

1. K.P. Keshab, VLSI Digital Signal Processing Systems: Design and Implementation, Jacaranda Wiley, 1999.

2. Richard J, Higgins, Digital Signal Processing in VLSI, Prentice Hall, ISBN-10: 013212887X, ISBN-13: 9780132128872

2nd Semester

DATA ENCRYPTION AND SECURITY

Module I **(14 Hours)**

Introduction: Security Goals, Attacks, Services and Mechanism, Techniques Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers Modern Symmetric-Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers Data Encryption Standard (DES):Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES, Differential Cryptanalysis, Linear Cryptanalysis of DES

Module II **(12 Hours)**

Advanced Encryption Standard (AES): Introduction, Transformations, Key Expansion, Cipher, Analysis of AES Message Integrity and Message Authentication: Message integrity, Random Oracle Model, Message authentication. Cryptographic Hash Functions: Introduction, SHA – 512, Whirlpool

Module III **(8 Hours)**

Entity Authentication: Introduction, Passwords, Challenge – response, Zero – knowledge .Key Management: Symmetric – key Distribution, Kerberos, Symmetric – key agreement, Public – key distribution.Security at application layer: E-mail, PGP, S/MIME

Module IV **(8 Hours)**

Security at the Transport layer: SSL architecture, Four protocols, SSL message format, Transport layer security Security at the network layer: Two modes, two security protocols, security association, security policy, Internet key exchange

Textbooks:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.2007, ISBN-10 0-07-066046-8:

Reference Books

1. Elements of Information Theory, By T.M. Cover &Joy.A.Thomas, 2ndedition, Wiley-Interscience, ISBN-10 0-471-24195-4

2. Cryptography & Network Security: AtulKahate, TMH. 2ndEdition, ISBN-10: 0-07-064823-9

2nd Semester

NETWORK ARCHITECTURE AND DESIGN

Module-I **(10 Hours)**

Introduction: overview of analysis, architecture, and design processes, System description, Service description, service characteristics, performance characteristics, Network supportability. Network Architecture: Component architecture, Reference architecture, Architectural models, System and network architectures.

Module: II **(8 Hours)**

Addressing and routing Architecture: Addressing mechanisms, Routing mechanisms, Addressing strategies, Routing strategies, Architectural considerations.Network Management Architecture: Defining network management, Network management mechanisms, Architectural consideration.

Module: III **(8 Hours)**

Performance Architecture: Goals for performance, Performance mechanisms, Architectural consideration. Security and Privacy Architecture: Security and privacy administration, Security and privacy mechanisms, Architectural consideration.

Module: IV **(14 Hours)**

Designing a Network: LAN specifics, Network type, Ethernet fundamentals Network operating systems, Hardware considerations, considering the client, choosing a protocol, connectivity devices, WAN technologies, Remote connectivity, Internet connectivity, securing the network.

Text Books:

1. Network Analysis, Architecture and Design, By James D. McCabe, Morgan Kauffmann publishers, 3rdedition, 2003

2. Network Architecture and Design, By J. F. DiMarzio, Sams Publishing, 2001, ISBN : 0-672-32082-7.

2nd Semester

ANTENNA DESIGN & MEASUREMENT

MODULE-I

Antenna parameters and array fundamental: Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization

Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays.

MODULE-II

Antenna Synthesis: Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods Dolph Chebyshev linear array, Taylor line source method.

MODULE-III

Method of Moments : Introduction to method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of antenna and scatter characteristics. CEM for Antennas: Finite Difference Time Domain Method Geometrical Optics Wedge diffraction theory, ray fixed coordinate system, uniform theory of wedge diffraction, E - Plane analysis of Horn antennas. Cylindrical parabolic antenna, radiation by a slot on a finite ground plane, radiation by a monopole on a finite ground plane, equivalent current concepts, multiple diffraction formulation, by curved surfaces, physical optics, method of stationary phase, Physical theory of diffraction, cylindrical parabolic reflector antennas.

MODULE-IV

Measurements of Antenna and design considerations:

Design consideration of different types of antennas: Aperture Antenna: Techniques for evaluating Gain, Reflector Antenna: - Parabolic reflector antenna principles, Axial-symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice, Microwave and optical Metamaterials, Nano antenna, Optical rectenna Antenna, Fractal Antenna, Smart Antenna, Antenna for Space and Medical Applications

2nd Semester

Text Books:

1. Antenna Theory: Analysis and Design, 3rd Edition by Constantine A. Balanis (Author)
2. Antenna Theory by J. D Kraus, TMH Publication.
3. Antenna Theory and Design 2nd Editionby Warren L. Stutzman (Author), Gary A. Thiele (Author)
4. Antennas 3rd Edition by John D. Kraus (Author), Ronald J. Marhefka (Author)

Recommended Reading:

1. .Practical Antenna Handbook 4th Edition by Joseph Carr (Author)
2. Cai**,** Wenshan, Shalaev**,** Vladimir, Optical Metamaterials, Fundamentals and Applications (Springer series)

2nd Semester

WIRELESS AND MOBILE COMMUNICATION

Module-I

Evolution of mobile radio communication fundamentals, General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling.

Module-II

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.

Module-III

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

Module-IV

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text Book:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson Publications, Second Edition.

2. Upena Dalal, “Wireless Communication and Networks”, Oxford Press Publications.

3. T L Singal ,“Wireless Communications ”, McGraw Hill Publications.

Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.

2. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

2nd Semester

BRANCH-Electronics and Telecommunication Engineering

Specialization: Signal Processing and Engineering

Second Semester							
	Theory				Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 DSP Algorithm and Architectures	4-0	4	100	50	-	-	-
Specialization Core-2 Digital Image and Video Processing	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Array Signal Processing 2.Multirate Signal Processing 3. Biomedical instrumentation & Signal Processing 4. Speech and Audio Signal Processing	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2.Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuits 4. Embedded System Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Bio-MEMS and Nanotechnology 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

2nd Semester

DSP ALGORITHM AND ARCHITECTURES

Module I: (20 hours)

DSP Algorithm & Architecture Design DSP representations (data-flow, control-flow, and signal-flow graphs, block diagrams),fixed-point DSP design (A/D precision, coefficient quantization, round-off and scaling),filter structures (recursive, nonrecursive and lattice), algorithmic simulations of DSP systems in C , behavioralmodeling in HDL. System modeling and performance measures. Fast filtering algorithms (Winograd's, FFT, short- length FIR), retiming and pipelining, block processing, folding, distributed arithmetic architectures, VLSI performance measures (area, power, and speed), structural modeling in VHDL.

Module II: (8 hours)

Analog signal processing for fast operation.Impact of nonideal characteristics of analog functional blocks on the system performance.DSP Module Synthesis Distributed arithmetic (DA).Advantageous of using DA?Size reduction of look-up tables. Canonic signed digit arithmetic.

Module III: (16 hours)

Implementation of elementary functions Table-oriented methods.Polynomial approximation Random number generators. Linear feedback shift register. High performance arithmetic unit architectures (adders, multipliers, dividers), bit-parallel, bit-serial, digit-serial, carry-save architectures, redundant number system, modeling for synthesis in HDL, synthesis place-and-route.Parallel algorithms and their dependence Applications to some common DSP algorithms.System timing using the scheduling vector.

Module III: (12 hours)

Projection of the dependence graph using a projection direction. The delay operator and z-transform techniques for mapping DSP algorithms onto processor arrays.Algebraic technique for mapping algorithms.The computation domain.The dependence matrix of a variable.The scheduling and projection functions.Data broadcast and pipelining. Applications using common DSP algorithms.

Reference Books

1. Digital Signal Processors: Architectures, Implementations, and Applications SenM.Kuo ,Woon-Seng S. Gan Prentice Hall 2004

2. VLSI Signal Processing Systems, Design and Implementation.Keshab K. Parhi, John Wiley & Sons,1999.

2nd Semester

3. Digital Signal Processing with Field Programmable Gate Array, Uwe Meyer-Baese, Springer- Verlag 2001

4. DSP Principles, Algorithms and Applications, John G. Proakis , Dimitris Manolakis K - Prentice Hall 1995

5. Architectures for Digital Signal Processing, Pirsch, John Wiley and Sons, 1998.

6. DSP Integrated Circuits, Lars Wanhammar, Academic Press, 1999

7. Computer Arithmetic: Algorithms and Hardware Designs, Parhami, Behrooz, Oxford University Press, 2000

8. Computer Arithmetic Algorithms, Israel Koren, A. K. Peters, Natick, MA, 2002

2nd Semester

DIGITAL IMAGE AND VIDEO PROCESSING

Module I **(10 Hrs)**

Image representation: Gray scale and colour Images, image sampling and quantization. Two dimensional orthogonal transforms: DFT, WHT, Haar transform, KLT, DCT. Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Edge detection - non parametric and model based approaches, LOG filters, localisation problem.

Module II **(10 Hrs)**

Image Restoration: Degradation Models, PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods. Image Segmentation: Pixel classification, Bi-level thresholding, Multi-level thresholding, P-tile method, Adaptive thresholding, Spectral & spatial classification, Edge detection, Hough transform, Region growing.

Module III **(8 Hrs)**

Image compression: Fundamental concepts of image compression - Compression models - Information theoretic perspective - Fundamental coding theorem - Lossless Compression: Huffman Coding- Arithmetic coding - Bit plane coding - Run length coding - Lossy compression: Transform coding - Image compression standards.

Module IV: **(10 Hrs)**

Video Processing: Representation of Digital Video, Spatio-temporal sampling; Motion Estimation; Video Filtering; Video Compression, Video coding standards.

Texts/References

1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education. II Ed.,2002
3. W. K. Pratt, Digital image processing, Prentice Hall, 1989
4. A. Rosenfold and A. C. Kak, Digital image processing, Vols. 1 and 2, Prentice Hall, 1986.
5. H. C. Andrew and B. R. Hunt, Digital image restoration, Prentice Hall, 1977
6. R. Jain, R. Kasturi and B.G. Schunck, Machine Vision, McGraw-Hill International Edition, 1995
7. A. M. Tekalp, Digital Video Processing , Prentice-Hall, 1995
8. A. Bovik, Handbook of Image & Video Processing, Academic Press, 2000

2nd Semester

ARRAY SIGNAL PROCESSING

Module I : **(10 hours)**

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

Module II : **(8 hours)**

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

Module III : **(8 hours)**

Spatial Frequency:Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum.Spatial Domain Filtering.BeamForming.Spatially white signal.

Module IV : **(12 hours)**

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

Text book:

1. Dan E. Dugeon and Don H. Johnson. (1993). Array Signal Processing: Concepts and Techniques. Prentice Hall.

2. PetreStoica and Randolph L. Moses. (2005, 1997) Spectral Analysis of Signals. Prentice Hall. 3. Bass J, McPheeters C, Finnigan J, Rodriguez E. Array Signal Processing [Connexions Web site]. February 8, 2005. Available at: http://cnx.rice.edu/content/col10255/1.3/

2nd Semester

MULTIRATE SIGNAL PROCESSING

Module 1: **(10 hours)**

The sampling theorem - sampling at subnyquist rate - Basic Formulations and schemes. Basic Multirate operations- Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Polyphase representation Maximally decimated filter banks: Polyphase representation

Module II: **(12 hours)**

Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank .Uniform band and non uniform filter bank - tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity

Module II: **(8 hours)**

Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property.Quantization Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling.

Module III: **(8 hours)**

Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase distortion- Closed form expression- Polyphase structure- PR Systems

Text Books

1. P.P. Vaidyanathan. “Multirate systems and filter banks.” Prentice Hall. PTR. 1993.
2. N.J. Fliege. “Multirate digital signal processing .” John Wiley 1994.

Reference Books

1. Sanjit K. Mitra. “ Digital Signal Processing: A computer based approach.” McGraw Hill. 1998.
2. R.E. Crochiere. L. R. “Multirate Digital Signal Processing”, Prentice Hall. Inc.1983.
3. J.G. Proakis. D.G. Manolakis. “Digital Signal Processing: Principles. Algorithms and Applications”,3rdEdn. Prentice Hall India, 1999.

2nd Semester

BIOMEDICAL INSTRUMENTATION & SIGNAL PROCESSING

MODULE – I **(10 hours)**

Introduction: Cell structure, basic cell function, origin of bio-potentials, electric activity of cells. Biotransducers: Physiological parameters and suitable transducers for its measurements, operating principles and specifications for the transducers to measure parameters like blood flow, blood pressure, electrode sensor, temperature, displacement transducers.

MODULE – II **(10 hours)**

Cardiovascular system: Heart structure, cardiac cycle, ECG (electrocardiogram) theory (B.D.), PCG (phonocardiogram). EEG, X-Ray, Sonography, CT-Scan,The nature of biomedical signals. Analog signal processing of Biosignals: Amplifiers, Transient Protection, Interference Reduction, Movement Artifact Circuits, Active filters, Rate Measurement. Averaging and Integrator Circuits, Transient Protection circuits.

MODULE – III **(8 hours)**

Time-frequency representations: Introduction, Short-time Fourier transform, spectrogram, wavelet signal decomposition.Biomedical applications: Fourier, Laplace and z-transforms, autocorrelation, crosscorrelation, power spectral density.

MODULE – IV **(8 hours)**

Noise: Different sources of noise, Noise removal and signal compensation.Software based medical signal detection and pattern recognition.

TextBooks:

1. R S Kandpur, Handbook of Biomedical Instrumentation, 2nd Edn, TMH Publication, 2003

2. E. N. Bruce, Biomedical Signal Processing and Signal Modelling, John Wiley, 2001.

References

1. Wills J. Tompkins, Biomedical Digital Signal Processing, PHI.

2. M. Akay, Time Frequency and Wavelets in Biomedical Signal Processing, IEEE Press, 1998. 3. Cromwell, Biomedical Instrumentation and Measurements, 2nd Edn, Pearson Education.

2nd Semester

SPEECH & AUDIO SIGNAL PROCESSING

Module I **(11hrs)**

Digital models for the speech signal - mechanism of speech production - acoustic theory - lossless tube models - digital models - linear prediction of speech - auto correlation - formulation of LPC equation -solution of LPC equations - Levinson Durbin algorithm - Levinson recursion - Schur algorithm – lattice formulations and solutions - PARCOR coefficients - Spectral analysis of speech - Short Time Fourier analysis- filter bank design. Auditory Perception: Psychoacoustics- Frequency Analysis and Critical Bands – Maskingproperties of human ear:

Module II **(10hrs)**

Speech coding -subband coding of speech - transform coding - channel vocoder - formant vocoder– cepstralvocoder - vector quantizer coder- Linear predictive Coder. Speech synthesis - pitch extraction algorithms -gold rabiner pitch trackers - autocorrelation pitch trackers - voice/unvoiced detection - homomorphic speechprocessing - homomorphic systems for convolution - complex cepstrums

Module II **(10hrs)**

Pitch extraction usinghomomorphic speech processing. Sound Mixtures and Separation - CASA, ICA & Model based separation. Speech Transformations - Time Scale Modification - Voice Morphing. Automatic speech recognition systemsisolated word recognition - connected word recognition -large vocabulary word recognition systems -pattern classification - DTW, HMM - speaker recognition systems - speaker verification systems – speakeridentification Systems.

Module III **(11 hrs)**

Audio Processing: Non speech and Music Signals - Modeling -Differential, transform and subband coding ofaudio signals & standards - High Quality Audio coding using Psychoacoustic models - MPEG Audio codingstandard. Music Production - sequence of steps in a bowed string instrument - Frequency responsemeasurement of the bridge of a violin. Audio Data bases and applications - Content based retrieval.

2nd Semester

Text books:

1. Thomas F. Quatieri , "Discrete-time Speech Signal Processing: Principles and Practice" Prentice Hall, Signal Processing Series.

2. Ben Gold & Nelson Morgan , " Speech and Audio Signal Processing", John Wiley & Sons, Inc.

Reference books:

1. A. M. Kondoz, "Digital Speech: Coding for Low Bit Rate Communication Systems

2. Rabiner L.R. & Schafer R.W., "Digital Processing of Speech Signals", Prentice Hall Inc.

3. O'Shaughnessy, D. "Speech Communication, Human and Machine". Addison-Wesley.

4. Dr.Shaila D. Apte, "Speech And Audio Processing, Willy India.

5. Deller, J., J. Proakis, and J. Hansen. "Discrete-Time Processing of Speech Signals." Macmillan.

6. Owens F.J., "Signal Processing of Speech", Macmillan New Electronics

7. Saito S. & Nakata K., "Fundamentals of Speech Signal Processing", Academic Press, Inc.

8. Papamichalis P.E., "Practical Approaches to Speech Coding", Texas Instruments, Prentice Hall 9. Rabiner L.R. & Gold, "Theory and Applications of Digital Signal Processing", Prentice Hall of India

2nd Semester

ADVANCED TECHNIQUES IN DSP

MODULE – I

Multi-rate Digital Signal Processing: Decimation by a factor D, interpolation by a factor 1, sampling rate conversion by a national factor I/D.

MODULE – II

Sampling rate conversion of band pass signals. Implementation of low pass filter and digital filter banks. ; lattice filters, Linear prediction, forward and backward linear prediction, FIR wiener filter.

MODULE – III

Power spectrum estimation, non-parametric method Barlett, Parametric method. ; Yule-Walker MA and ARMA models. Higher order statistics and its applications.

MODULE – IV

DSP transforms: Discrete Hartely transform, Discreteconsine transform, Discrete Wavelet transform, Stransform. DSP techniques for bioinformatics., recent topics

Text Book

1. J.G. Proakis, D.G. Manolakis, Digital Signal Processing, PHI, New Delhi, 1995.

2. S.J. Orfanidis, Optimum Signal Processing, Mac Millan Publishing Co., USA, 1985.

Reference Book

1. C.K. Chui, An Introduction to Wavelets,Academic Press, USA, 1992.

2. Guoan Bi and Y. Zeng, Transforms and Fast Algorithms for signal analysis and representations, Springer, NY, USA, 2003.

2nd Semester

STATISTICAL SIGNAL PROCESSING

Module – 1 **(9 hrs)**

Discrete Random Process: Random Process- Ensemble Average, Gaussian Process, Stationary Process, The Autocorrelation and Autocovariance Matrix, Ergodicity, White Noise, The Power Spectrom, Filtering Random Process, Special Types of Random Process-ARMV Process, AR Process, MA Process, Harmonic Process. [Read Hayes Chapter 3.3.1 – 3.3.8, 3.4, 3.6.1 – 3.6.4] Signal Modeling: Introduction, Stochastic Models- ARMA Models, AR Models, MA Models, Application: Power Spectrum Estimation. [Read Hayes Chapter 4.1, 4.7.1 – 4.7.4]

Module – 2 **(8 hrs)**

Winer Filtering: Introduction, The FIR Wiener Filter- Filtering, Linear Prediction, Noise Cancellation, IIR Wiener Filter- Noncausal IIR Wiener Filter, The Causal IIR Wiener Filter, Causal Wiener Filtering, Causal Linear Prediction, Wiener Deconvolution, Discrete Kalman Filter. [Read Hayes Chapter 7.1, 7.2.1 – 7.2.3, 7.3.1 – 7.3.5, 7.4)

Module – 3 **(10 hrs)**

Spectrum Estimation: Introduction, Nonparametric Method- The Periodogram, Performance of Periodogram. Parametric Methods- AR Spectrum Estimation, MA Spectrum Estimation, ARMA Spectrum Estimation. Frequency EstimationEigendecomposition of the Autocorrelation Matrix, MUSIC. [Read Hayes Chapter 8.1, 8.2.1, 8.2.2, 8.5.1 – 8.5.3, 8.6.1, 8.6.3]

Module – 4 **(11 hrs)**

Adaptive Filtering: Introduction, FIR Adaptive Filters- The Steepest Descent Adaptive Filter, The LMS Algorithm, Convergence of LMS Algorithm, NLMS, Noise Cancellation, LMS Based Adaptive Filter, Channel Equalization, Adaptive Recursive Filter, RLSExponentially Weighted RLS, Sliding Window RLS. [Read Hayes Chapter 9.1, 9.2.1 – 9.2.6, 9.2.9, 9.3, 9.4]

Text Book

1. Monson H. Hayes, Statistical Digital Signal Processing &Modeling, John Wiley & Sons

Reference Books

1. Steven M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall.

2nd Semester

RF AND MIXED-SIGNAL INTEGRATED CIRCUITS

MODULE – I **(13 hours)**

Introduction: Overview of wireless principles, Characteristics of passive IC components – resistors, Capacitors, Inductors, Transformers, Interconnect at RF and high frequencies, Skin effect. Bandwidth Estimation Techniques: Method of open-circuit time constants, Method of short-circuit time constants, Rise time, Delay and Bandwidth. High-frequency Amplifier Design: Zeros as bandwidth enhancers, Shunt-series amplifier, Bandwidth enhancement with fT doublers, Tuned amplifiers, Neutralization and unilateralization, Cascaded amplifiers, AM-PM conversion.

MODULE – II **(13 hours)**

Voltage Reference: Review of diode behavior, Diodes and Bipolar Transistors in CMOS technology, Supply-independent bias circuits, Bandgap voltage reference, Constant-gm bias. Noise: Thermal noise, Short noise, Flicker noise, Popcorn noise, Classical two-port noise theory, Examples of noise calculations. Low-Noise Amplifier (LNA) Design: Derivation of intrinsic MOSFET two-port noise parameters, LNA topologies – Power match Vs. Noise match, Power-constrained noise optimization, Design Example, Linearity and large signal performance, Spurious-free dynamic range.

MODULE – III **(8hours)**

Mixers: Mixer fundamentals, Non-linear systems as linear mixers, Multiplier-based mixers, Sub-sampling mixers, Diode-ring mixers. RF Power Amplifiers: Classes of power amplifiers, RF power amplifier design example, Power amplifier characteristics and Design consideration.

MODULE – IV **(8 hours)**

Phase-Locked Loops (PLL): Introduction to PLL, Linearized PLL models, Some noise properties of PLLs, Phase detectors, Sequential phase detectors, Loop filters and charge pumps, PLL design examples. Oscillators and Synthesizers: Problems with purely linear oscillators, Describing functions, Resonators, Tuned oscillators, Negative resistance oscillators, Frequency synthesis.

Textbooks:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd Edn., Cambridge University Press, 2004.

Recommended Reading:

1. E.N. Farag and M.I. Elmasry, Mixed Signal VLSI Wireless Design: Circuits & Systems, Kluwer, 1999.

2nd Semester

EMBEDDED SYSTEM DESIGN

MODULE I

Introduction to Embedded Computing: Terms and scope, Application areas, Growing importance of embedded systems.Specifications: Requirements, Models of computation, State Charts: Modelling of hierarchy, Timers, Edge labels and State Charts semantics, Evaluation and extensions, General language characteristics: Synchronous and asynchronous languages, Process concepts, Synchronization and communication, Specifying timing, Using non-standard I/O devices, SDL, Petri nets: Introduction, Condition/event nets, Place/transition nets, Predicate/transition nets, Evaluation, Message Sequence Charts, UML, Process networks: Task graphs, Asynchronous message passing, Synchronous message passing.

MODULE II

Embedded System Hardware: Introduction, Input: Sensors, Sample-and-hold circuits, A/D-converters, Communication: Requirements, Electrical robustness, Guaranteeing real-time behaviour, Examples, Processing units: Application-Specific Circuits (ASICs), Processors, Reconfigurable Logic, Memories, Output: D/A-converters, Actuators.Standard Software: Embedded Operating Systems, Middleware, and Scheduling: Prediction of execution times, Scheduling in real-time systems: Classification of scheduling algorithms, Aperiodic scheduling, Periodic scheduling, Resource access protocols, Embedded operating systems: General requirements, Real-time operating systems, Middleware: Real-time data bases, Access to remote objects

MODULE III

Implementing Embedded Systems: Hardware/Software Co-design, COOL, Actual design flows and tools: SpecC methodology, IMEC tool flow, The COSYMA design flow, Ptolemy II, The OCTOPUS design flow.Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, Different Phases of EDLC.Overview of PIC and AVR Family of Microcontrollers and ARM Processors .Introduction to PIC and AVR Family of Microcontrollers and ARM Processors

MODULE IV

Basic Features of VHDL: Major Language Constructs, Lexical Description, VHDL Source File, Data Types, Data Objects, Language Statements, Advanced Features of VHDLBasic VHDL Modelling Techniques: Modelling Delay in VHDL, The VHDL Scheduling Algorithm, Modelling Combinational and

2nd Semester

Sequential Logic HDL-Based Design Techniques: Design of Combinational Logic Circuits, Design of Sequential Logic Circuits;Modelling for Synthesis: Behavioral Model Development, The Semantics of Simulation and Synthesis, Modelling Sequential Behaviour, Modelling Combinational Circuits for Synthesis, Inferred Latches and Don't Cares, Tristate Circuits

Textbooks:

1. Peter Marwedel, Embedded System Design, Springer, 2006 http://ls12-www.cs.unidortmund.de/~marwedel/kluwer-es-book/

Reference Book:

1. Wayne Wolf, Computers as Components, Morgan Kaufmann, 2001 http://www.ee.princeton.edu/~wolf/embedded-book

2. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software CoDesign, Morgan Kaufmann, Systems-on-Silicon Series Embedded

3. Frank Vahid and Tony D. Givargis, System Design: A Unified Hardware/Software Introduction, Addison Wesley, 2002.

4. Michael Barr, Programming Embedded Systems in C and C++, O'Reilly, 1999.

5. David E. Simon, An Embedded Software Primer, Addison Wesley, 1999.

6. Jack Ganssle, The Art of Designing Embedded Systems, Newnes, 2000.

7. K. Short, Embedded Microprocessor System Design, Prentice Hall, 1998. C. Baron, J. Geffroy and G. Motet, Embedded System Applications, Kluwer, 1997.

2nd Semester

DATA ENCRYPTION AND SECURITY

Module I **(14 Hours)**

Introduction: Security Goals, Attacks, Services and Mechanism, Techniques Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers Modern Symmetric-Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers Data Encryption Standard (DES):Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES, Differential Cryptanalysis, Linear Cryptanalysis of DES

Module II **(12 Hours)**

Advanced Encryption Standard (AES): Introduction, Transformations, Key Expansion, Cipher, Analysis of AES Message Integrity and Message Authentication: Message integrity, Random Oracle Model, Message authentication. Cryptographic Hash Functions: Introduction, SHA – 512, Whirlpool

Module III **(8 Hours)**

Entity Authentication: Introduction, Passwords, Challenge – response, Zero – knowledge Key Management: Symmetric – key Distribution, Kerberos, Symmetric – key agreement, Public – key distribution Security at application layer: E-mail, PGP, S/MIME

Module IV **(8 Hours)**

Security at the Transport layer: SSL architecture, Four protocols, SSL message format, Transport layer security Security at the network layer: Two modes, two security protocols, security association, security policy, Internet key exchange

Textbooks:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.2007, ISBN-10 0-07-066046-8:

Reference Books:

1. Elements of Information Theory, By T.M. Cover &Joy.A.Thomas, 2ndedition, Wiley-Interscience, ISBN-10 0-471-24195-4

2. Cryptography & Network Security: AtulKahate, TMH. 2ndEdition, ISBN-10: 0-07-064823-9

2nd Semester

NETWORK ARCHITECTURE AND DESIGN

Module-I **(10 Hours)**

Introduction: overview of analysis, architecture, and design processes, System description, Service description, service characteristics, performance characteristics, Network supportability.Network Architecture: Component architecture, Reference architecture, Architectural models, System and network architectures.

Module: II **(8 Hours)**

Addressing and routing Architecture: Addressing mechanisms, Routing mechanisms, Addressing strategies, Routing strategies, Architectural considerations.Network Management Architecture: Defining network management, Network management mechanisms, Architectural consideration.

Module: III **(8 Hours)**

Performance Architecture: Goals for performance, Performance mechanisms, Architectural consideration. Security and Privacy Architecture: Security and privacy administration, Security and privacy mechanisms, Architectural consideration.

Module: IV **(14 Hours)**

Designing a Network: LAN specifics, Network type, Ethernet fundamentals Network operating systems, Hardware considerations, considering the client, choosing a protocol, connectivity devices, WAN technologies, Remote connectivity, Internet connectivity, securing the network.

Text Books:

1. Network Analysis, Architecture and Design, By James D. McCabe, Morgan Kauffmann publishers, 3rdedition, 2003

2. Network Architecture and Design, By J. F. DiMarzio, Sams Publishing, 2001, ISBN : 0-672-32082-7.

2nd Semester

BIO-MEMS AND NANOTECHNOLOGY

Module-I

Mems and Microsystems: Mems and Microsystems-General principles, advantages, materials used properties, Technology involved in MEMS. Fabrication techniques-Lithography- etching- Ion implantation wafer bonding. Integrated processing- Bulk Micro machining- Surface micro machining-coating technology and CVD- LIGA process.

Module-II

Microsensors and Microactuators: Microsensors and Microactuators –working principle, types-pressure sensors, thermal sensors and actuators, piezoelectric crystals-Intelligent materials and structures, Magnetic sensors and actuators- magnetic materials used for MEMS.

Module-III

Mems and Microfluidic System: Principle of MOEMS- light modulator, beam splitter, digital micro mirror device, light detectors and optical switch. Micro fluidic System- Fluid actuation method, dielectrophoresis, micro fluid dispenser, micro needle, micro pumps. Application of BioMEMS: Healthcare, drug delivery, micrototal analysis system detection and measurement methods, electronic nose, biochip.

Module- IV:

Introduction to Nanotechnology: Essence of Nanotech, Nanofying electronics, Properties of nanomaterials, metal nano clusters, semiconductor nano particles, nano composites. Introduction to carbonnano structure, carbon molecules, carbon clusters, nanotubes application.

Nanotechnology for photonics: Photonic crystal 1d,2d,3d,;light propagation in photonic crystal abd fiber, photonic band gap, fiber bragg grating, coupled mode theory, and fiber Bragg grating spectrum. Applications of photonic crystal in optical logic gates , sensing and communication. Applications of fiber grating. Numerical techniques (PWE,FDTD,FEM) to design nanophotonics devices.

Medical Applications of Nanotechnology: Nanotechnology and Biomedicine-Drug synthesis and delivery– Nanobiomedicine and diagnostic-nano fabrication methods-nanomaterials in human body-toxicity in nanomaterials.

Text books:

1. Tai Ram Hsu, “Mems and Microsystems, Design and Manufacture”, McGraw Hill, 2002.
2. Mohamed Gad-el-Hak, “MEMS: Introduction and Fundamentals”, CRC Press, 2005.
3. Neelina H. Malsch, “Biomedical Nanotechnology”, CRC Press, 2005

Reference books:

1. Marc J Madou, “Fundamentals of Microfabrication and Nanotechnology”, CRC Press, 2011.
2. Hari Singh Nalwa, “Encylopedia of Nanoscience and Nanotechnology”, American Scientific Publishers,2004.
3. ELLIS MENG “Biomedical Microsystems”, CRC Press, 2011
4. J. Joannopoulos, S.G. Johnson, J. Winn, R.D. Meade, Photonic Crystals: Molding the Flow of Light, 2nd ed., Princeton University Press, Princeton, 1995

2nd Semester

Wireless and Mobile Communication

Module-I

Evolution of mobile radio communication fundamentals, General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling.

Module-II

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.

Module-III

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

Module-IV

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.
Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text Book:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson Publications, Second Edition.
2. Upena Dalal, “Wireless Communication and Networks”, Oxford Press Publications.
3. T L Singal ,“Wireless Communications ”, McGraw Hill Publications.

Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
2. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

2nd Semester

BRANCH-Electronics and Telecommunication Engineering

Specialization: VLSI & Embedded System Design/ VLSI & Embedded System/ VLSI Design & Embedded System

Second Semester							
Theory					Practical		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 Embedded System Design	4-0	4	100	50	-	-	-
Specialization Core-2 VLSI Fabrication Technology	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Low Power Digital VLSI Design 2.Introduction to Nanoelectronics 3.Microsystems – Principle, Design and Application 4.VLSI Physical Design	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2. Adaptive Signal Processing. 3. RF and Mixed-Signal Integrated Circuits 4. ASIC &SoC Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3. Bio-MEMS and Nanotechnology 4.Wireless and Mobile communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

2nd Semester

EMBEDDED SYSTEM DESIGN

MODULE I

Introduction to Embedded Computing: Terms and scope, Application areas, Growing importance of embedded systems.Specifications:Requirements,Models of computation, State Charts: Modelling of hierarchy, Timers, Edge labels and State Charts semantics, Evaluation and extensions, General language characteristics: Synchronous and asynchronous languages, Process concepts, Synchronization and communication, Specifying timing, Using non-standard I/O devices, SDL, Petri nets: Introduction, Condition/event nets, Place/transition nets, Predicate/transition nets, Evaluation, Message Sequence Charts, UML, Process networks: Task graphs, Asynchronous message passing, Synchronous message passing.

MODULE II

Embedded System Hardware: Introduction, Input: Sensors, Sample-and-hold circuits, A/D-converters, Communication: Requirements, Electrical robustness, Guaranteeing real-time behaviour, Examples, Processing units: Application-Specific Circuits (ASICs), Processors, Reconfigurable Logic, Memories, Output: D/A-converters, Actuators.Standard Software: Embedded Operating Systems, Middleware, and Scheduling: Prediction of execution times, Scheduling in real-time systems: Classification of scheduling algorithms, Aperiodic scheduling, Periodic scheduling, Resource access protocols, Embedded operating systems: General requirements, Real-time operating systems, Middleware: Real-time data bases, Access to remote objects

MODULE III

Implementing Embedded Systems: Hardware/Software Co-design, COOL, Actual design flows and tools: SpecC methodology, IMEC tool flow, The COSYMA design flow, Ptolemy II, The OCTOPUS design flow.Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, Different Phases of EDLC.Overview of PIC and AVR Family of Microcontrollers and ARM Processors.Introduction to PIC and AVR Family of Microcontrollers and ARM Processors

MODULE IV

Basic Features of VHDL: Major Language Constructs, Lexical Description, VHDL Source File, Data Types, Data Objects, Language Statements, Advanced Features of VHDL.Basic VHDL Modelling Techniques: Modelling Delay in VHDL, The VHDL Scheduling Algorithm, Modelling Combinational and

2nd Semester

Sequential Logic.HDL-Based Design Techniques: Design of Combinational Logic Circuits, Design of Sequential Logic Circuits;Modelling for Synthesis: Behavioral Model Development, The Semantics of Simulation and Synthesis, Modelling Sequential Behaviour, Modelling Combinational Circuits for Synthesis, Inferred Latches and Don't Cares, Tristate Circuits

Textbooks:

1. Peter Marwedel, Embedded System Design, Springer, 2006 http://ls12-www.cs.unidortmund.de/~marwedel/kluwer-es-book/

Reference Book:

1. Wayne Wolf, Computers as Components, Morgan Kaufmann, 2001 http://www.ee.princeton.edu/~wolf/embedded-book

2. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software CoDesign, Morgan Kaufmann, Systems-on-Silicon Series Embedded

3. Frank Vahid and Tony D. Givargis, System Design: A Unified Hardware/Software Introduction, Addison Wesley, 2002.

4. Michael Barr, Programming Embedded Systems in C and C++, O'Reilly, 1999.

5. David E. Simon, An Embedded Software Primer, Addison Wesley, 1999.

6. Jack Ganssle, The Art of Designing Embedded Systems, Newnes, 2000.

7. K. Short, Embedded Microprocessor System Design, Prentice Hall, 1998. C. Baron, J. Geffroy and G. Motet, Embedded System Applications, Kluwer, 1997.

2nd Semester

VLSI FABRICATION TECHNOLOGY

MODULE – I **(10 hours)**

Introduction: Moore's Law and material processing, Defects in crystals, Eutectic phase diagram, Solid solubility, Homogeneous nucleation, Heterogeneous Nucleation, Growth processes Crystal Growth: Necking and dislocation free CZ crystal growth, Segregation of impurities along length and diameter, Defects in CZ crystals, FZ Crystal growth.Epitaxy: Vapour phase epitaxy, LPE, MBE, CVD deposition of Polysilicon, SILOX Process

MODULE – II **(10 hours)**

Diffusion: Constant & limited source diffusion, Concentration dependent diffusion, Field assisted diffusion, Junction depth, Open tube and closed tube diffusion, Diffusion sources.Ion Implantation: Basic process, Ion Implantation Systems, Ion penetration and profile, Ion Implantation Damage, Annealing Oxidation: Purpose, Dry and wet oxidation, Deal-Grove model, Oxidation system, Properties of oxides – Masking and charges in oxides Deposition Processes: Fundamentals of vacuum systems, Vacuum evaporation of thin films, DC and RF Sputtering of thin films, Interconnects, Contacts and dielectrics in IC Fabrication, Deposition of Silicon Nitride, Silicides and insulating layers

MODULE – III **(10 hours)**

Lithography: Pattern generation and mask making, Optical Lithography – Contact, Proximity and Projection Printing, Photoresists – Negative, Positive, Lift-off process, Electron beam and X-ray lithographic techniques. Etching: Wet Etching, Isotropic and Anisotropic Etching, Plasma Etching, Reactive Ion Beam Etching. IC Process Integration: Bipolar Transistor Fabrication, Isolation techniques, P-MOS, N-MOS and C-MOS processes, IC Fabrication Process Integration, IC Process Yield and Reliability

MODULE – IV **(8 hours)**

MEMS Fabrication Processes: Micro machining, Bulk Micro machining, Surface Micro machining, Deep RIE, Advanced Lithography, HEXIL & SCREAM Process, Polymer molding and LIGA Process.

Text Books:

1. S.K. Gandhi, VLSI Fabrication Principles: Silicon and Gallium Arsenide, Wiley India Pvt. Ltd., New Delhi, 2nd edn. (1994), ISBN: 0471580058.

2. Marc J. Madou, Fundamentals of Microfabrication, CRC Press (2002), ISBN: 0849308267

2nd Semester

Reference Books:

1. J. Plummer, M. Deal and P. Griffin, Silicon VLSI Technology, Prentice Hall, 2000, ISBN: 0130850373.

2. S.M.Sze, VLSI Technology, Tata McGraw Hill, 1983, ISBN: 0070582912.

3. S.Mahajan, Principles of Growth and Processing of Semiconductors, McGraw Hill International Book Company, 1999, ISBN: 0070396051.

4. S.A.Campbell, The Science and Engineering of Microelectronics Fabrication, Oxford University Press, ISBN: 0195105087.

2nd Semester

LOW POWER DIGITAL VLSI DESIGN

MODULE – I **(8 hours)**

Introduction: Sources of power dissipation, Static power dissipation, Active power dissipation. Circuit Techniques for Low-Power Design: Designing for low-power, Circuit techniques for leakage power reduction – Standby leakage control using transistor stacks, Multiple Vth techniques, Dynamic Vth technique, Supply voltage scaling technique, Leakage reduction techniques for chace (SRAM). Low-Voltage Low-Power Adders: Standard adder cells – Half adders, Full adders and their various schematic configurations, CMOS addrer's architecture – Ripple carry adders, Carry lookahead adders, Carry select adders, Carry save adders, Carry skip adders, Conditional sum adders.

MODULE – II **(10 hours)**

Performance valuation of various adder architectures, BiCMOS adders – PT-BiCMOS Gate, Low-voltage low-power design techniques – Trends of technology and power supply voltage, Low-voltage low-power logic styles, Current-mode adders – Current-mode CMOS adders using multiple-valued logic, Residue adders based on binary adders, Fast addition using single-digit number system.Low-Voltage Low Power Multipliers: Overview of multiplication – Unsigned multiplication, Shift/add multiplication algorithms, Multiplication of signed numbers, Types of multipliers architecture – Serial multipliers, Parallel multipliers, serial-parallel multipliers, Braun multiplier, Baugh-Wooley multiplier, Booth multiplier, Wallace tree multiplier.

MODULE – III **(12 hours)**

Low-Voltage Low Power Read-Only Memories: Types of ROM, Basic physics of floating gate non-volatile devices, Floating gate memories, Basics of ROM – Chip architecture, ROM cell arrays, Low-power ROM Technology – Sources of power dissipation, Low-power techniques at architecture level, Low-power techniques at circuit level. Low-Voltage Low Power Static Random-Access Memories: Basics of SRAM, Memory cell, Pre-charge and equalization circuit, Decoder, Address transition detection, Sense amplifier, Output latch, Low-power SRAM technology – Sources of SRAM power, Development of low power circuit techniques.

Low-Voltage Low Power Static Random-Access Memories: Types of DRAM – Conventional DRAM, Fast page mode DRAM, Enhanced DRAM, Extended data out DRAM, Burst extended data output DRAM, Synchronous DRAM, Enhanced synchronous DRAM, Double data-rate DRAM, Synchronous link DRAM, Rambus DRAM, Direct Rambus DRAM, Video RAM, Embedded DRAM, Basics of DRAM, Self-refresh Circuit, Half-voltage generator, Back-bias generator, Boosted-voltage generator,

Reference-voltage generator, Voltage-down converter. Large Low-Power VLSI System Design Applications: Behavioral level transform, Algorithm and architecture level transforms for low power

MODULE – IV **(8 hours)**

Differential coefficient for FIR filters, Algorithm using first-order differences, Algorithm using generalized mth-order differences, Negative differences, Sorted recursive differences, Shared multiplier based vector scaling operation, Architecture-driven voltage scaling, Power optimization using operation reduction, Power optimization using operation substitution, Precomputation based optimization for low power, Multiple and dynamic supply chain – Multiple supply voltage design, Dynamic supply voltage design, Choice of supply voltages, Rate of change of supply voltages, Power-supply network, Varying the clock speed, Varying the VDD of RAM structure, Level conversion on the path from V_{DD}^{L} to V_{DD}^{H}.

Text Books:

1. Kiat-Seng Yeo and Kaushik Roy, Low-Voltage Low-Power VLSI Subsystems, TMH Pvt. Ltd., 2009, ISBN-13: 978-0-07-067750-0, ISBN-10: 0-07-067750-6.

2. Kaushik Roy, Sharat C. Prasad, Low-Power CMOS VLSI Circuit Design , Wiley India Pvt Ltd, 2009, ISBN: 812652023X, ISBN-13: 9788126520237, 978-8126520237.

Recommended Reading:

1. AbdellatifBellaouar and Mohamed Elmasry, Low-Power Digital VLSI Design: Circuits and Systems, Kluwer Academic Publishers, 1995

2. Gary K. Yeap, Practical Low Power Digital VLSI Design, Kluwer Academic Pub, 1998

3. Anantha P Chandrakasan, A P Chandrakasan and R W Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995, ISBN: 079239576X, EAN: 9780792395768

2nd Semester

INTRODUCTION TO NANOELECTRONICS

MODULE – I **(11 hours)**

Introduction to Nanoelectronics: The "top-down" approach, The "bottom-up" approach, Nanoelectronis and nanotechnology potential. Classical Particles, Classical Waves and Classical Quantum Particles: Comparison of classical and quantum systems, Origin of quantum mechanics, Light as a wave and light as a particle, Electrons as particles and electron as waves, Wavepackets and uncertainty.

Quantum Mechanics of Electrons: General postulates of quantum mechanics, Time independent Schrodinger's equation, Analogies between quantum mechanics and classical electromagnetics, Probabilistic current density, Multiple particle systems, Spin and angular momentum.

Free and Confined Electrons: Free electrons, The free electron gas theory of metals, Electrons confined to a bounded region of space and quantum numbers, Fermi level and chemical potential, Partially confined electrons – Finite potential wells, Electrons confined to atoms – The hydrogen atom and the periodic table, Quantum dots wires and wells.

MODULE – II **(8 hours)**

Electrons Subject to a Periodic Potential – Band Theory of Solids: Crystalline materials, Electrons in a periodic potential, Kronig-Penney model of band structure, Band theory of solid – Doping in Semiconductors, Interacting systems model, The effect of an electric field on energy bands, Band structures of some semiconductors, Electronic bond transitions – interaction of electromagnetic energy and materials, Graphene and carbon nanotubes.

Tunnel Junctions and Applications of Tunneling: Tunneling through a potential barrier, Potential energy profiles for material interfaces, Applications of tunneling – Field emission, Gateoxidetunneling and hot electron effects in MOSFETs, Scanning tunneling microscope, Double barrier tunneling and the resonant tunneling diode. Coulomb Blockade and the Single-Electron Transistor

MODULE – III **(8 hours)**

Electron Transistor: Coulomb blockade – Coulomb blockade in a nanocapacitor, Tunnel junctions, Tunnel junction excited by a current source, Coulomb blockade in a quantum dot circuit, The single electron transistor, Other SET and FET structures – Carbon nanotube transistor, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics.

Particle Statistics and Density of States: Density of states in lower dimensions, Density of states in a semiconductor, Classical and quantum statistics – Carrier concentration in materials, The importance

of the Fermi electrons, Equilibrium carrier concentration and the Fermi level in semiconductor. **Models of Semiconductor Quantum Wells, Quantum Wires and Quantum Dots**: Semiconductor heterostructures and quantum wells, Quantum wires and nanowires, Quantum dots and nanoparticles.

MODULE – IV **(8 hours)**

Fabrication techniques for nanostructures – Lithography, Nanoimprint lithography, Split-gate technology, Self-assembly.

Nanowires, Ballistic Transport and Spin Transport: Classical and semiclassical transport – Classical theory of conduction – free electron gas model, Semi-classical theory of electrical conduction – Fermi gas model, Classical resistance and conductance, Conductivity of metallic nanowires – the influence of wire radius, Ballistic transport – Electron collisions and length scales, Ballistic transport model, Quantum resistance and conductance, Origin of quantum resistance, Carbon nanotubes and nanowires, Nano fiber and its application, Integrated photonic application including photnic crystal fiber Transport of spin and spintronics – the transport of spin, Sprintonic devices and applications.

Text Books:

1. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009, ISBN: 978- 81-317-2679-2.

Recommended Reading:

1. Vladimir V. Mitin, Viatcheslav A. Kochelap and Michael A. Stroscio, Introduction to Nanoelectronics Science, Nanotechnology, Engineering, and Applications, Cambridge University Press, 2008, ISBN: 978-0-521-88172-2

2. M. Kuno, Introduction to Nanoscience and Nanotechnology: A Workbook, http://nd.edu/~mkuno/Class_downloads/Chem647_nano_text.pdf

3. G.L. Hornyak, H.F. Tibbals, Joydeep Dutta, and J.J. Moore,Introduction to Nanoscience & Nanotechnology, CRC Press, 2008 ISBN: 9781420047790 ISBN 10: 1420047795.

4. Jeremy Ramsden, Essentials of Nanotechnology, BOOKBOON.com, ISBN 978-87-7681-418-2.

5. I.A. Sukhoivanov, I.V. Guryev, Physics and Practical Modeling: Photonic Crystals, 1st ed., Springer, Heidelberg, 2009.

2nd Semester

MICROSYSTEMS-PRINCIPLE, DESIGN AND APPLICATION

MODULE – I **(8 hours)**

Introduction: MEMS, MEMS Processing, Micromachining, Wafer Bonding, LIGA, MEMS Examples, Scaling Laws MEMS.Materials: MEMS Materials, Silicon, Crystal Defects, Mechanical Properties of Materials, Beams and structures, Piezoelectric Materials, Piezoresistive Materials

MODULE – II **(8 hours)**

MEMS Sensor: Resistive and Capacitive methods, Strain gauges, Piezoresistivity, MEMS Capacitive Sensors, MEMS Position sensor, MEMS Pressure sensor.MEMS Accelerometer, MEMS Gyroscope, MEMS Gas Sensors, Cantilever Sensors MEMS Actuator: Electrostatic MEMS actuators, Comb drives, MEMS RF resonator, Scratch drive.

MODULE – III **(8 hours)**

MEMS Sensor (Continued): Inchworm motor, Piezoelectric MEMS actuators, Thermal MEMS actuators, Magnetic MEMS actuators.Optical MEMS: MEMS Infrared sensor, Digital Mirror Displays, Grating Light Valve Displays, Micro-optical elements Micro-fluidics.

MODULE – IV **(8 hours)**

Chemical MEMS: Microfluidics – Fluid flow, Electro-osmotic flow, Electrophoresis, Micropumps, Microvalves, Fabrication Process for microfuidic chip, Labon-a-Chip, µ-TAS, Inkjet Printer Head Bio MEMS: DNA Analysis, Micro-array Gene Chip, Micro-surgery, Drug delivery

Text Books:

1. Stephen D. Senturia, Microsystem Design, Kluwer Academic/Springer, 2nd edn.
(2005), ISBN: 0792372468

2. R.S. Muller and A.P. Pisano, Micro Actuators, IEEE Press, 2000.

3. P. Rai-Choudhury, Recent Advances in MEMS/MOEMS Technologies, SPIE
Press, 2000. 4. S.M. Sze, Semiconductor Sensors, Wiley-Interscience Publishers,
1994.

4. T. Fukuda, and W. Menz, (Eds), Micro Mechanical Systems: Principles and
Technology, Handbook of Sensors and Actuators, Vol. 6, Elsevier, 1998.

2nd Semester

VLSI PHYSICAL DESIGN

MODULE – I **(11 hours)**

VLSI Physical Design Automation: VLSI Design Cycle, Physical Design Cycle, Design Styles, System Packaging Styles, Historical Perspectives, Existing Design Tools Design and Fabrication of VLSI Devices: Fabrication Materials, Transistor Fundamentals, Fabrication of VLSI Circuits, Design Rules, Layout of Basic Devices Fabrication Process and its Impact on Physical Design: Scaling Methods, Status of Fabrication Process, Issues Related to the Fabrication Process, Future of Fabrication Process, Solutions for Interconnect Issues, Tools for Process Development.

MODULE – II **(11 hours)**

Data Structure and Basic Algorithms: Basic Terminology, Complexity Issues and NP-hardness, Basic Algorithms, Basic Data Structures, Graph Algorithm for Physical Design Partitioning: Problem Formulation, Classification of Partitioning Algorithms, Group Migration Algorithm, Simulated Annealing and Evolution, Other Partitioning Algorithms, Performance Driven Partitioning Floor Planning and Pin assignment: Floor Planning, Chip Planning, Pin Assignment, Integrated Approach

MODULE – III **(8 hours)**

Placement: Problem Formulation, Classification of Placement Algorithms, Simulation Based Placement Algorithms, Partitioning Based Placement Algorithms, Other Placement Algorithms, Performance Driven Placement Over-the-Cell Routing and Via Minimisation,

MODULE – IV **(8 hours)**

Clock and Power Routing: Over-the-Cell Routing, Via Minimisation, Clock Routing, Power and Ground Routing Physical Design Automation of FPGAs: FPGA Technologies, Physical Design Cycle for FPGAs, Partitioning, Routing Physical Design Automation of MCMs: MCM Technologies, MCM Physical Design Cycle, Partitioning, Placement, Routing.

Text Books:

1. Naved A. Sherwani, Algorithms for VLSI Physical Design Automation, 3rd Edn., Springer (India) Pvt. Ltd., 2005, ISBN: 0792383931
2. Gerez, Algorithms for VLSI Design Automation, Wiley India Pvt. Ltd., New Delhi, ISBN 10: – 8126508211, ISBN 13: – 9788126508211.

2nd Semester

ADVANCED TECHNIQUES IN DSP

MODULE – I

Multi-rate Digital Signal Processing: Decimation by a factor D, interpolation by a factor 1, sampling rate conversion by a national factor I/D.

MODULE – II

Sampling rate conversion of band pass signals. Implementation of low pass filter and digital filter banks. ; lattice filters, Linear prediction, forward and backward linear prediction, FIR wiener filter.

MODULE – III

Power spectrum estimation, non-parametric method Barlett, Parametric method. ; Yule-Walker MA and ARMA models. Higher order statistics and its applications.

MODULE – IV

DSP transforms: Discrete Hartely transform, Discreteconsine transform, Discrete Wavelet transform, Stransform. DSP techniques for bioinformatics., recent topics

Text Book

1. J.G. Proakis, D.G. Manolakis, Digital Signal Processing, PHI, New Delhi, 1995.

2. S.J. Orfanidis, Optimum Signal Processing, Mac Millan Publishing Co., USA, 1985.

Reference Book

1. C.K. Chui, An Introduction to Wavelets,Academic Press, USA, 1992.

2. Guoan Bi and Y. Zeng, Transforms and Fast Algorithms for signal analysis and representations, Springer, NY, USA, 2003.

2nd Semester

ADAPTIVE SIGNAL PROCESSING

MODULE – I

Adaptive System Definition and Characteristics, Areas of Application, Example of an Adaptive System, Adaptive Linear Combiner, The Performance Function, Gradient and Minimum Mean-Square Error, Alternative Expression of the Gradient, Decorrelation of Error and Input Components. [Read Widrow: Chapter 1 and 2] Winer Filter Linear Optimum Filtering, Principle of Orthogonality, Minimum Mean Square Error, Winer-Hopf Equation, Error Performance Surface. [Read Haykin: Chapter 2.1-2.5]

MODULE – II

Linear Prediction Forward Linear Prediction, Backward Linear Prediction, Properties of Prediction Error Filters. [Read Haykin: Chapter 3.1, 3.2, 3.4] Method of Steepest Descent Basic Idea of Steepest-Descent Algorithm, Steepest-Descent Algorithm Applied to Winer Filter, Stability of Steepest-Descent Algorithm, Limitations of Steepest-Descent Algorithm. [Read Haykin: Chapter 4.1 – 4.3, 4.6] Least-Mean Square Adaptive Filter Overview, LMS Adaptation Algorithm, Application, Comparison of LMS With Steepest-Descent Algorithm. [Read Haykin: Chapter 5.1 – 5.3, 5.5]

MODULE – III

Normalized Least-Mean Square Adaptive Filter Normalized LMS Filter as the Solution to Constrained Optimization Problem, Stability of the NLMS. [Read Haykin: Chapter 6.1, 6.2]Frequency-Domain and Subband Adaptive Filters Block Adaptive Filters [Read Haykin: Chapter 7.1]

MODULE – IV

RLS Adaptive Filters Statement of Linear Least-Square Estimation Problem, Matrix Inversion Lemma, The Exponentially Weighted RLS Algorithm. [Read Haykin: Chapter 8.1,9.1 – 9.3] Kalman Filter Recursive Minimum Mean-Square Estimation For Scalar Random Variable, Kalman Filtering Problem, Initial Conditions, Summary of Kalman Filter. [Read Haykin: Chapter 10.1, 10.2, 10.6, 10.7]

Textbooks:

1.BernardWidrow and Samuel D. Stearns, Adaptive Signal Processing, Pearson Education.

2.SimonHaykin, Adaptive Filter Theory, 4thEdn. Pearson Education.

2nd Semester

RF AND MIXED-SIGNAL INTEGRATED CIRCUITS

MODULE – I **(13 hours)**

Introduction: Overview of wireless principles, Characteristics of passive IC components – resistors, Capacitors, Inductors, Transformers, Interconnect at RF and high frequencies, Skin effect.Bandwidth Estimation Techniques: Method of open-circuit time constants, Method of short-circuit time constants, Rise time, Delay and Bandwidth. High-frequency Amplifier Design: Zeros as bandwidth enhancers, Shunt-series amplifier, Bandwidth enhancement with fT doublers, Tuned amplifiers, Neutralization and unilateralization, Cascaded amplifiers, AM-PM conversion.

MODULE – II **(13 hours)**

Voltage Reference: Review of diode behavior, Diodes and Bipolar Transistors in CMOS technology, Supply-independent bias circuits, Bandgap voltage reference, Constant-gm bias.Noise: Thermal noise, Short noise, Flicker noise, Popcorn noise, Classical two-port noise theory, Examples of noise calculations. Low-Noise Amplifier (LNA) Design: Derivation of intrinsic MOSFET two-port noise parameters, LNA topologies – Power match Vs. Noise match, Power-constrained noise optimization, Design Example, Linearity and large signal performance, Spurious-free dynamic range.

MODULE – III **(8hours)**

Mixers: Mixer fundamentals, Non-linear systems as linear mixers, Multiplier-based mixers, Sub-sampling mixers, Diode-ring mixers.RF Power Amplifiers: Classes of power amplifiers, RF power amplifier design example, Power amplifier characteristics and Design consideration.

MODULE – IV **(8 hours)**

Phase-Locked Loops (PLL): Introduction to PLL, Linearized PLL models, Some noise properties of PLLs, Phase detectors, Sequential phase detectors, Loop filters and charge pumps, PLL design examples. Oscillators and Synthesizers: Problems with purely linear oscillators, Describing functions, Resonators, Tuned oscillators, Negative resistance oscillators, Frequency synthesis.

Textbooks:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd Edn., Cambridge University Press, 2004.
2. Gerez, Algorithms for VLSI Design Automation, Wiley India Pvt. Ltd., New Delhi, ISBN 10: – 8126508211, ISBN 13: – 9788126508211.

2nd Semester

ASIC AND SOC DESIGN

MODULE – I **(11 hours)**

Introduction: Voice over IP SOC, Intellectual Property, SOC Design Challenges, Design Methodology. Overview of ASICs: Introduction, Methodology and Design Flow, FPGA to ASIC Conversion, Verification.

MODULE – II **(11 hours)**

SOC Design and Verification: Introduction, Design for Integration, SOC Verification, Set-Top-Box SOC, Set-Top-Box SOC Example. Summary. References. Physical Design: Introduction, Overview of Physical Design Flow, Some Tips and Guidelines for Physical Design, Modern Physical Design Techniques.

MODULE – III **(10 hours)**

Low-Power Design: Introduction, Power Dissipation, Low-Power Design Techniques and Methodologies, Low-Power Design Tools, Tips and Guidelines for Low-Power Design. Low-Power Design Tools: PowerTheater, PowerTheater Analyst, PowerTheater Designer.

MODULE – IV **(6 hours)**

Open Core Protocol (OCP): Highlights, Capabilities, Advantages, Key Features. Phase-Locked Loops (PLLs): PLL Basics, PLL Ideal Behavior, PLL Errors.

Text Books:

1. FarzadNekoogar and FaranakNekoogar, From ASICs to SOCs: A Practical Approach, Pearson Education, 2003, ISBN-10: 0-13-033857-5, ISBN-13: 978-0- 13-033857-0

Recommended Reading:

1. Michael Smith, Application Specific Integrated Circuit, Addison-Wesley, 1997, ISBN: 0201500221

2. JariNurmi, Processor Design: System-On-Chip Computing for ASICs and FPGAs, Springer, 1st edition, 2007, ISBN: 1402055293

3. Douglas J. Smith, HDL Chip Design – a practical guide for designing, synthesizing and simulating ASICs and FPGAs using VHDL or Verilog, Doone Publications, 2000, ISBN: 0965193438

2nd Semester

DATA ENCRYPTION AND SECURITY

Module I **(14 Hours)**

Introduction:Security Goals, Attacks, Services and Mechanism,Techniques Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers. Modern Symmetric-Key Ciphers:Modern Block Ciphers, Modern Stream Ciphers.Data Encryption Standard (DES):Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES, Differential Cryptanalysis, Linear Cryptanalysis of DES

Module II **(12 Hours)**

Advanced Encryption Standard (AES): Introduction, Transformations, Key Expansion, Cipher, Analysis of AES.Message Integrity and Message Authentication: Message integrity, Random Oracle Model, Message authentication.Cryptographic Hash Functions: Introduction, SHA – 512, Whirlpool

Module III **(8 Hours)**

Entity Authentication: Introduction, Passwords, Challenge – response, Zero – knowledge Key Management: Symmetric – key Distribution, Kerberos, Symmetric – key agreement, Public – key distribution Security at application layer: E-mail, PGP, S/MIME

Module IV **(8 Hours)**

Security at the Transport layer: SSL architecture, Four protocols, SSL message format, Transport layer security.Security at the network layer: Two modes, two security protocols, security association, security policy, Internet key exchange

Textbooks:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.2007, ISBN-10 0-07-066046-8:

References

1. Elements of Information Theory, By T.M. Cover &Joy.A.Thomas, 2nd edition, Wiley-Interscience, ISBN-10 0-471-24195-4

2. Cryptography & Network Security: AtulKahate, TMH. 2nd Edition, ISBN-10: 0-07-064823-9

2nd Semester

NETWORK ARCHITECTURE AND DESIGN

Module-I **(10 Hours)**

Introduction: overview of analysis, architecture, and design processes, System description, Service description, service characteristics, performance characteristics, Network supportability.Network Architecture: Component architecture, Reference architecture, Architectural models, System and network architectures.

Module: II **(8 Hours)**

Addressing and routing Architecture: Addressing mechanisms, Routing mechanisms, Addressing strategies, Routing strategies, Architectural considerations.Network Management Architecture: Defining network management, Network management mechanisms, Architectural consideration.

Module: III **(8 Hours)**

Performance Architecture: Goals for performance, Performance mechanisms, Architectural consideration.Security and Privacy Architecture: Security and privacy administration, Security and privacy mechanisms, Architectural consideration.

Module: IV **(14 Hours)**

Designing a Network: LAN specifics, Network type, Ethernet fundamentals.Network operating systems, Hardware considerations, considering the client, choosing a protocol, connectivity devices, WAN technologies, Remote connectivity, Internet connectivity, securing the network.

Text Books:

1. Network Analysis, Architecture and Design, By James D. McCabe, Morgan Kauffmann publishers, 3rd edition, 2003

2. Network Architecture and Design, By J. F. DiMarzio, Sams Publishing, 2001, ISBN : 0-672-32082-7.

2nd Semester

BIO-MEMS AND NANOTECHNOLOGY

Module-I

Mems and Microsystems: Mems and Microsystems-General principles, advantages, materials used properties, Technology involved in MEMS. Fabrication techniques-Lithography- etching- Ion implantation wafer bonding. Integrated processing- Bulk Micro machining- Surface micro machining-coating technology and CVD- LIGA process.

Module-II

Microsensors and Microactuators: Microsensors and Microactuators –working principle, types-pressure sensors, thermal sensors and actuators, piezoelectric crystals-Intelligent materials and structures, Magnetic sensors and actuators- magnetic materials used for MEMS.

Module-III

Mems and Microfluidic System: Principle of MOEMS- light modulator, beam splitter, digital micro mirror device, light detectors and optical switch. Micro fluidic System- Fluid actuation method, dielectrophoresis, micro fluid dispenser, micro needle, micro pumps. Application of BioMEMS: Healthcare, drug delivery, micrototal analysis system detection and measurement methods, electronic nose, biochip.

Module- IV:

Introduction to Nanotechnology: Essence of Nanotech, Nanofying electronics, Properties of nanomaterials, metal nano clusters, semiconductor nano particles, nano composites. Introduction to carbonnano structure, carbon molecules, carbon clusters, nanotubes application.

Nanotechnology for photonics: Photonic crystal 1d,2d,3d,;light propagation in photonic crystal abd fiber, photonic band gap, fiber bragg grating, coupled mode theory, and fiber Bragg grating spectrum. Applications of photonic crystal in optical logic gates , sensing and communication. Applications of fiber grating. Numerical techniques (PWE,FDTD,FEM) to design nanophotonics devices.

Medical Applications of Nanotechnology: Nanotechnology and Biomedicine-Drug synthesis and delivery– Nanobiomedicine and diagnostic-nano fabrication methods-nanomaterials in human body-toxicity in nanomaterials.

Text books:

1. Tai Ram Hsu, “Mems and Microsystems, Design and Manufacture”, McGraw Hill, 2002.
2. Mohamed Gad-el-Hak, “MEMS: Introduction and Fundamentals”, CRC Press, 2005.
3. Neelina H. Malsch, “Biomedical Nanotechnology”, CRC Press, 2005

Reference books:

1. Marc J Madou, “Fundamentals of Microfabrication and Nanotechnology”, CRC Press, 2011.
2. Hari Singh Nalwa, “Encylopedia of Nanoscience and Nanotechnology”, American Scientific Publishers,2004.
3. ELLIS MENG “Biomedical Microsystems”, CRC Press, 2011
4. J. Joannopoulos, S.G. Johnson, J. Winn, R.D. Meade, Photonic Crystals: Molding the Flow of Light, 2nd ed., Princeton University Press, Princeton, 1995

2nd Semester

WIRELESS AND MOBILE COMMUNICATION

Module-I

Evolution of mobile radio communication fundamentals, General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling.

Module-II

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.

Module-III

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

Module-IV

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text Book:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson Publications, Second Edition.
2. Upena Dalal, “Wireless Communication and Networks”, Oxford Press Publications.
3. T L Singal ,“Wireless Communications ”, McGraw Hill Publications.

Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
2. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

2nd Semester

BRANCH-Electronics and Telecommunication Engineering

Specialization: Wireless Communication Technology

Second Semester							
Theory					**Practical**		
Course Name	**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Specialization Core-1 MIMO Wireless Communication System	4-0	4	100	50	-	-	-
Specialization Core-2 Ultra Wide Band Communication system	4-0	4	100	50	-	-	-
Elective-I (Specialization related) 1.Wireless Communication Management 2.Spread Spectrum Communication Technique 3.VLSI for Wireless Communication 4.Satellite Communication System	4-0	4	100	50	-	-	-
Elective-II (Departmental related) 1. Advanced Techniques in DSP 2. Statistical Signal Processing 3. RF and Mixed-Signal Integrated Circuits 4. Embedded System Design	4-0	4	100	50	-	-	-
Elective-III (from any Department) 1.Data Encryption and Security 2. Network Architecture and Design. 3.Antenna Design & Measurement 4. Wireless and Mobile Communication	4-0	4	100	50	-	-	-
Lab-2 (Specialization lab to be decided by the Department)					4	4	150
Seminar/Project					4	4	150
Total							
Total Marks: 1050							
Total Credits: 28							

2nd Semester

MIMO WIRELESS COMMUNICATION SYSTEM

Module I **(12 Hours)**

Introduction: MIMO Wireless communication, MIMO Channel and signal model, A fundamental trade-off, MIMO transceiver design, MIMO in wireless networks, MIMO in wireless standards. **Capacity Limits of MIMO systems**: Introduction, Mutual information and Shannon capacity, Single – user MIMO, Multi - user MIMO, Multi – cell MIMO, MIMO for ad-hoc networks.

Module II **(10Hours)**

Precoding Design: Transmit channel side information, Information – theoretic foundation for exploiting CSIT, A transmitter structure, Precoding design criteria, Linear precoder design, Precoder performance results and discussion, Application in practical systems.

Module III **(8Hours)**

Space – time coding for wireless communications: Introduction, background, Space – time coding principles, Applications, Discussion and future challenges.

Fundamentals of Receiver design: Introduction, Reception of uncoded signals, Factor graphs and iterative processing, MIMO receiver for uncoded signals, MIMO receiver for coded signals.

Module IV **(8 Hours)**

Multi-user Receiver design: Introduction, Multiple access MIMO systems, Iterative space – time multi – user detection, Multi – user detection in space time coded system, adaptive linear spacetime multi-user detection.

Text Book:

1. MIMO Wireless Communications By E.Biglieri, R. Calderbank, A.Constantinides, Andrea Goldsmith, A. Paulraj & H. V. Poor, Cambridge University Press, ISBN: 9780521873284

Reference Books:

1. Fundamentals of Wireless Communication by David Tse and Pramod Viswanath, Cambridge University Press, 2005

2nd Semester

ULTRA WIDE BAND COMMUNICATION SYSTEM

Module I **(14 Hours)**

UWB: Single-Band Approaches: Overview of Single-Band Approaches, Modulation Techniques, Multiple Access Techniques, Demodulation Techniques, MIMO Single-Band UWB, Performance **Analysis OFDM Sytem issues**: OFDM concept, OFDM model, Time frequency interpretation, Impairment issues in OFDM systems, Frequency offset

Module II **(13 Hours)**

Analysis OFDM Sytem issues: Timing offset, Carrier phase noise, Multipath issues, ISI issues, PAPR, OFDMA, Frequency Hopping OFDMA, OFDMA system description .

UWB: Multiband OFDM Approach: Overview of Multiband OFDM Approach, IEEE 802.15.3a WPAN Standard Proposal, Physical Layer Design, MAC Layer Design, MIMO Multiband

Module III **(13 Hours)**

OFDM: MIMO-OFDM Communications, MIMO Multiband OFDM System Model, Performance Analysis

Performance Characterization: System Model, Performance Analysis, Analysis for MIMO Multiband OFDM systems

Module IV **(13 Hours)**

Performance Under Practical Considerations: System Model, Average Signal-to-Noise Ratio, Average Bit Error Rate, Performance Bound, Differential Multiband OFDM, Cooperative UWB Multiband OFDM

Text Books:

1. OFDM Towards fixed and mobile Broadband Wireless Access by Uma Sankar Jha and Ramjee Prasad. ARTECH House Publication.

2. Ultrawideband communications Systems Multiband OFDM Approach By W.Pam Siriwongpairat and K.J.Ray Liu IEEE Press Publn

2nd Semester

WIRELESS COMMUNICATION MANAGEMENT

Module-I **(14 hrs)**

Resource Management: Call admission control in wireless LANs, Traffic aware routing for RTC in wireless Multi-hop Networks, Reliable multicast for Wireless LAN, Wireless Network Tele-traffic modeling with Lossy Link.

Heterogeneous Wireless Nteworks: Optimal resource management and QoS Provisioning, Medium Access Control in Wireless Ad Hoc Networks, Advanced Radio resource management for future Mobile Networks**.**

Module – II **(8 hrs)**

Mobility Management: Fractional resource reservation in mobile cellular systems, Fractional Guard channel schemes .

Mobility management for Mobile IP networks: Triangular routing, smooth handoffs in mobile IPv6.

Module – III **(10 Hrs)**

Location management in Wireless Networks: Issues and Technologies, Network Topologies, Time based location update.

Network Mobility.

Security Management: Key management in wireless sensor networks: Challenges and Solutions, Global Key management schemes, vehicle location register .Secure routing for Mobile Ad Hoc Networks.

Module – IV **(8Hrs)**

Security and privacy in future Mobile networks, vehicle networks, user identity confidentiality, User untracability, The effects of Authentication on Quality - of – service in wireless networks.

Text Book:

1. Resource, mobility, and security management in wireless networks and mobile communications, by Yan Zhang, Masayuki Fujise, Auerbach Publications, 2007, Taylor and Francis group, ISBN:0849380367
2. Resource management in wireless Networking, by Mihaela Cardei, Ionut Cardei, Dingzhu Du, Springer, 2005, ISBN:038723807.

2nd Semester

SPREAD SPECTRUM COMMUNICATION TECHNIQUE

Module – I **(12 hrs)**

Direct-Sequence Systems: Definitions and concepts, Spreading sequences and waveforms, Systems with PSK modulation, Quaternary systems, Pulsed interference, Despreading with matched filter, Rejection of narrowband interference.

Frequency Hopping System: Concepts and characteristics, Modulation, Codes for partialband interference, Frequency synthesizers

Module – II **(14 hrs)**

Code Synchronization: Acquisition of spreading Sequences, Serial-search Acquisition, Acquisition correlator, code tracking, frequency-hopping patterns .

Code-Division Multiple Access: Spreading sequence for DS/CDMA, Systems with random spreading sequences, wideband Direct-sequence systems, Cellular networks and power control, multi-user detectors, Frequency-Hopping Multiple access

Module –III **(8 hrs)**

Detection of Spread-Spectrum signals: Detection of Direct-sequence signals: Ideal detection, radiometer,Detection of frequency-hopping signals: Ideal detection, Wideband Radiometer, Channelized Radiometer.

Module –IV **(8 hrs)**

Application of Spread spectrum methods: Space systems, Avionic systems, Test systems and equipments, Message protection, position location, Real systems. Test and evaluation: Sensitivity, selectivity, Jamming margin, Sync acquisition, Loss of synchronization, SNR vs Interference level, Process gain.

Text Book:

1. Principles of Spread- Spectrum communication systems, by Don Torrieri, Springer, 2005, ISBN: 0-387- 22782 - 2

References:

1. IS-95 CDMA and cdma2000: Cellular/PCS Systems Implementation, By V.K Garg, Pearson Education, 2005, ISBN: 8177584170, 9788177584172

2. Spread spectrum in communication, By Reidar Skaug, Jens F. Hjelmstad, Peter Peregrinus Ltd, London, 1985, ISBN: 0-86341-034-0

3. Multi-Carrier and Spread Spectrum Systems, By K. Fazel, S. Kaiser, John Wiley & Sons, 2003, ISBN: 0-470-84899-5

4. Spread spectrum Systems with Commercial application, By Robert C. Dixon, Wiley- Inter science Publication, 3rd edition, 1994, ISBN: 0-471-59342-7.

2nd Semester

VLSI FOR WIRELESS COMMUNICATION

MODULE – I **(10 hours)**

Communication Concepts in terms circuit designer perspective: Introduction, Overview of Modulation schemes, Clasical Channel, Wireless channel description, Path loss, Multipath fading (channel model and envelope fading, frequency selective).

Receiver Architectures: Introduction, Receiver front end, Filter design, Rest of receiver front end, Receiver front end

MODULE – II **(10 hours)**

Low Noise Amplifier: Introduction, Wideband LNA design, Narrowband LNA (Impedance matching and Core Amplifier)

Active Mixer: Introduction, balancing, Qualititative description of Gilbert Mixer, Conversion Gain, Distortion (Low frequency and high frequency case), Noise and a complete active mixer.

MODULE – III **(8 hours)**

Passive Mixer: Introduction, Switching Mixer, Distortion, Conversion Gain and Noise in Unbalanced Switching Mixer, A practical Unbalanced Switching Mixer, Sampling Mixer, Conversion Gain, Distortion, and noise in Single-Ended Sampling Mixer.

Analog-to-Digital Converters: Introduction, Demodulators, A/D Converters used in a Receiver, Low-Pass Sigma- Delta Modulators, Implementation of Low-pass Sigma-Delta Modulators, Bandpass Sigma-Delta Modulators and its implementation,

MODULE – IV **(8 hours)**

Frequency Synthesizer: Phase/Frequency-Processing Components Introduction, PLL based Frequency Synthesizer, Phase Detector/Charge Pump, Dividers, VCO, LCO, Ring Oscillator, Phase noise Frequency Synthesizer: Loop Filter and System Design Introduction, Loop Filter (General description and design approaches), A case study of complete synthesizer

Text Book:

1. Bosco Leung, “VLSI for Wireless Communication”, Prentice Hall Electronics and VLSI series, 2002.

2nd Semester

SATELLITE COMMUNICATION SYSTEM

Module – I **(8 hrs)**

Basic Principles of Satellite Communication: Origin, Overview, Types, Satellite orbits and orbital errors, Communications via satellite, characteristic features of communication satellites, Message security, Coverage area and satellite networks, Geometric distances, Swath width, Communication time, and satellite visibility.

Module - II **(10 hrs)**

System design procedure: Mission requirement, system specifications, System design: Bus, Electrical and Mechanical, System reliability and Availability analysis, Antennas, Satellite power systems Chap:1.1 -1.4, 2.1 – 2.8(# 2),

Satellite Links: Link equations Satellite Link design : Introduction, Basic transmission theory, System Noise temperature and G/T ratio, Noise temperature, calculation of System Noise Temperature, G/T ration earth stations,

Module – III **(12 hrs)**

Design of downlink: Link budgets, Satellite systems using small earth stations: Direct broadcast TV, Uplink design: Design for specified C/N: Combining C/N and C/I values in satellite links, System design examples Chap: 4.1 (#2), 4.1 – 4.8 (#1)

Propagation Effects and their Impact on Satellite-Earth Links: Introduction, Attenuation and Depolarization, Atmospheric attenuation, Cloud attenuation, Rain and Ice effects, Prediction of rain attenuation, Prediction of XPD, Propagation impairment countermeasures

Module – IV **(8 hrs)**

VSAT Systems: Overview, Network architecture, Access control protocols, Basic technique, system design procedure Mobile Satellite System services: Overview, Mobile satellite system architecture, the internet and satellite. Chap: 8.1 – 8.7 (#1), 9.1- 9.8 (#1), 8.1 - 8.3 (#2)

Text book:

1. Satellite Communication by T. Pratt, C. Bostian, J. Allnutt, 2nd edition ,Wiley Publication, 2008, ISBN: 978-81-265-0833-4

2. Satellite Communication Engineering by M.O. Kolawole, Signal processing and communication series, Marcel Dekker, 2009, ISBN: 0-8247-0777-X

2nd Semester

ADVANCED TECHNIQUES IN DSP

MODULE I

Multi-rate Digital Signal Processing: Decimation by a factor D, interpolation by a factor 1, sampling rate conversion by a national factor I/D. ;

MODULE II

Sampling rate conversion of band pass signals. ; Implementation of low pass filter and digital filter banks. ; lattice filters, Linear prediction, forward and backward linear prediction,

MODULE III

FIR wiener filter. ; Power spectrum estimation, non-parametric method Barlett, Parametric method. ; Yule-Walker MA and ARMA models. Higher order statistics and its applications. ;

MODULE IV

DSP transforms: Discrete Hartely transform, Discrete consine transform, Discrete Wavelet transform, Stransform. DSP techniques for bioinformatics., recent topics

Text Book

1. J.G. Proakis, D.G. Manolakis, Digital Signal Processing, PHI, New Delhi, 1995.

2. S.J. Orfanidis, Optimum Signal Processing, Mac Millan Publishing Co., USA, 1985.

Reference Book

1. C.K. Chui, An Introduction to Wavelets,Academic Press, USA, 1992.

2. Guoan Bi and Y. Zeng, Transforms and Fast Algorithms for signal analysis and representations, Springer, NY, USA, 2003.

2nd Semester

STATISTICAL SIGNAL PROCESSING

Module – 1 **(9 hrs)**

Discrete Random Process: Random Process- Ensemble Average, Gaussian Process, Stationary Process, The Autocorrelation and Autocovariance Matrix, Ergodicity, White Noise, The Power Spectrom, Filtering Random Process, Special Types of Random Process-ARMV Process, AR Process, MA Process, Harmonic Process. [Read Hayes Chapter 3.3.1 – 3.3.8, 3.4, 3.6.1 – 3.6.4] Signal Modeling: Introduction, Stochastic Models- ARMA Models, AR Models, MA Models, Application: Power Spectrum Estimation. [Read Hayes Chapter 4.1, 4.7.1 – 4.7.4]

Module – II **(8 hrs)**

Winer Filtering: Introduction, The FIR Wiener Filter- Filtering, Linear Prediction, Noise Cancellation, IIR Wiener Filter- Noncausal IIR Wiener Filter, The Causal IIR Wiener Filter, Causal Wiener Filtering, Causal Linear Prediction, Wiener Deconvolution, Discrete Kalman Filter. [Read Hayes Chapter 7.1, 7.2.1 – 7.2.3, 7.3.1 – 7.3.5, 7.4)

Module – III **(10 hrs)**

Spectrum Estimation: Introduction, Nonparametric Method- The Periodogram, Performance of Periodogram. Parametric Methods- AR Spectrum Estimation, MA Spectrum Estimation, ARMA Spectrum Estimation. Frequency EstimationEigendecomposition of the Autocorrelation Matrix, MUSIC. [Read Hayes Chapter 8.1, 8.2.1, 8.2.2, 8.5.1 – 8.5.3, 8.6.1, 8.6.3]

Module – IV **(11 hrs)**

Adaptive Filtering: Introduction, FIR Adaptive Filters- The Steepest Descent Adaptive Filter, The LMS Algorithm, Convergence of LMS Algorithm, NLMS, Noise Cancellation, LMS Based Adaptive Filter, Channel Equalization, Adaptive Recursive Filter, RLSExponentially Weighted RLS, Sliding Window RLS. [Read Hayes Chapter 9.1, 9.2.1 – 9.2.6, 9.2.9, 9.3, 9.4]

Text Book

1. Monson H. Hayes, Statistical Digital Signal Processing &Modeling, John Wiley & Sons

Reference Books

1. Steven M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall.

2nd Semester

RF AND MIXED-SIGNAL INTEGRATED CIRCUITS

MODULE – I **(13 hours)**

Introduction: Overview of wireless principles, Characteristics of passive IC components – resistors, Capacitors, Inductors, Transformers, Interconnect at RF and high frequencies, Skin effect. Bandwidth Estimation Techniques: Method of open-circuit time constants, Method of short-circuit time constants, Rise time, Delay and Bandwidth. High-frequency Amplifier Design: Zeros as bandwidth enhancers, Shunt-series amplifier, Bandwidth enhancement with fT doublers, Tuned amplifiers, Neutralization and unilateralization, Cascaded amplifiers, AM-PM conversion.

MODULE – II **(13 hours)**

Voltage Reference: Review of diode behavior, Diodes and Bipolar Transistors in CMOS technology, Supply-independent bias circuits, Bandgap voltage reference, Constant-gm bias. Noise: Thermal noise, Short noise, Flicker noise, Popcorn noise, Classical two-port noise theory, Examples of noise calculations. Low-Noise Amplifier (LNA) Design: Derivation of intrinsic MOSFET two-port noise parameters, LNA topologies – Power match Vs. Noise match, Power-constrained noise optimization, Design Example, Linearity and large signal performance, Spurious-free dynamic range.

MODULE – III **(14 hours)**

Mixers: Mixer fundamentals, Non-linear systems as linear mixers, Multiplier-based mixers, Sub-sampling mixers, Diode-ring mixers. RF Power Amplifiers: Classes of power amplifiers, RF power amplifier design example, Power amplifier characteristics and Design consideration.

MODULE – IV

Phase-Locked Loops (PLL): Introduction to PLL, Linearized PLL models, Some noise properties of PLLs, Phase detectors, Sequential phase detectors, Loop filters and charge pumps, PLL design examples. Oscillators and Synthesizers: Problems with purely linear oscillators, Describing functions, Resonators, Tuned oscillators, Negative resistance oscillators, Frequency synthesis.

Textbooks:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd Edn., Cambridge University Press, 2004.

Recommended Books:

1. E.N. Farag and M.I. Elmasry, Mixed Signal VLSI Wireless Design: Circuits & Systems, Kluwer, 1999.

2nd Semester

EMBEDDED SYSTEM DESIGN

MODULE I

Introduction to Embedded Computing: Terms and scope, Application areas, Growing importance of embedded systems. Specifications: Requirements, Models of computation, State Charts: Modelling of hierarchy, Timers, Edge labels and State Charts semantics, Evaluation and extensions, General language characteristics: Synchronous and asynchronous languages, Process concepts, Synchronization and communication, Specifying timing, Using non-standard I/O devices, SDL, Petri nets: Introduction, Condition/event nets, Place/transition nets, Predicate/transition nets, Evaluation, Message Sequence Charts, UML, Process networks: Task graphs, Asynchronous message passing, Synchronous message passing.

MODULE II

Embedded System Hardware: Introduction, Input: Sensors, Sample-and-hold circuits, A/D-converters, Communication: Requirements, Electrical robustness, Guaranteeing real-time behaviour, Examples, Processing units: Application-Specific Circuits (ASICs), Processors, Reconfigurable Logic, Memories, Output: D/A-converters, Actuators.Standard Software: Embedded Operating Systems, Middleware, and Scheduling: Prediction of execution times, Scheduling in real-time systems: Classification of scheduling algorithms, Aperiodic scheduling, Periodic scheduling, Resource access protocols, Embedded operating systems: General requirements, Real-time operating systems, Middleware: Real-time data bases, Access to remote objects

MODULE III

Implementing Embedded Systems: Hardware/Software Co-design, COOL, Actual design flows and tools: SpecC methodology, IMEC tool flow, The COSYMA design flow, Ptolemy II, The OCTOPUS design flow.Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, Different Phases of EDLC.Overview of PIC and AVR Family of Microcontrollers and ARM Processors .Introduction to PIC and AVR Family of Microcontrollers and ARM Processors

MODULE IV

Basic Features of VHDL: Major Language Constructs, Lexical Description, VHDL Source File, Data Types, Data Objects, Language Statements, Advanced Features of VHDL.Basic VHDL Modelling Techniques: Modelling Delay in VHDL, The VHDL Scheduling Algorithm, Modelling Combinational and Sequential Logic.HDL-Based Design Techniques: Design of Combinational Logic Circuits, Design of Sequential Logic Circuits; Modelling for Synthesis: Behavioral Model Development, The Semantics of Simulation and Synthesis, Modelling Sequential Behaviour, Modelling Combinational Circuits for Synthesis, Inferred Latches and Don't Cares, Tristate Circuits

Textbooks:

1. Peter Marwedel, Embedded System Design, Springer, 2006 http://ls12-www.cs.unidortmund.de/~marwedel/kluwer-es-book/

Reference Book:

1. Wayne Wolf, Computers as Components, Morgan Kaufmann, 2001 http://www.ee.princeton.edu/~wolf/embedded-book

2. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software CoDesign, Morgan Kaufmann, Systems-on-Silicon Series Embedded

3. Frank Vahid and Tony D. Givargis, System Design: A Unified Hardware/Software Introduction, Addison Wesley, 2002.

4. Michael Barr, Programming Embedded Systems in C and C++, O'Reilly, 1999.

5. David E. Simon, An Embedded Software Primer, Addison Wesley, 1999.

6. Jack Ganssle, The Art of Designing Embedded Systems, Newnes, 2000.

7. K. Short, Embedded Microprocessor System Design, Prentice Hall, 1998. C. Baron, J. Geffroy and G. Motet, Embedded System Applications, Kluwer, 1997.

2nd Semester

DATA ENCRYPTION AND SECURITY

Module I **(14 Hours)**

Introduction: Security Goals, Attacks, Services and Mechanism, Techniques Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers Modern Symmetric-Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers Data Encryption Standard (DES):Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES, Differential Cryptanalysis, Linear Cryptanalysis of DES

Module II **(12 Hours)**

Advanced Encryption Standard (AES): Introduction, Transformations, Key Expansion, Cipher, Analysis of AES Message Integrity and Message Authentication: Message integrity, Random Oracle Model, Message authentication. Cryptographic Hash Functions: Introduction, SHA – 512, Whirlpool

Module III **(8 Hours)**

Entity Authentication: Introduction, Passwords, Challenge – response, Zero – knowledge Key Management: Symmetric – key Distribution, Kerberos, Symmetric – key agreement, Public – key distribution Security at application layer: E-mail, PGP, S/MIME

Module IV **(8 Hours)**

Security at the Transport layer: SSL architecture, Four protocols, SSL message format, Transport layer security Security at the network layer: Two modes, two security protocols, security association, security policy, Internet key exchange

Textbooks:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.2007, ISBN-10 0-07-066046-8:

Reference Books:

1. Elements of Information Theory, By T.M. Cover &Joy.A.Thomas, 2ndedition, Wiley-Interscience, ISBN-10 0-471-24195-4

2. Cryptography & Network Security: AtulKahate, TMH. 2ndEdition, ISBN-10: 0-07-064823-9

2nd Semester

NETWORK ARCHITECTURE AND DESIGN

Module-I **(10 Hours)**

Introduction: overview of analysis, architecture, and design processes, System description, Service description, service characteristics, performance characteristics, Network supportability.Network Architecture: Component architecture, Reference architecture, Architectural models, System and network architectures.

Module: II **(8 Hours)**

Addressing and routing Architecture: Addressing mechanisms, Routing mechanisms, Addressing strategies, Routing strategies, Architectural considerations.Network Management Architecture: Defining network management, Network management mechanisms, Architectural consideration.

Module: III **(8 Hours)**

Performance Architecture: Goals for performance, Performance mechanisms, Architectural consideration. Security and Privacy Architecture: Security and privacy administration, Security and privacy mechanisms, Architectural consideration.

Module: IV **(14 Hours)**

Designing a Network: LAN specifics, Network type, Ethernet fundamentals Network operating systems, Hardware considerations, considering the client, choosing a protocol, connectivity devices, WAN technologies, Remote connectivity, Internet connectivity, securing the network.

Text Books:

1. Network Analysis, Architecture and Design, By James D. McCabe, Morgan Kauffmann publishers, 3rdedition, 2003

2. Network Architecture and Design, By J. F. DiMarzio, Sams Publishing, 2001, ISBN : 0-672-32082-7.

2nd Semester

ANTENNA DESIGN & MEASUREMENT

MODULE-I

Antenna parameters and array fundamental: Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization

Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays.

MODULE-II

Antenna Synthesis: Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods Dolph Chebyshev linear array, Taylor line source method.

MODULE-III

Method of Moments : Introduction to method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of antenna and scatter characteristics. CEM for Antennas: Finite Difference Time Domain Method Geometrical Optics Wedge diffraction theory, ray fixed coordinate system, uniform theory of wedge diffraction, E - Plane analysis of Horn antennas. Cylindrical parabolic antenna, radiation by a slot on a finite ground plane, radiation by a monopole on a finite ground plane, equivalent current concepts, multiple diffraction formulation, by curved surfaces, physical optics, method of stationary phase, Physical theory of diffraction, cylindrical parabolic reflector antennas.

MODULE-IV

Measurements of Antenna and design considerations:

Design consideration of different types of antennas: Aperture Antenna: Techniques for evaluating Gain, Reflector Antenna: - Parabolic reflector antenna principles, Axial-symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice, Microwave and optical Metamaterials, Nano antenna, Optical rectenna Antenna, Fractal Antenna, Smart Antenna, Antenna for Space and Medical Applications

2nd Semester

Text Books:

1. Antenna Theory: Analysis and Design, 3rd Edition by Constantine A. Balanis (Author)
2. Antenna Theory by J. D Kraus, TMH Publication.
3. Antenna Theory and Design 2nd Editionby Warren L. Stutzman (Author), Gary A. Thiele (Author)
4. Antennas 3rd Edition by John D. Kraus (Author), Ronald J. Marhefka (Author)

Recommended Reading:

1. .Practical Antenna Handbook 4th Edition by Joseph Carr (Author)
2. Cai**,** Wenshan, Shalaev**,** Vladimir, Optical Metamaterials, Fundamentals and Applications (Springer series)

2nd Semester

WIRELESS AND MOBILE COMMUNICATION

Module-I

Evolution of mobile radio communication fundamentals, General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling.

Module-II

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.

Module-III

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

Module-IV

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.

Text Book:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson Publications, Second Edition.
2. Upena Dalal, “Wireless Communication and Networks”, Oxford Press Publications.
3. T L Singal ,“Wireless Communications ”, McGraw Hill Publications.

Reference Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
2. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

2nd Semester