BijuPatnaik University of Technology, Odisha
Rourkela

Syllabus
of

M.Tech

in

ELECTRONICS

&

COMMUNICATION ENGINEERING

(Specialization: Signal Processing & Communication Engineering)

From 2014 -2015 Academic Session

Syllabus for Signal Processing & Communication Engineering

1st Semester				2nd Semester			
Theory (Compulsory)				**Theory (Compulsory)**			
Code	**Subject**	**Contact Hours (L-T-P)**	**Credit**	**Code**	**Subject**	**Contact Hours (L-T-P)**	**Credit**
SCPC 101	Modern Digital Communication Technique	4-0-0	04	SCPC201/ SPPC 201	Digital Image & Video Processing	4-0-0	04
SCPC 102	Architecture of DSP	4-0-0	04	SCPC202/ SPPC 202	Detection & Estimation Theory	4-0-0	04
ETPC 102	Information theory, Coding & Cryptography	4-0-0	04				
Professional Elective-I (any One)				**Professional Elective-III (any One)**			
ETPC103	Telecommunication Switching networks	3-0-0	03	VLPE208	Statistical Signal Processing	3-0-0	03
SCPE 101	Digital Filter Design	3-0-0	03	ETPE 101	Adaptive Signal Processing	3-0-0	03
VLPC 102	Digital Integrated Circuit Design	3-0-0	03	SPPE203	Radar & Sonar Signal Processing		
SCPE 102	VLSI Digital Signal Processing	3-0-0	03	ETPE203	Biomedical Instrumentation and Signal Processing		
Professional Elective-II (any One)				**Professional Elective-IV (any One)**			
SCPE 103	Digital Image Processing	3-0-0	03	ETPC202	Wireless communication	3-0-0	03
ETPE105	Fibre Optics Components & Devices	3-0-0	03	ETPE204	Optical Communication	3-0-0	03
VLPE 104	Analog Integrated Circuit Design	3-0-0	03	SPPE204	Pattern Reorganization & Analysis	3-0-0	03
ETPE 102	Satellite Communication System	3-0-0	03	VLPC202	RF and Mixed Signal Integrated Circuit Design	3-0-0	03
Credits (Theory)			**18**				
				Professional Elective-VI (any One)			
				SPPE206	Neural Network	3-0-0	03
				SPPE207	LabVIEW Digital Signal Processing	3-0-0	03
				SCPE 201	Mobile Communications	3-0-0	03
				SCPE 202	Advanced Techniques in DSP	3-0-0	03
				Credits (Theory)			**17**
Practical/Sessionals				**Practical/Sessionals**			
SCPR 101	Communication System Lab	0-0-3	04	SCPR 201	Signal & Systems Simulation Lab	0-0-6	04
SCPT 101	Seminar –I on Pre Thesis Work	0-0-3	02	SCCV 201	Comprehensive Viva	0-0-3	02
				SCCT 201	Technical Seminar	0-0-3	02
Credits(Practicals/Sessionals)			**06**	**Credits(Practicals/Sessionals)**			**08**
Total Semester Credits			**24**	**Total Semester Credits**			**25**
Total Cumulative Credits			**24**	**Total Cumulative Credits**			**49**
3rd Semester				**4th Semester**			
OE	**Open Electives (any ONE)**						
	Project Management / Project Costing / Technology Management / Research Methodology / Optimization Techniques	3-0-0	03				
			03				
			03				
Credits (Theory)			**03**	**Credits (Theory)**			**00**
Practical/Sessionals				**Practical/Sessionals**			
SCPT 301	Thesis Part – I	0-0-3	14	SCPT 401	Thesis Part – II	0-0-6	20
Credits (Practical/Sessional)			**14**	SCCV 402	Technical Seminar	0-0-3	02
Total Semester Credits			**17**	SCCV 401	VIVA	0-0-3	02
				Credits (Practical/Sessional)			**24**
				Total Semester Credits			**24**
				Total Cumulative Credits			**90**

FIRST SEMESTER

MODERN DIGITAL COMMUNICATION TECHNIQUES

Module 1:

Deterministic & Random Signal Analysis

Bandpass&Lowpass Signals, Lowpass Equivalent of Bandpass Signals, Energy Considerations, Lowpass Equivalent of a Bandpass System. Vector Space Concepts, Signal Space Concepts, Orthogonal Expansions of Signals, Gram-Schmidt Procedure. Bounds on Tail Probabilities, Limit Theorems for Sum of Random Variables.Complex Random Vectors.WSS Random Process, Cyclostationary Random Process, Proper and Circular Random Process, Markov Chains.Sampling Theorem for Band-limited Random Process, The Karhunen-LoeveExpansion.Banpass and Lowpass Random Processes. [Proakis&Salehi Sections 2.1, 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9]

Module 2:

Digital Modulation Scheme

Representation of Digitally Modulated Signals, Memoryless Modulation Methods; Pulse Amplitude Modulation, Phase Modulation, Quadrature Amplitude Modulation, Multidimensional Signaling. Signaling Schemes With Memory; Continuous-Phase Frequency-Shift Keying, Continuous-Phase Modulation. Power Spectrum of Digitally Modulated Signals; Power Spectral Density of a Digitally Modulated Signal With Memory, Power Spectral Density of Linearly Modulated Signals, Power Spectral Density of Digitally Modulated Signals With Finite Memory, Power Spectral Density of Modulated Schemes With a Markov Structure, Power Spectral Density of CPFSK and CPM Signals. [Proakis&Salehi Sections 3.1, 3.2, 3.3, 3.4, 3.5]

Optimum Receivers for AWGN Channels

Waveform and Vector Channel Models; Optimum Detection for a General Vector Channel. Waveform and Vector AWGN Channels; Optimal Detection for the Vector AWGN Channel, Implementation of the Optima Receiver for the AWGN Channels. Optimal Detection and Error Probability for ASK, PAM,PSK AND QAM Signaling. [Proakis&Salehi Sections 4.1-1, 4.2-1,4.2-2, 4.3-1, 4.3-2, 4.3-3]

Carrier and Symbol Synchronization

Signal Parameter Estimation; TheLikelyhood Function, Carrier Recovery and Symbol Synchronization in Signal Demodulation. Carrier Phase Estimation; Maximum Likelyhood Carrier Phase Estimation, The Phase-Locked Loop, Effect of Additive Noise in the Phase Estimate. Symbol Timing Estimation; Maximum Likelyhood Timing Estimation. [Proakis&Salehi Sections 5.1-1, 5.1-2, 5.2-1, 5.2-2,5.2-3]

Module 3:

Digital Communication Through Band-Limited Channels

Characterization of Band-Limited Channels. Signal Design for Band-Limited Channels; Design of Band-Limited Signals for No Intersymbol Interference-The Nyquist Criterion, Optimum Maximum-Likelihood Receiver. [Proakis&Salehi Sections 9.1, 9.2-1, 9.3-1]

Multichannel and Multicarrier Systems

Multichannel Digital Communications in AWGN Channels; Binary Signals, M-ary Orthogonal Signals. Multicarrier Communications; Single Carrier verses Multicarrier Modulation, Capacity of a Nonideal Linear Filter Channel, OFDM, Modulation & Demodulation in an OFDM, An FFT Algorithm Implementation of an OFDM System. [Proakis&Salehi Sections 11.1, 11.2-1, 11.2-2, 11.2-3, 11.2-4, 11.2-5]

Spread Spectrum Signals for Digital Communication

Model of Spread spectrum Digital Communication System. Direct Sequence Spread Spectrum Signals; Error Rate Performance of the Decoder, Some Applications of DS Spread Spectrum Signals. Frequency-Hopped Spread-Spectrum Signals; Performance of FH Spread Spectrum Signals in an AWGN Channel, A CDMA System Based on FH Spread Spectrum Signals. [Proakis&Salehi Section 12.1]

Text Book

1. John G. Proakis and MasoudSalehi, ***Digital Communication***, McGraw-Hill, 5th Edition

Reference Books

1. Simon Haykin, ***Digital Communication***, Willy
2. Tube & Schilling, ***Principle of Communication***, PHI

ARCHITECTURE OF DSP

INTRODUCTION TO DIGITAL SIGNAL PROCESING: Introduction, Analysis and Design tool for DSP Systems, DSP using MATLAB. ; **COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATIONS:** Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter. ; **ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES:** The Programmable DSPArchitecture, Top-Down Design of Dedicated DSPs. A Library-Based Systems Design Environment An Abstract Computing Machine, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing. Optimization of Performance, Interconnection between Functional Units, A Multi-level Classification.SISC Architectures, Addressing Modes, External Interface Units. The SISC Processor, Pipeline Control in SISCs, Superscalar Processors. ; **EXECUTION CONTROL AND PIPELINING:** Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models. ; **PROGRAMMABLE DIGITAL SIGNAL PROCESSORS:** Commercial Digital signal-processing Devices, Data Addressing modes, Memory space, instructions and Programming, On-Chip Peripherals, Pipeline Operation of Commercial DSP Processor ; **IMPLEMENTATIONS OF BASIC DSP ALGORITHMS :** The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing. An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, Computation of the signal spectrum. ; **INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES :**Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

Text Book

1. B. VenkataRamani and M. Bhaskar,*Digital Signal Processors*, Architecture, Programming and Applications –TMH, 2004.

Reference Book

1. JonathamStein,*Digital Signal Processing*, John Wiley, 2005.
2. Avtar Singh and S. Srinivasan,*Digital Signal Processing* –Thomson Publications, 2004.
3. Vijay K. Madisetti, *"VLSI Digital Signal Processors – An Introduction to Rapid Prototyping and Design Synthesis"*, IEEE Press, 1999.
4. Richard J. Higgins, *"Digital Signal Processing in VLSI"*, Prentice Hall, 1990

INFORMATION THEORY, CODING AND CRYPTOGRAPHY

Module: 1

Source Coding

Introduction to information theory, uncertainty of information, Information measure, entropy, source coding Theorem, Huffman Coding, runlength encoding, rate distortion function, JPEG and MPEG standards in image compression.

Channel Capacity and Coding

Channel models, Channel Capacity, Channel Coding, Information Capacity Theorem, The Shannon Limit.

Module: 2

Error Control Coding

Linear Block Codes: Introduction, Basic definition, equivalent codes, parity - check matrix, decoding, syndrome decoding, Perfect Codes, Hamming Codes, Optimal Linear codes.

Cyclic Codes

Introduction polynomials, The division Algorithm, Method for generating cyclic codes, Burst Error correction, Fire Codes, Golay Codes, CRC Codes, Circuit implementation.

Bose ChaudhuriHocquenghem (BCH)

Introduction, Primitive elements, minimum polynomials, Examples of BCH codes, Decoding of BCH codes, Recd - Solomon codes.

Module: 3

Convolution Codes

Introduction, Tree Codes and Trellis Codes, Polynomial description, The Generating function, Matrix Description, Viterbi Decoding, Distance bounds, Turbo Codes, Turbo Decoding.

Trellis Coded Modulation (TCM)

Introduction, the concept of coded modulation, Mapping by set Partitioning, Design rules, TCM Decoder.

Coding for Secure Communication, Cryptography

Introduction, encryption techniques, Symmetric cryptography, data encryption standard, Asymmetric Algorithm the RSA Algorithm.

Textbooks:

1. *Ranjan Bose, **Information Theory, Coding and Cryptography**, 2nd Edn., Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008. ISBN-10: 0-07-066901-5, ISBN-13: 978-0-07-066901-7.*

Recommended Reading:

1. *R. Avudaiammal, **Information Coding Techniques**, 2nd Edn., Tat McGraw-Hill Education Pvt. Ltd., New Delhi. ISBN(10): 0-07-067282-2, ISBN(13): 978-0-067282-6.*
2. *J. G. Proakis, **Digital Communication**, 3rd Edition, McGraw-Hill Publication,.*

TELECOMMUNICATION SWITCHING & NETWORKS

MODULE – I

Introduction

Evolution, simple telephone communication, basis of switching system,telecommunicationnetworks.

Electronic space division switching

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

Time Division Switching

Basic time division space switching, basic time division time switching, timemultiplexed space and time switching, combination switching, three-stagecombination switching.

MODULE – II

Traffic Engineering

Network traffic load and parameters, Grade of service, modelling switchingsystems, incoming traffic, blocking models and loss estimates.

Telephone Networks

Subscriber loop systems, switching hierarchy and routing, transmission plan,transmission systems, signalling techniques

MODULE – III

Data Networks

Data transmission in PSTN, switching techniques, Data communicationarchitecture, link-to-link layers, end-to-end layers, satellite based datanetworks, LAN, MAN, Fibre optic networks, an overview of data networkstandards

Integrated Service Digital Network, motivation, new services, transmission channels, signalling, service characterization, ISDN standards, broad bandISDN, voice data integration.

Textbooks:

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

*2.Alberto Leon-Gracia and IndraWidjaja, **Communication Networks**, TataMcGrawHill Education Pvt. Ltd., New Delhi.*

DIGITAL FILTER DESIGN

Transforms: Discrete-time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT), Modified DCT (MDCT). Discrete Time systems: linear and circular convolution, overlap add, overlap save, stability triangle, allpass filters, group delay, minimum phase systems. 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. 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.

DIGITAL INTEGRATED CIRCUIT DESIGN

MODULE – I

Introduction, Design Metrics and Manufacturing Process:

A Historical Perspective, Issues in Digital Integrated Circuit Design, Quality Metrics of a DigitalDesign, Introduction to Manufacturing Process, Manufacturing CMOS Integrated Circuits, Design Rules – The Contract between Designer and Process Engineer, Packaging Integrated Circuits

The Devices:

Introduction, The Diode, The MOS(FET) Transistor, The Wire, Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical Wire Models, SPICE Wire Models

The CMOS Inverters and CMOS Logic Gates – the Static View:

Introduction to CMOS Inverter, The Static CMOS Inverter – An Intuitive Perspective, Evaluating the Robustness of the CMOS Inverter, Introduction to Static CMOS Design, Complementary CMOS, Ratioed Logic, Pass-Transistor Logic

CMOS Inverter – the Dynamic View:

Performance of CMOS Inverter: The Dynamic Behavior, Power, Energy, and Energy-Delay, Perspective: Technology Scaling and its Impact on the Inverter Metrics

MODULE – II

Dynamic CMOS Logic, Timing Metrics:

Dynamic CMOS Design, CMOS Logic Design Perspectives, Timing Metrics: Timing Metrics for Sequential Circuits, Classification of Memory Elements

Static and Dynamic Sequential Circuits:

Static Latches and Registers, Dynamic Latches and Registers, Alternative Register Styles: Pulse Registers and Sense-Amplifier Based Registers, Pipelining: An Approach to Optimize Sequential Circuits – Latch Vs Register-Based Pipelines and NORA-CMOS – A Logic Style for Pipelined Structures, Nonbistable Sequential Circuits

Coping with Interconnect:

Introduction, Capacitive Parasitics, Resistive Parasitics, Inductive Parasitics, Advanced Interconnect Techniques, Networks-on-a-Chip

Timing Issues in Digital Circuits:

Introduction, Timing Classification of Digital Systems, Synchronous Design – An In-depth Perspective, Self-Timed Circuit Design, Synchronisers and Arbiters, Clock Synthesis and Synchronisation Using a Phase-Locked Loop, Future Directions and Perspectives

MODULE – III

Designing Arithmetic Building Blocks:

Introduction, Datapaths in Digital Processor Architecture, The Adder, The Multiplier, The Shifter, Other Arithmetic Operators, Power and Speed Trade-off's in Datapath Structures, Perspective: Design as a Trade-off

Designing Memory and Array Structures:
Introduction, The Memory Core, Memory Peripheral Circuitry, Memory Reliability and Yield, Power Dissipation in Memories, Case Studies in Memory Design: The PLA, A 4-Mbit SRAM and A 1-Gbit NAND Flash memory, Perspective: Semiconductor Memory Trends and Evolution
Validation and Test of Manufactured Circuits:
Introduction, Test Procedure, Design for Testability, Test Pattern Generation

Textbooks:

1. Jan M. Rabaey, AnanthaChandrakasan, BorivojeNikolic, ***Digital Integrated Circuits*** – A Design Perspective**,** 2nd edn., Pearson Education, 2003. ISBN: 8178089912.

Recommended Reading:

1. K. Eshraghian, and N.H.E. Weste, Principles of CMOS VLSI Design – a Systems Perspective, 2nd edn., Addison Wesley, 1993.
2. Wayne Wolf,***Modern VLSI Design System–on–Chip Design***, 3rd edn,Pearson Ed, 2003.
3. M. Michael Vai, ***VLSI Design***, CRC Press, 2001.
4. John P. Uyemura, ***CMOS Logic Circuit Design***, Springer (Kluwer Academic Pub), 2001.
5. Ken Martin, ***Digital Integrated Circuit Design***, Oxford University Press, 2000.

VLSI DIGITAL SIGNAL PROCESSING SYSTEMS

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.
Retiming: Definitions and properties, Solving systems of inequalities, Retiming techniques.

MODULE – II
Unfolding: An algorithm for unfolding, Properties of unfolding, Critical path, unfolding and retiming, Applications of unfolding.
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 – III
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.

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

DIGITAL IMAGE PROCESSING

Digital Image Fundamentals, Image Transforms: Fourier, Hadamard, Walsh, Discrete cosine and Hotelling Transforms; Image Enhancement: Histogram modification, Histogram equalisation, Smoothing, Filtering, Sharpening, Homomorphic filtering. ; 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. Matching and Registration: Image modeling, Stereo mapping, Landmark matching, Rectification in geometric transformations, Match measurement, Matching of binary pattern, Distortion tolerant matching; 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.

Text Book

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.

FIBRE-OPTIC COMPONENTS AND DEVICES

MODULE – I

Fibre-Optic Light Sources and Detectors

Brief description on the principle of optical sources,Internal Quantum efficiencyofLED,Modulationcapability,Power-Bandwidth product, Laser diodes, Laserdiode modes, Threshold conditions,Resonant frequencies, Laser diodestructures, Single mode lasers, modulation of laser diodes.

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

MODULE – II

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 eccentricconnectors, Duplex fibre connectors, Expanded beam connectors, Fibre couplers, Three port couplers, Four port couplers, Star couplers, WDMcouplers.

MODULE – III

Optical Amplification and Integrated Optics

ptical amplifiers, Semiconductor laser amplifiers, Fibre amplifiers, Rare earthdoped fibre amplifiers, Raman fibre amplifiers, Brillouin fibre amplifiers, Integrated optics, Integrated optical devices, Beam splitters, Directionalcouplers, 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.

ANALOGUE INTEGRATED CIRCUIT DESIGN

MODULE – I

Introduction:

The MOS Transistor, I-V Characteristics, Equivalent Circuits, Noise

Resistor, Capacitors and Switches:

Integrated Resistors, Integrated Capacitors, Analog Switches, Layout of Switches

Basic Building Blocks:

Inverter with Active Load, Cascode, Cascode with Cascode Load, Source Follower, Threshold Independent Level Shift, Improved Output Stages

MODULE – II

Current and Voltage Sources:

Current Mirrors, Current References, Voltage Biasing, Voltage References

CMOS Operational Amplifiers:

General Issues, Performance Characteristics, Basic Architecture, Two Stages Amplifier, Frequency Response and Compensation, Slew Rate

MODULE – III

Operational Amplifiers and OTAs

Design of Two Stage OTAs: Guidelines, Single Stage Schemes, Class AB Amplifiers, Fully Differential Op-Amps, Micro-Power OTAs, Noise Analysis, Layout

CMOS Comparators:

Performance Characteristics, General Design Issues, Offset Compensation, Latches

Textbooks:

1. Franco Maloberti, ***Analog Design for CMOS VLSI Systems***, Kluwer Academic Publishers, 2001. ISBN: 0-7923-7550-5.

Reference Books:

1. BehzadRazavi, ***Design of Analog CMOS Integrated Circuits***, McGraw-Hill, 2001. ISBN: 0-07-238032-2.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, ***Analysis andDesign of Analog Integrated Circuit***, John Wiley & Sons, Inc., 4th edn., 2000. ISBN: 0471-32168-0.
3. Phillip E. Allen and Douglas R. Holberg, ***CMOS Analog Circuit Design***, Oxford UniversityPress, 2nd edn., 2002. ISBN: 0-19-511644-5
4. Johan H. Huijsing, ***Operational Amplifiers – Theory and Design,*** Kluwer. ISBN:0792372840

SATELLITE COMMUNICATION SYSTEM

Module: 1

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. Earth station design - Digital transmitter and receiver, antenna and beam steering techniques.

Module: 2

Link Design

Digital satellite link analysis and design for FSS and BSS - link budget and Eb/No calculations, Performance impairments - Noise, interference, propagation effects and frequency considerations.

Module: 3

Access Techniques

FDMA concept- Intermodulation and back off - SPADE system. TDMA concept - Frame and burst structure - Frame acquisition and synchronization - Satellite Switched TDMA system. CDMAconcepts - DS and FH System acquisition and Tracking.Audio broadcasting via satellite – World Space Services through Teledesic, LEO system and Globstar.

Textbooks:

1. Tri T. Ha, ***Digital Satellite Communication Systems Engineering***, McGraw Hill, 1990.
2. Wilbur L. Pritchard, Henri G. Suyderhoud, and Robert A. Nelson, ***SatelliteCommunication System Engineering***, 2nd Edn., Pearson Education, New delhi.

Recommended Reading:

1. Pratt and Bostain, ***Satellite Communication***, John Wiley and Sons, 1986.
2. M. Richharia, ***Mobile Satellite Communications – Principles and Trends***, PearsonEducation, 2003.
3. Robert.M.Gagliardi, ***Satellite Communication***, CBS Publishers.

SECOND SEMESTER

DIGITAL IMAGE & VIDEO PROCESSING

Module I (12 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.
Image Restoration: Degradation Models, PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.

Module II (14 Hrs)
Image Segmentation: Pixel classification, Bi-level thresholding, Multi-level thresholding, P-tile method, Adaptive thresholding, Spectral & spatial classification, Edge detection, Hough transform, Region growing.
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 III: (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

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

STATISTICAL SIGNAL PROCESSING

Module I

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

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)

Spectrum Estimation: Introduction, Nonparametric Method- The Periodogram, Performance of Periodogram. Parametric Methods- AR Spectrum Estimation, MA Spectrum Estimation, ARMA Spectrum Estimation. Frequency Estimation- Eigendecomposition 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 III

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, RLS- Exponentially 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.

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]
Linear Prediction
Forward Linear Prediction, Backward Linear Prediction, Properties of Prediction Error Filters. [Read Haykin: Chapter 3.1, 3.2, 3.4]

MODULE – II
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]

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]

MODULE – III

Frequency-Domain and Subband Adaptive Filters

Block Adaptive Filters [Read Haykin: Chapter 7.1]

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***, 4th Edn. Pearson Education.

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.
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 II: 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 III: 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.

BIOMEDICAL INSTRUMENTATION AND SIGNAL PROCESSING

MODULE – I

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

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

Time-frequency representations: Introduction, Short-time Fourier transform, spectrogram, wavelet signal decomposition.

Biomedical applications: Fourier, Laplace and z-transforms, autocorrelation, crosscorrelation, power spectral density.

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.

WIRELESS COMMUNICATION

Module – I

A brief introduction to evolution of mobile radio communications, technologies and choices. Development of Wireless networks, Cellular Concept – System Design: Fundamentals: Frequency reuse, channel Assignment, Handoff Strategies, Interfaces and System Capacity, Trunking and Grade of Service; Improving coverage and capacity in Cellular Systems- Cell Splitting, Sectoring, Repeaters and Range Extension, Microcell &Picocell Zone Concept, multipath effects in mobile communication, mobile communication – antennas.

Large – Scale Propagation: basic propagation mechanisms – Reflection, Diffraction, Scattering. Outdoor propagation Model – Longly Rice model, Durkin's model, Okumura model, Hata model, PCS extension; Indoor Propagation Model; Partition loses, Log distance Path loss Model, Attenuation Factor model, Ray tracing & site specific modeling.

Small Scale Propagation: small scale multi path propagation. Small scale multi path measurements, Parameters of multi path channels, types of multi path fading, Rayleigh and Ricean distribution, Clarke's model, multi path space factors, fading rate variance.

Module – II

Spread spectrum modulation techniques, Equalization Technique – Linear equalizer and Nonlinear equalization, algorithms for adaptive equalization, Diversity techniques – space, polarization, frequency and time, Speech coding – quantization, ADPCM, frequency domain coding, Vocoders, linear predictive coders, GSM codec. Multiple Access Techniques: Frequency Division Multiple Access (FDMA – Wideband and narrow band), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access – Frequency Hopped multiple Access (FHMA), Code Division Multiple Access (CDMA). Space Division Multiple Access (SDMA), Spectral efficiency of different access technologies, Packet ratio protocols – ALOHA, carrier sense Multiple Access (CSMA/CD, CSMA/CA), Packet reservation Multiple Access (PRMA), capacity of cellular systems

Module – III

Evolution of Modern Mobile Wireless Communication systems

WPAN, IEEE 802.15, DECT, PACS, brief survey of: 1G wireless networks, 2G wireless cellular networks, GSM (radio subsystem, operation subsystem), GSM multiple access scheme, GSM channel organization, call setup procedure, 2.5G networks, GPRS network architecture, classes of GPRS equipments. IS-95 systems, 3G (UMTS) (without details) of network architecture.

Fundamentals of WLAN (802.11) transmission technology (spread spectrum and infrared transmission) logical architecture, CSMA/CA, CSMA/CD, assess method, MAC frame format system performance.

Cellular and WLAN integration: (step towards 4G networks) benefits of integration. Suitable point of integration, integration architecture.

A brief overview of WiMAx technology (broadband wireless communication).

TEXT BOOKS:

1. Wireless Communications by T. S. Rappaport, 2nd Edition, Pearson Education.
2. Wireless Communications & Network 3G and beyond Itisaha Mishra, Tata Mc-Graw Hill Education Pvt. Ltd.
3. Mobile cellular Telecommunications by W. C. Y. Lee, 2nd Edition, McGraw Hill.

REFERENCE BOOKS:

1. Wireless Communication by T. L. Singal, Tata Mc-Graw Hill Education Pvt. Ltd.
2. Wireless Communication and Networks by V. K. Garg, Elsevier.
3. Wireless Digital Communication by KamiloFeher, PHI.
4. Wireless Communication and Networks by William Stalling, 2nd Ed, LPE, Pearson.
5. Introduction to CDMA Wireless Communication by Mosaali Abu Rgheff, Elsevier.
6. 3G Networks by SumitKasera&NishitNarang, Tata McGraw Hill.

OPTICAL COMMUNICATION

Module – I

Evolution of Fibre Optic systems, Elements of an optical Fibre transmission link, Basic optical laws and definitions, Optical fibre modes and configurations, Rays and modes, Ray optics representation, Wave representation, mode theory for circular wave guides, wave guide equations, wave equation for step index

Fibres, modes in step index fibres, linearly polarised modes, power flow in step index fibres, Single mode fibres, propagation modes in single- modes fibres. Graded index fibre structure, graded-index numerical aperture (NA).Elementary ideas on fibre Materials, fabrication and fibre optic cables.

Module – II

Signal degradation in Optical fibres, Attenuation, Absorption, scattering losses, bending loses core and cladding losses. Signal distortion in optical wave guides, information capacity of optical fibres, Material dispersion, wave guide dispersion, signal distortion in single mode fibres, Inter modal distortion. Pulse broadening in graded index fibre guides, Design optimization of single-mode fibres (elementary concepts)
Basic ideas of light sources and their principle of operation (LEDs and LASERS), power-bandwidth product of LEDs and modulation capability, resonant frequencies of LASER diodes, Physical principles of photo detectors, Avalanche photo diodes
Optical receiver operation (Fundamentals) digital signal transmission, error sources, Digital transmission systems, link power budget, Rise time budget Transmission distance for single mode links, first window transmission distance, Line codes used computer aided modeling of an optical fibre link; Receiver noises.

Module – III

Coherent Optical fibre communications, definition and classification of coherent system, fundamental concepts; Homodyne detection, heterodyne detection, source line widths, wavelength tuning, modulation techniques. Direct-detection OOK, OOK homodyne system, PSK homodyne system, heterodyne detection schemes. Performance improvement with coding. Polarization control requirements.
Wave length division multiplexing optical fibre ring as LAN, FDDI.Optical amplifiers; type of amplifiers with expression for gains and noise figure, optical bandwidth, Photonic switching integrated optical switches.

TEXT BOOK

1. Gerdkeiser, Optical Fibre Communications, McGraw Hill, Inc.

REFERENCE BOOK

1.G. K. Sarksr, D. C. Sarkar –Opto Electronics and Fibre Optics Communication, New Age International Published (P) Limited, Delhi.

PATTERN RECOGNITION AND ANALYSIS

Module 1:

Introduction - features, feature vectors and classifiers, Supervised versus unsupervised pattern recognition. Classifiers based on Bayes Decision theory- introduction, discriminant functions and decision surfaces, Bayesian classification for normal distributions, Estimation of unknown probability density functions, the nearest neighbour rule. Linear classifiers,- Linear discriminant functions and decision hyper planes, The perceptron algorithm, MSE estimation, Logistic determination, Support Vector machines.

Module II:

Non-Linear classifiers- Two layer and three layer perceptrons, Back propagation algorithm, Networks with Weight sharing, Polynomial classifiers, Radial Basis function networks, Support Vector machines-nonlinear case, Decision trees, combining classifiers, Feature selection, Receiver Operating Characteristics (ROC) curve, Class separability measures, Optimal feature generation, The Bayesian information criterion.
Feature Generation 1- Linear transforms-KLT, SVD, ICA, DFT, DCT, DST, Hadamard Transform, Wavelet Transform, Wavelet Packets etc- Two dimensional generalizations - Applications. Feature Generation 2- regional features, features for shape and characterization, Fractals, typical features for speech and audio classification, Template Matching, Context dependent classification-Bayes classification, Markov chain models, HMM, Viterbi Algorithm. System evaluation - Error counting approach, Exploiting the finite size of the data.

Module III:

Clustering- Cluster analysis, Proximity measures, Clustering Algorithms - Sequential algorithms, Neural Network implementation.Hierarchical algorithms - Agglomerative algorithms, Divisive algorithms. Schemes based on function optimization - Fuzzy clustering algorithms, Probabilistic clustering, K - means algorithm. Clustering algorithms based on graph theory , Competitive learning algorithms, Binary Morphology Clustering Algorithms Boundary detection methods, Valley seeking clustering, Kernel clustering methods. Clustering validity.

References
1. SergiosTheodoridis, KonstantinosKoutroumbas, "Pattern Recognition", Academic Press, 2006.
2. Duda and Hart P.E, Pattern classification and scene analysis, John Wiley and sons, NY, 1973.
3. Earl Gose, Richard Johnsonbaugh, and Steve Jost; Pattern Recognition and Image Analysis, PHI Pvte.Ltd., NewDelhi-1, 1999.
4. Fu K.S., Syntactic Pattern recognition and applications, Prentice Hall, Eaglewood cliffs, N.J., 1982
5. Rochard O. Duda and Hart P.E, and David G Stork, Pattern classification , 2nd Edn., John Wiley & Sons Inc., 2001
6. Andrew R. Webb, " Statistical Pattern Recognition", John Wiley & Sons, 2002

RF AND MIXED SIGNAL INTEGRATED CIRCUIT

MODULE – I
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
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
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. **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.

NEURAL NETWORK

Module I:
Introduction to neural networks.Artificial intelligence and neural networks.The human brain and the nervous system.The biological neuron.Models of the single neuron. Neural networks viewed as directed graphs. Network architectures.Knowledge representation in neural networks.Applications of neural networks.
Module II:
Learning in neural networks.Types of learning methods.Classification of learning methods.Statistical nature of the learning processs.Statistical learning theory.The Probably Approximately Correct (PAC) model.Learning in a single layer perceptron.Adaptive filtering and the LMS algorithm.Learning rate

annealing techniques.Perceptron convergence theorem. Multilayer perceptron: the error back-propagation learning method. Accelerated convergence in back-propagation learning.Radial basis function network.The counter-propagation network.

Module III:

Support vector machines. Optimal hyperplane for non-separable patterns. Building support vector machines. Principal component analysis (PCA).Hebbian based and lateral inhibition based adaptive PCA. Kernel based PCA. Self OrganizationMaps.Learning vector quantization.Information theoretic models.Maximum Entropy Principle. Mutual information and Kullback-Leibler divergence

References :

1. Simon Haykin, Neural Networks - A comprehensive foundation, Pearson Education Asia, 2001.
2. Frederic M. Ham &IvicaKostanic, Principles of Neuro-computing for Science and Engineering, Tata McGraw hill, 2002.

3. Kumar S, Neural Networks : A Classroom Approach, TMH

4. J.S.R. Jjang, C.T. Sun and E. Mizutani, Neuro fuzzy and Soft Computing : A computational approach to learning and machine intelligence, Prentice Hall of India,2002

5. YegnaNarayana B – Artificial Neural Networks – PHI

6. Timothy J Ross – Fuzzy logic with Engineering Applications

7. Christopher Bishop, Neural Networks for Pattern Recognition, Oxford University Press

8. J M Zurada, Introduction to Atificial Neural Networks, Jaico Publishing House

LABVIEW DIGITAL SIGNAL PROCESSING

Module I:

Digital Communications and LabVIEW: Conventional Digital Receiver, Subsampling Receiver

Getting a Signal into LabVIEW: Conventional Digital Receiver, Subsampling Digital Receiver, Choosing a sample rate, Subsampling SNR, Subsampling signal placement, ther Sampling Methods, Digital oscilloscope, RF spectrum analyzer, Analog sampling card, Soundcard

Module II: Building Blocks

Spectral Analysis: Low-Level Frequency Domain Functions, Simple FFT, Improved FFT, Analyzing the DFT Results, Spectral leakage, Sampling window shape, High-Level Spectral Functions, Adding C Routines to LabVIEW, Spectral Measurements Toolset

Digital Filters: Filter Types, FIR Filters, FIR filter design by windowing, Equiripple FIR filters, IIR Filters, Comparing IIR and FIR Filters, IIR versus FIR magnitude, Effects of filter-phase response, Pulse-Shaping Filter

Multirate Signal Processing in LabVIEW: Upsampling, Downsampling, Resampling Filters, Halfband filters, Polyphase filters

Generating Signals with LabVIEW: Basic Functions, Sinusoids, Complex mixer, Sinc function, Chirp sequence, Generating Channel Models, Rayleigh fading, White gaussian noise, Generating Symbols

Module III: Building a Communication System

Assembling the Pieces: Modulator, Demodulator, Channel Impairments, Signal Detection and Recovery, Matched filter detection, Threshold decisions

Synchronization: Time synchronization, Frequency synchronization, NI Modulation Toolset

System Performance: Performance Measurements, Bit-error rate, Error vector magnitude, Improving System Performance, Channel estimation, Channel coding, Viterbi decoder

Optimizing LabVIEW Signal Processing: General LabVIEW Coding Guidelines, Signal Processing Tips, Linear convolution with the FFT, Fast real FFT

More LabVIEW DSP Applications, Roots of difference equations, Linear predictive speech coder

Text book

1. Cory L. Clark, “LabVIEW Digital Signal Processing and Digital Communications” McGraw-Hill, 2005

2. Nasser Kehtarnavaz and Namjin Kim, “Digital Signal Processing System-Level Design Using LabVIEW”, Elsevier publication, 2005.
3. Nasser Kehtarnavaz, “Digital Signal Processing System Design: LabVIEW - Based Hybird Programming”, 2nd Edition, Elsevier, ISBN 13 : 9788131222478.
LabVIEW Signal Processing Course Manual

Recommended Reading:

1. Jerome Jovitha, Virtual Instrumentation Using Labview, PHI Learning,, 2010, ISBN-10: 8120340302, ISBN-13: 9788120340305, 978-8120340305.
2. Sanjay Gupta and Joseph John, Virtual Instrumentation Using LabVIEW, 2nd Edn., Tata McGraw-Hill, 2010, ISBN-10: 0-07-070028-1, ISBN-13: 978-0-07-070028-4.
3. Gary W. Johnson and Richard Jeninngs, LabVIEW Graphical Programming, 4th Edn.,McGrawHill, 2006.
4. J. Travis and J. Kring, LabVIEW for Everyone, 3rd Edn., Prentice Hall, 2006.
5. Peter A. Blume, TheLabVIEW Style ***Book***, Prentice Hall, 2007.

MOBILE COMMUNICATIONS

Evolution Mobile Systems around the World, Example of the mobile radio systems, recent trends,Frequency reuse, Channel assignment, hand off process, Interference. Path less:– Radio wavepropagation, diffraction, Scattering, link budget; Outdoor and indoor propagation models; Principleof multi path propagation, Impulse response model of channels, parameters for mobile multi pathchannels, concept of fading, Rayleigh and Ricean fading; simulation of fading channels. Modulationstechniques for mobile communication:- Linear Modulation techniques, constant envelop modulation, QPSK, MSK, GMSK, spread spectrum modulation techniques. Equalization:-Fundamentals, General adaptive equalizer, Linear and non-linear equalizers, diversity techniques,RAKE receivers. Basic concept of coding. Multiple access techniques: - Introduction, FDMA, TDMA, CDMA, Space division multiple access, capacity of cellular systems. Introduction to OFDM and wireless LAN.

Text Book

1. T.S. Rappaport, *Wireless Communications – Principles and Practice*, Prentice Hall of India/ Pearson Education India, 2002.
2. W C Y Lee; *Mobile Communication Engineering*, Tata McGraw Hill, India, 2008

Reference Book

1. W.C.Y. Lee, *Digital Cellular Systems*, McGraw Hill, 2000.
2. G. Stuber; *Principles of Mobile Communication*, 2001, Springer

ADVANCED TECHNIQUES IN DSP

Multi-rate Digital Signal Processing: Decimation by a factor D, interpolation by a factor 1, sampling rate conversion by a national factor I/D. ; 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. ; Power spectrum estimation, non-parametric method Barlett, Parametric method. ; Yule-Walker MA and ARMA models. Higher order statistics and its applications. ; DSP transforms: Discrete Hartely transform, Discreteconsine transform, Discrete Wavelet transform, S-transform. 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 andrepresentations, Springer, NY, USA, 2003.