FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY IN ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI (2020-2021)

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Established Under Section 3 of UGC Act 1956)
COIMBATORE 641 021 INDIA

FACULTY OF ENGINEERING

DOCTORATE IN PHILOSOPHY (Ph.D.)

REGULATIONS 2020

These regulations are effective from the academic year 2020-2021 and applicable to the candidates admitted to Ph.D. during 2020-2021and onwards.

I. ELIGIBILITY CRITERIA

First class or 55% marks (50% marks for SC/ST), in M. Tech degree in Electronics and Communication Engineering or in related disciplines.

II. MODE OF SELECTION

The guidelines as given in the Regulations for M.Phil.,/ Ph.D., of Karpagam Academy of Higher Education are applicable.

III. PROGRAMME STRUCTURE AND RESEARCH WORK

Upon successful completion of the degree, the candidate will be conferred with the degree of Doctorate of Philosophy (Ph.D.) in Electronics and Communication Engineering under the Faculty of Engineering.

PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN ELECTRONICS AND COMMUNICATION ENGINEERING

SL.NO	Course code	TITLE OF THE COURSE	C	EXAM. HRS	MARKS
1	20RECE101	PAPER I-Research Methodology and Pedagogy	4	3	100
2	20RECE201	PAPER II-Research and Publication Ethics	4	3	100
3	20RECE301	PAPER III Synthesis and Optimization of Digital Circuits	4	3	100
4	20RECE302	PAPER III Advanced DSP	4	3	100
5	20RECE303	PAPER III Soft Computing	4	3	100
6	20RECE304	PAPER III Wireless Sensor Networks	4	3	100
7	20RECE305	PAPER III VLSI signal processing	4	3	100
8	20RECE306	PAPER III Wavelets and multi-resolution processing	4	3	100
9	20RECE307	PAPER III Computer Vision and Image processing	4	3	100
10	20RECE308	PAPER III-Special Paper I: Solid State Device Modeling and Simulation	4	3	100

11	20RECE309	Paper III-Special Paper II Mobile Ad-Hoc Networks	4	3	100
12	20RECE310	Paper III-Special Paper III: Network Routing Algorithms	4	3	100
13	20RECE311	PAPER III-Special PAPER IV**:** Low Power VLSI Design	4	3	100
14	20RECE312	Paper III-Special Paper V: Testing of VLSI Circuits	4	3	100
15	20RECE313	Paper III- Special Paper VI:Advanced Digital Image Processing	4	3	100
16	20RECE314	Paper III-Special Paper VII: Bio-Medical Signal Processing	4	3	100
17	20RECE315	Paper III-Special Paper VIII: Pattern Recognition	4	3	100
18	20RECE316	Paper III-Special Paper IX: Design of Analog and Mixed Mode VLSI Circuits	4	3	100
		TOTAL	72	54	1800

20RECE101 **Paper I:** Research Methodology and Pedagogy 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I Introduction to Research

Research – Definition – Importance and Meaning of research – Characteristics of research – Types of Research – Steps in research – Identification, Selection and formulation of research problem – Research questions – Research design – Formulation of Hypothesis – Review of Literature.

UNIT II Sampling Techniques

Sampling techniques: Sampling theory – types of sampling – Steps in sampling – Sampling and Non-sampling error – Sample size – Advantages and limitations of sampling. Collection of Data : Primary Data – Meaning – Data Collection methods – Secondary data – Meaning – Relevances, limitations and cautions.

UNIT III Statistics in Research

Statistics in Research – Measure of Central tendency – Dispersion – Skewness and Kurtosis in research. Hypothesis – Fundamentals of Hypothesis testing – Standard Error – Point and Interval estimates – Important Non-Parametric tests : Sign, Run, Kruskal – Wallis tests and Mann-Whitney test.

UNIT IV Testing Methods

Para metric tests : Testing of significance – mean, Proportion, Variance and Correlation – testing for Significance of difference between means, proportions, variances and correlation co-efficient. Chi-square tests – ANOVA – One-way and Two-way. Research Report : Types of reports – contents – styles of reporting – Steps in drafting reports – Editing the final draft – Evaluating the final draft.

UNIT V Pedagogical Methods in Higher Learning

Pedagogical Methods in Higher Learning Objectives and roll of higher education – Important characteristics of an effective Lecture – Quality teaching and learning – Lecture preparation – Characteristics of instructional design – Methods of teaching and learning : Large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing Demonstration, Brain storing, case discussion, and assignment, Methods of evaluation – Self evaluation, student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education: - ‘e’ learning researches – web based learning

Suggested Readings

1. Gupta S.P. (2017) Statistical Methods Sultan Chand & Sons – Tb Publishers (P) Ltd.
2. Kothari C.R.(2004) Research Methodology Methods and Techniques-New age International (P) Ltd.Publishers.
3. Gupta B.N. Statistics(2015) (Theory and Practice) Publishers (P) Ltd SBPD Publications (P) Ltd.
4. Santosh Gupta, Research Methodology and Statistical Techniques, Publisher (P) New Delhi, Deep and Deep Publications Pvt. Ltd., 2010.
5. Rajasekar.S (2005) Computer Education and educational computing. Hyderabad: Neelkamal Publications.
6. Kumar K.L. (1997) Educational Technologies, New Delhi: New age International (P) Ltd.Publishers.

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20RECE201 Paper II: Research Publication Ethics 4H:4C

Instruction hours/week:L:T:P:C-	4 0 0 4	Marks:External 100	Total 100
		End semester Exam:	3Hrs

THEORY

Unit I: Philosophy and Ethics

Introduction to Philosophy: Definition, nature and scope, concept, branches – Ethics: Definition, moral Philosophy, nature of moral /judgments and reactions.

Unit II: Scientific Conduct

Ethics with respect to science and research – Intellectual honesty and research integrity – Scientific misconduct: Falsification – Fabrication and Plagiarism (FFP) – Redundant publications: duplicate and overlapping publications – salami slicing – Selective reporting and misrepresentation of date.

Unit III: Publication Ethics

Publication Ethics: Definition, introduction and importance – Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. – Conflicts of interest – Publication Misconduct: definition, concept, problems that lead to unethical behavior and vice versa, type – Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals – Predatory publishers and journals.

Unit IV: Publication Misconduct

Group Discussion: Subject specific ethical issues, FFP, authorship – Conflicts of interest – Complaints and appeals: examples and fraud from India and abroad.

Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit V: Databases and Research Metrics

Database: Indexing database – Citation database: Web of Science, Scopus, etc.

Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score – Metrics: h-index, g index, i10 index, altimetric.

Unit VI: Development of e-content & IPR

Integrated Library Management System (ILMS) : e-journals – e-books – e-shodhsindu – Shodhganga – Database – e-content Development – Learning Management System (LMS) – e-PG- Pathshala – CEC (UG) SWAYAM – MOOCs – NPTEL – NMEICT.

IPR: Patent – Copyrights – Trademark – Geographical Indication.

PRACTICE

Open Access Publishing

Open access publications and initiatives – SHERPA / ROMEO online resource to check polisher copyright & self-archiving policies – Software tool to identify predatory publications developed by SPPU – Journal finder / journal suggestion tool viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

Suggested Reading

Peer Review and Manuscript Management in Scientific Journals, Guidelines for Good Practice, Irene Hames, Blackwell Publishing, 2007

20RECE301 Paper III: Synthesis And Optimization Of Digital Circuits 4H:4C

Instruction hours/week:L:T:P:C-4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT-I Introduction

Microelectronics, semiconductor technologies and circuit taxonomy, Microelectronic design styles, computer aided synthesis and optimization. Graphs: Notation, undirected graphs, directed graphs, combinatorial optimization, Algorithms, tractable and intractable problems, algorithms for linear and integer programs, graph optimization problems and algorithms, Boolean algebra and Applications.

UNIT-II Hardware Modeling & Schedule Algorithms

Hardware Modeling Languages, distinctive features, structural hardware language, Behavioral hardware language, HDLs used in synthesis, abstract models, structures logic networks, state diagrams, data flow and sequencing graphs, compilation and optimization techniques. Schedule Algorithms: A model for scheduling problems, Scheduling with resource and without resource constraints, Scheduling algorithms for extended sequencing models, Scheduling Pipe lined circuits.

UNIT-III Two Level Combinational Logic Optimization

Logic optimization, principles, operation on two level logic covers, algorithms for logic minimization, symbolic minimization and encoding property, minimization of Boolean relations.

UNIT-IV Multiple Level Combinational Optimizations

Models and transformations for combinational networks, algebraic model, Synthesis of testable network, algorithm for delay evaluation and optimization, rule based system for logic optimization.

UNIT-V Sequential Circuit Optimization & Cell Library Binding

Sequential circuit optimization using state based models, sequential circuit optimization using network models. Problem formulation and analysis, algorithms for library binding, specific problems and algorithms for library binding (lookup table F.P.G.As and Antifuse based F.P.G.As), rule based library binding.

Suggested Readings

1. Giovanni De Micheli, “Synthesis and Optimization of Digital Circuits", Tata McGraw-Hill, 2003.
2. Srinivas Devadas, Abhijit Ghosh, and Kurt Keutzer, “Logic Synthesis”, McGraw-Hill, USA, 1994.
3. Neil Weste and K. Eshragian,b, “Principles of CMOS VLSI Design: A System Perspective”, 2nd edition, Pearson Education (Asia) Pte. Ltd., 2000.
4. Kevin Skahill, “VHDL for Programmable Logic”, Pearson Education (Asia) Pte. Ltd., 2000.

20RECE302 **Paper III: Advanced DSP** 4H:4C

Instruction hours/week:L:T:P:C-4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT 1 : Multirate Digital Signal Processing

Introduction, Decimation by a factor 'D', Interpolation by a factor 'I', Sampling rate Conversion by a factor 'I/D', implementation of Sampling rate conversion, Multistage implementation of Sampling rate conversion, Sampling rate conversion of Band Pass Signals, Sampling rate conversion by an arbitrary factor, Applications of Multirate Signal Processing, Digital Filter banks, Two Channel Quadrature Mirror Filter banks, MChannel QMF bank (Text 1).

UNIT 2 : Transform Analysis of LTI Systems

The frequency response of LTI systems, System functions for systems characterized by linear constant coefficient difference equations, frequency response for rational system functions, Relationship between magnitude and phase, All pass systems, minimum phase systems, linear systems with generalized linear phase (Text 2).

UNIT 3 : Linear Prediction And Optimum Linear Filters

Representation of a random process, Forward and backward linear prediction, Solution of normal equations, Properties of the linear error-prediction filters, AR lattice and ARMA lattice-ladder filters, Wiener filters for filtering and prediction.

UNIT 4: Time Frequency Transformation

The Fourier Transform: Its Power and Limitations, The short Time Fourier Transform, The Gabor transform, The wavelet transform, Perfect reconstruction Filter Banks and Wavelets, Recursive Multi resolution Decomposition, Haar Wavelet.

UNIT 5: Hardware and Software for Digital Signal Processors

Digital signal processor architecture, Digital signal processor hardware units, Fixed- point and floating-point formats

Suggested Readings

1. Proakis and Manolakis, "Digital Signal Processing", Prentice Hall, 4th edition, 1996.

2. Alan V. Oppenheim and Ronald W.Schafer, “Discrete-Time signal Processing”, PHI Learning, 2003.
3. Roberto Cristi, “Modern Digital Signal Processing”, Cengage Publishers, India, Eerstwhile Thompson Publications, 2003.
4. Li Tan, “Digital Signal Processing – Fundamentals and Applications”, Elsevier, 2008.
5. S.K.Mitra, “Digital Signal Processing: A Computer Based Approach”, 3rd edition, Tata McGraw Hill, India, 2007.

20RECE303 **Paper III: Soft Computing** 4H:4C

Instruction hours/week:L:T:P:C-4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS

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

UNIT II GENETIC ALGORITHMS

Introduction to Genetic Algorithms (GA) – Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition.

UNIT III NEURAL NETWORKS

Machine Learning Using Neural Network, Adaptive Networks – Feed forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architectures – Advances in Neural networks.

UNIT IV FUZZY LOGIC

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

UNIT V NEURO-FUZZY MODELING

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

SUGGESTED READINGS:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani,(2003) "Neuro-Fuzzy and Soft Computing", Prentice-Hall of Indi,.
2. George J. Klir and Bo Yuan,(1995) "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall.
3. James A. Freeman and David M. Skapura,(2003) "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn.,.
4. Mitchell Melanie,(1998) "An Introduction to Genetic Algorithm", Prentice Hall,.
5. David E. Goldberg,(1997) "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley,.

20RECE304 Paper III: Wireless Sensor Networks 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I INTRODUCTION

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

UNIT II PHYSICAL LAYER

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

UNIT III DATA LINK LAYER

MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, Link Layer protocols –fundamentals task and requirements, error control, framing, link management

UNIT IV NETWORK LAYER

Gossiping and agent-based uni cast forwarding , Energy-efficient unicast, Broadcast and multicast, geographic routing , mobile nodes, Data –centric and content-based networking –Data –centric routing, Data aggregation, Data-centric storage, Higher layer design issues

UNIT V CASE STUDY

Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Sensor Network Platforms and tools-Sensor node hardware, Node-level software platforms, node – level simulators.

Suggested Readings:

1. Feng zhao, Leonidas (2004), Wireless Sensor Networks An information processing approach – guibas, Elsivier publication,.
2. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati,(2004)- Wireless Sensor Networks – Springer publication,.
3. Holger Karl, Andrea's willig, John(2006) Wireless Sensor Networks: Architecture and protocol –Edgar H .Callaway, CRC press.Protocol and Architecture for Wireless Sensor Networks –wiley publication.
4. Wireless Sensor Networks: First European workshop, EWSN 2004, Berlion, germany,
5. January 2004 proceedings –Holger Karl, Andreas willig,Adam holisz,Springer publication.
6. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.
7. Jamal N. Al-karaki, Ahmed E. Kamal," Routing Techniques in Wireless sensor networks: A survey", IEEE wireless communication, December 2004, 6 – 28.

20RECE305 Paper III: VLSI signal processing 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I - PIPELINING AND PARALLEL PROCESSING OF DIGITAL FILTERS

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs – critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II – ALGORITHMIC STRENGTH REDUCTION TECHNIQUE

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – parallel FIR filter, parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

UNIT- III ALGORITHIMIC STRENGTH REDUCTION

Fast convolution –Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV - BIT-LEVEL ARITHMETIC ARCHITECTURES

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, bit-serial FIR filter, CSD representation, CSD multiplication, Distributed Arithmetic fundamentals and FIR filters

UNIT V- NUMERICAL STRENGTH REDUCTION, WAVE AND ASYNCHRONOUS PIPELINING

Numerical strength reduction – sub expression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining bundled data versus dual rail protocol.

Suggested Readings:

1. Keshab K. Parhi, (2007)"VLSI Digital Signal Processing Systems, Design and implementation ", Wiley, Interscience, 2007.
2. U. Meyer – Baese,(2004) "Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition.

20RECE306 Paper III: Wavelets and Multi-Resolution Processing
4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I - INTRODUCTION

Vector Spaces - properties - dot product - basis - dimension, orthogonality and orthonormality - relationship between vectors and signals - Signal spaces – concept of Convergence - Hilbert spaces for energy signals - Generalized Fourier Expansion.

UNIT I I- MULTI RESOLUTION ANALYSIS

Definition of Multi Resolution Analysis (MRA) – Haar basis - Construction of general orthonormal MRA-Wavelet basis for MRA – Continuous time MRA interpretation for the DTWT – Discrete time MRA- Basis functions for the DTWT – PRQMF filter banks

UNIT- III CONTINUOUS WAVELET TRANSFORM

Wavelet Transform - definition and properties - concept of scale and its relation with frequency - Continuous Wavelet Transform (CWT) - Scaling function and wavelet functions (Daubechies, Coiflet, Mexican Hat, Sinc, Gaussian, Bi-Orthogonal) – Tiling of time -scale plane for CWT.

UNIT IV - DISCRETE WAVELET TRANSFORM

Filter Bank and sub band coding principles - Wavelet Filters - Inverse DWT computation by Filter banks -Basic Properties of Filter coefficients - Choice of wavelet function coefficients - Mallat's algorithm for DWT - Lifting Scheme: Wavelet Transform using Polyphase matrix Factorization – Geometrical foundations of lifting scheme - Lifting scheme in Z –domain

UNIT V- APPLICATIONS

Image Compression using DWT – Sequential / Progressive - JPEG 2000 standard - Image denoising - Edge detection and object Isolation and Object Detection - Image Fusion -Wavelet Packets ,Multiwavelets - Non linear wavelets – Ridgelets – Curvelets – Contourlets.

Suggested Readings:

1. C. Sidney Burvus, Ramesh A.Gopinath haito ,(1995) “Introduction to wavelets and wavelet Transform”, Prentice Hall International,.
2. Gilbert Strang, “Linear Algebra and its Applications”, 3rd edition.
3. J.C. Goswami, A.K. Chan,(1999) “Fundamentals of wavelets”, John wiley and sons.
4. Mallat S., (1996)"Wavelet Signal Processing”, Academic Press,.

20RECE307 Paper III: Computer Vision and Image processing 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I - IMAGE FORMATION

Image Formation and Coordinate Transformations, Camera Matrix, Motion/Stereo Pin-hole model, Human eye, cognitive aspects of colour space; illumination; Sampling and Quantization, Coordinate transformations and camera parameters.

UNIT II – IMAGE PROCESSING

Noise Removal, Blurring, Edge Detection: Canny , Gaussian,Gabor,Texture Edges, Curvature , Corner Detection.

UNIT III – SEGMENTATION

Types of segmentation techniques, Watershed, Change Detection, Background Subtraction, Texture Segmentation, Gaussian Mixture Models - Applications in Color based Image Segmentation, Background Modeling and Shape Clustering

UNIT IV - MACHINE LEARNING TECHNIQUES IN VISION

Bayesian Classification, Maximum Likelihood Methods, Neural Networks; Non-parametric models; Manifold estimation Support Vector Machines ; Temporal sequence learning

UNIT V - INTRODUCTION TO OBJECT TRACKING

Exhaustive vs. Stochastic Search Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models, Object Modeling and Recognition Applications: Surveillance, Object detection.

Suggested Readings:

1. David Forsyth and Jean Ponce, (2004)Computer Vision: A modern Approach, Prentice Hall India .
2. Christopher Bishop,(2008) Pattern Recognition and Machine Learning, Springer.
3. E.R. Davies,(2005) Machine Vision, Theory Algorithms Practicalities, Elsevier .
4. Richard O. Duda, Peter E. Hart, and David G. Stork, (2002)Pattern Classification, 2nd ed., Wiley Asia.

20RECE308 Paper III-Special Paper I: Solid State Device Modelling and Simulation 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I BASIC SEMICONDUCTOR PHYSICS

Quantum Mechanical Concepts, Carrier Concentration, Transport Equation, Band gap, Mobility and Resistivity, Carrier Generation and Recombination, Avalanche Process, Noise Sources.
Diodes: Forward and Reverse biased junctions – Reverse bias breakdown – Transient and AC conditions -– Static and Dynamic behavior- Small and Large signal models – SPICE model for a Diode – Temperature and Area effects on Diode Model Parameters.

UNIT II BIPOLAR DEVICE MODELING
Transistor Models: BJT – Transistor Action – Minority carrier distribution and Terminal currents - Switching- Eber - Molls and Gummel Poon Model, SPICE modeling - temperature and area effects.

UNIT III MOSFET MODELING
MOS Transistor – NMOS, PMOS – MOS Device equations - Threshold Voltage – Second order effects - Temperature Short Channel and Narrow Width Effect, Models for Enhancement, Depletion Type MOSFET, CMOS Models in SPICE.

UNIT IV PARAMETER MEASUREMENT
Bipolar Junction Transistor Parameter – Static Parameter Measurement Techniques – Large signal parameter Measurement Techniques, Gummel Plots, MOSFET: Long and Short Channel Parameters, Measurement of Capacitance.

UNIT V OPTOELECTRONIC DEVICE MODELING
Static and Dynamic Models, Rate Equations, Numerical Technique, Equivalent Circuits, Modeling of LEDs, Laser Diode and Photo detectors.

Suggested Readings:

1. Ben.G.Streetman, (1997), "Solid State Devices", 3rd Edition,Prentice Hall.
2. Giuseppe Massobrio and Paolo Antogentti, (1993), "Semiconductor Device Modeling with SPICE", 2nd Edition, McGraw-Hill Inc, New York.
3. Mohammed Ismail & Terri Fiez, (2001), "Analog VLSI-Signal & Information Processing", 1st Edition,Tata McGraw Hill Publishing company Ltd, New Delhi.

20RECE309 Paper III-Special Paper II: Mobile Ad-Hoc Networks 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I INTRODUCTION

Introduction to adhoc networks – definition, characteristics features, applications. Charectristics of Wireless channel, Adhoc Mobility Models:- Indoor and outdoor models.

UNIT II MEDIUM ACCESS PROTOCOLS

MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT III NETWORK PROTOCOLS

Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV END-END DELIVERY AND SECURITY

Transport layer : Issues in desiging- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary prespective. Intergration of adhoc with Mobile IP networks.

Suggested Readings:

1. C.Siva Ram Murthy and B.S.Manoj,(2007)' Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000

3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic,(2004) Mobile adhoc networking, Wiley-IEEE press,.
4. Mohammad Ilyas, (2002)The handbook of adhoc wireless networks, CRC press,.
5. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research," Wireless Commun. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.
6. A survey of integrating IP mobility protocols and Mobile Ad hoc networks, Fekri M. Abduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, v 9.no.1 2007
7. V.T.Raisinhani and S.Iyer "Cross layer design optimization in wireless protocol stacks"Comp. communication, vol 27 no. 8, 2004.
8. V.T.Raisinhani and S.Iyer,"ÉCLAIR; An Efficient Cross-Layer Architecture for wireless protocol stacks",World Wireless cong., San francisco,CA,May 2004.
9. V.Kawadia and P.P.Kumar,"A cautionary perspective on Cross-Layer design,"IEEE Wireless commn., vol 12, no 1,2005.

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2020-2021

20RECE310 Paper III - Special Paper III: Network Routing Algorithms 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

UNIT I CIRCUIT SWITCHING NETWORKS

AT & T's Dynamic Routing Network, Routing in Telephone Network-Dynamic Non Hierarchical Routing-Trunk Status Map Routing-Real Time Network Routing, Dynamic Alternative Routing-Distributed Adaptive Dynamic Routing-Optimized Dynamic Routing

UNIT II PACKET SWITCHING NETWORKS

Distance vector Routing, Link State Routing, Inter domain Routing-Classless Interdomain routing (CIDR), Interior Gateway routing protocols (IGRP) - Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Exterior Gateway Routing Protocol (EGRP) - Border Gateway Protocol (BGP), Apple Talk Routing and SNA Routing

UNIT III HIGH SPEED NETWORKS

Routing in optical networks-The optical layer, Node Designs, Network design and operation, Optical layer cost tradeoffs, Routing and wavelength assignment, Architectural variations, Routing in ATM networks-ATM address structure, ATM Routing, PNNI protocol, PNNI signaling protocol, Routing in the PLANET network and Deflection Routing.

UNIT IV MOBILE NETWORKS

Routing in Cellular Mobile Radio Communication networks-Mobile Network Architecture, Mobility management in cellular systems, Connectionless Data service for cellular systems, Mobility and Routing in Cellular Digital Packet Data (CDPD) network, Packet Radio Routing-DARPA packet radio network, Routing algorithms for small, medium and large sized packet,radio networks.

UNIT V MOBILE AD-HOC NETWORKS (Manet)

Internet based mobile ad-hoc networking, communication strategies, routing algorithms – Table-driven routing - Destination Sequenced Distance Vector (DSDV), Source initiated on demand routing- Dynamic Source Routing (DSR), Ad-hoc On- demand Distance Vector (AODV), Hierarchical based routing-Cluster head Gateway Switch Routing (CGSR) and Temporally-Ordered Routing Algorithm (TORA), Quality of Service.

Suggested Readings:

1. Steen strub.M,(1995), “Routing in Communication networks”, PH International, New York.
2. William Stallings,(2004), “ISDN & Broadband ISDN with Frame Relay & ATM”, PHI, New Delhi.
3. Behrouz A Forouzan,(2004), “Data Communications and Networking (3/e), TMH, New Delhi.
4. William Stallings,(1998), “High Speed Networks TCP/IP and ATM Design Principles”, Prentice Hall International, New York.
5. Mohammad Ilyas,(2002), “The Handbook of Ad hoc Wireless Networks”, CRC Press, USA.

20RECE311 Paper III-Special Paper IV: Low Power VLSI Design 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I POWER DISSIPATION IN CMOS

Sources of power dissipation – Physics of power dissipation in CMOS FET devices- Basic principle of low power design.

UNIT II POWER OPTIMIZATION

Logical level power optimization – Circuit level low power design: logic styles, transistor sizing and ordering – Circuit techniques for reducing power consumption in adders and multipliers.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS

Computer Arithmetic techniques for low power systems – Reducing power consumption in memories – Advanced techniques: Adiabatic Computation, Asynchronous Circuits – Special techniques

UNIT IV POWER ESTIMATION AND ANALYSIS

Logic level power estimation – Simulation power analysis – Probabilistic power analysis

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER

Synthesis for low power –Behavioral level transforms- Software design for low power – Software Power Estimation – Software Power Optimization

Suggested Readings:

1. Roy.K and Prasad.S.C, (2000) Low Power CMOS VLSI circuit design, Wiley, New Jersey.
2. Dimitrios Soudris, Chirstian Pignet, Costas Goutis,(2002) Designing CMOS Circuits For Low Power, Kluwer academic publishers, Boston,.
3. Kuo.J.B and Lou.J.H, (2009)Low voltage CMOS VLSI Circuits, Wiley, New Jersey,.
4. Chandrakasan.A.P and Broadersen.R.W, (1995)Low power digital CMOS design, Kluwer academic publishers, Boston .
5. Gary Yeap Practical low power digital VLSI design,(1998) Kluwer academic publishers, Boston.

20RECE312 Paper III-Special Paper V: Testing of VLSI Circuits 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I BASICS OF TESTING AND FAULT MODELLING

Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models - Fault detection - Fault location - Fault dominance - Logic Simulation – Types of simulation - Delay models - Gate level Event-driven simulation.

UNIT II TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS

Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.

UNIT III DESIGN FOR TESTABILITY

Design for Testability - Ad-hoc design - Generic scan based design - lassical scan based design - System level DFT approaches.

UNIT IV SELF-TEST AND TEST ALGORITHMS

Built-In Self Test - Test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.

UNIT V FAULT DIAGNOSIS

Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

SUGGESTED READINGS:

1. M. Abramovici, M.A. Breuer and A.D. Friedman,(2002) "Digital Systems and Testable Design", Jaico Publishing House,.
2. P.K. Lala, (2002)"Digital Circuit Testing and Testability", Academic Press,.
3. M.L. Bushnell and V.D. Agrawal,(2002) "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,.
4. A.L. Crouch(2002), "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International,.

20RECE313 Paper III-Special Paper VI: Advanced Digital Image Processing 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

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

UNIT II SEGMENTATION

Edge detection, Thresholding, Region growing, Fuzzyclustering, Watershed algorithm, Activecontour methods, Texture feature based segmentation, Model based segmentation, Atlas basedsegmentation, Wavelet based Segmentation methods

UNIT III FEATURE EXTRACTION

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

UNIT IV REGISTRATION AND IMAGE FUSION

Registration-Preprocessing, Feature selection-points, lines, regions and templates Featurecorrespondence-Point pattern matching, Line matching, region matching Template matching.Transformation functions-Similarity transformationand Affine Transformation. Resampling-NearestNeighbour and Cubic SplinesImage Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusiondiscrete wavelettransform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION

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

Suggested Readings:

1. John C.Russ, (2007)"The Image Processing Handbook", CRC Press,.
2. Mark Nixon, Alberto Aguado, (2008)"Feature Extraction and Image Processing", Academic Press,.

3. Ardeshir Goshtasby,(2005) " 2D and 3D Image registration for Medical, Remote Sensing andIndustrial Applications",John Wiley and Sons,
4. Rafael C. Gonzalez, Richard E. Woods, (2004) Digital Image Processing', Pearson,Education, Inc.,Second Edition,.
5. Anil K. Jain, (2002) Fundamentals of Digital Image Processing', Pearson Education,Inc.,.
6. Rick S.Blum, Zheng Liu,(2006)" Multisensor image fusion and its Applications",Taylor& Francis,.

20RECE314 Paper III-Special Paper VII: Bio-Medical Signal Processing 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

UNIT I Introduction to Wavelet Transforms

Basics of FT,FFT, DTFT, DFT, DIT-FFT, DIF-FFT algorithms, Introduction to wavelet transforms, Advantages, Applications, Limitations, Different types of wavelet transforms & their characteristics, The Discrete Wavelet Series, The Discrete Wavelet Transform, Multi Resolution Analysis

UNIT II Neurological Signal Processing

The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination

UNIT III Cardiological Signal Processing

Basic electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, the use of multiscale analysis for parameters estimation of ECG waveforms, Arrhythmia analysis monitoring, Long-term continuous ECG is recording

UNIT IV Adaptive Filters & Ecg Data Reduction Techniques

Principal noise canceller model, 60- Hz adaptive canceling using a sine wave model, applications of adaptive filtering, Direct data compression techniques, Direct ECG data compression techniques, Transformation compression technique

UNIT V VLSI in DSP

Digital signal processors. High performance VLSI signal processing, VLSI applications in medicine, VLSI sensors for biomedical signals, VLSI tools, choice of custom, ASIC, or off- the- shelf components

Suggested Readings:

1. D.C. Reddy (2005)Biomedical Signal Processing, Principles and Techniques , Tata McGraw Hill,.
2. Wills J. Tompkins,(2007) “Biomedical digital signal processing”, Prentice Hall of India Pvt. Ltd.

20RECE315 Paper III-Special Paper VIII : Pattern Recognition 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

UNIT I – INTRODUCTION

Introduction and mathematical preliminaries What is pattern recognition?,Clustering vs. Classification; Applications; Linear Algebra, vector spaces, probability theory, estimation techniques.

UNIT II – CLASSIFICATION

Bayes decision rule, Error probability, Error rate, Minimum distance classifier, Mahalanobis distance; K-NN Classifier, Linear discriminant functions and Non-linear decision boundaries. Fisher's LDA, Single and Multilayer perceptron, training set and test sets, standardization and normalization.

UNIT III – CLUSTERING

Different distance functions and similarity measures, Minimum within cluster distance criterion, K-means clustering, single linkage and complete linkage clustering, MST, medoids, DBSCAN, Visualization of datasets, existence of unique clusters or no clusters.

UNIT IV - FEATURE SELECTION

Problem statement and Uses, Probabilistic separability based criterion functions, interclass distance based criterion functions, Branch and bound algorithm, sequential forward/backward selection algorithms, (l,r) algorithm.

UNIT V - FEATURE EXTRACTION

Principal component analysis, Kernel PCA. Recent advances in Pattern recognition: Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy.

Suggested Readings:

1. R.O.Duda, P.E.Hart and D.G.Stork, (2001.)Pattern Classification, John Wiley.
2. K. Fukunaga(2000); . Statistical pattern Recognition ,Academic Press,.
3. S.Theodoridis and K.Koutroumbas,(2009) Pattern Recognition, 4th Ed., Academic Press,.

20RECE317 Paper III-Special Paper IX : Design of Analog and Mixed Mode VLSI Circuits

4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Unit-1 INTRODUCTION

Basic MOS Device Physics: General considerations, MOS I/V Characteristics, second order effects, MOS device models.
Single stage Amplifier: Basic Concepts, Common Source stage.

Unit –II SINGLE STAGE AMPLIFIER

Source follower, common-gate stage, Cascode Stage, choice of device models.
Differential Amplifiers: Single ended and differential operation, Basic differential pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

Unit III PASSIVE AND ACTIVE CURRENT MIRRORS

Basic current mirrors, Cascode Current mirrors, Active Current mirrors. Operational Amplifiers (part-1): General Considerations, One Stage OP-Amp, Two Stage OP-Amp, Gain boosting.

Unit IV OPERATIONAL AMPLIFIERS (PART-2)

Common Mode Feedback, Slew rate, Power Supply Rejection.
Phase Locked Loops: Simple PLL, Charge pump PLLs, Non-ideal effects in PLLs, Delay-Locked Loops, Applications. (Text 1)

Unit V DATA CONVERTER ARCHITECTURES
DAC & ADC Specifications, Current Steering DAC, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. (Text 2)

SUGGESTED READINGS:

1. Behzad Razavi, ―Design of Analog CMOS Integrated Circuits‖, TMH, 2007.
2. R. Jacob Baker, ―CMOS Circuit Design, Layout, and Simulation‖, Second Edition, Wiley.
3. Phillip E. Allen, Douglas R. Holberg, ―CMOS Analog Circuit Design‖, Second Edition, Oxford University Press.