DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BE (E & C) Syllabus of III – VIII Semester – 2010 and later

	ODD SEMESTER						EVEN SEMESTER				
	Subject Code	**Subject. Name**	**L**	**T**	**P**	**C**	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
SECOND YEAR	MAT-203	Engineering Maths III	3	1	0	4	MAT-214	Engineering Maths IV	3	1	0	4
	ECE-201	Analog Electronic Circuits	3	1	0	4	ECE-202	IC systems	3	1	0	4
	ECE-203	Network Analysis	3	1	0	4	ECE-204	Microprocessors & Microcontrollers	3	1	0	4
	ECE-205	Logic Design	3	1	0	4	ECE-206	Digital System Design & HDL	3	1	0	4
	ECE-207	Computer Organisation & Architecture	3	1	0	4	ECE-208	Electromagnetic Waves	3	1	0	4
	ECE-209	Signals and Systems	3	1	0	4	*** ***	Open Elective	3	0	0	3
	ECE-211	Digital Electronics Lab.	0	0	3	1	ECE-212	Microprocessor Lab	0	0	3	1
	ECE-213	Signals & Circuits simulation Lab	0	0	3	1	ECE-214	Electronic Circuit Design Lab	0	0	3	1
		Total	**18**	**6**	**6**	**26**		**Total**	**18**	**5**	**6**	**25**
THIRD YEAR	ECE-301	Analog Communication	3	1	0	4	ECE-302	Digital Communication	3	1	0	4
	ECE-303	Digital Signal Processing	3	1	0	4	ECE-304	Microwave Components & Devices	3	1	0	4
	ECE-305	VLSI Design	3	1	0	4	ECE-306	Linear and Digital Control Systems	3	1	0	4
	ECE-307	Antennas	3	1	0	4	ECE-308	Embedded System Design	3	1	0	4
	ECE-309	Communication Networks	3	1	0	4	ECE-***	Elective-II	3	1	0	4
	ECE-***	Elective I	3	1	0	4	*** ***	Open Elective	2	1	0	3
	ECE-311	VLSI Lab	0	0	3	1	ECE-312	Embedded System Design Lab	0	0	3	1
	ECE-313	Digital Signal Processing Lab	0	0	3	1	ECE-314	Communication Lab - I	0	0	3	1
		Total	**18**	**6**	**6**	**26**		**Total**	**17**	**6**	**6**	**25**
FOURTH YEAR	HSS-401	Essentials of Management & Economics	3	1	0	4	ECE-404	Industrial Training	0	0	0	1
	ECE-401	Communication Systems	3	1	0	4	ECE-499	Project work	0	0	0	20
	ECE-403	Power Electronics	3	1	0	4						
	ECE-405	Wireless Communication	3	1	0	4						
	ECE-407	Information Theory and Coding	3	1	0	4						
	ECE-***	Elective-III	3	1	0	4						
	ECE-409	Communication Lab - II	0	0	3	1						
	ECE-411	Power Electronics Lab	0	0	3	1						
	ECE-413	Seminar	0	0	3	1						
		Total	**18**	**6**	**9**	**27**		**Total**	**0**	**0**	**0**	**21**

NOTE: **L** (Lecture Hours per Week); **T** (Tutorial Hours per Week); **P** (Practical Hours per Week); **C** (Credits)

Program Electives	Open Electives
ECE 323 Advanced Microprocessors and Microcontrollers ECE 325 VLSI/ULSI Process Technology ECE 327 Digital Measurement Techniques ECE 329 Electronic System Design ECE 331 Advanced Broadcasting and Display Techniques ECE 333 Cipher Systems ECE 324 ASIC Design ECE 326 Bio MEMS and Microsensors ECE 328 Optical Fiber Communication ECE 330 Digital Speech Processing ECE 332 Advanced Digital Signal Processing ECE 334 Mobile Communication ECE 336 Queuing theory ECE 338 Time-Frequency and Wavelet Transforms ECE 423 Advanced Embedded System Design ECE 425 Analog and Mixed Signal Design ECE 427 Soft Computing Techniques ECE 429 DSP Algorithms and Architectures ECE 431 Low Power VLSI Design ECE 433 System on Chip Design ECE 435 Data Communication Networking ECE 437 Spread Spectrum Communications ECE 439 Digital Image Processing ECE 441 Error Control Coding ECE 443 Microwave Integrated Circuits ECE 445 Material Science for Micro and Nanoelectronics	1. Introduction to Communication Systems 2. Transducers and Instrumentation 3. Consumer Electronics 4. Introduction to Microprocessors (not for circuit branches) 5. MEMS Technology 6. Microcontrollers and Applications (not for circuit branches) 7. Electronic Product Design and Packaging 8. Neural Network and Fuzzy Logic

MAT-203 ENGINEERING MATHEMATICS III [3 1 0 4]

Total number of lecture hours - 48

1. **Complex Variable**: Functions of complex variable (Basic concepts). Analytic function, C-R equations, differentiation, conformal mappings, Bilinear transformation. Integration of complex function, Cauchy's integral formula. Taylor's and Laurent Series, Singular points, Residues, Cauchy's residure theorem.

   10 Hrs.

2. **Fourier Series and Fourier Transform :**
   Periodic function, Conditions for Fourier Series expansion. Fourier series expansion of continuous functions, functions having finite discontinuities even and odd functions, change of interval. Half range series. Complex form of Fourier Series, Practical harmonic analysis. Infinite Fourier transform and inverse Fourier transform, Fourier sine and cosine transforms. Inverse Fourier sine and cosine transforms (Problems on integral theorem to be avoided).
   10 Hrs.
3. **Partial Differential Equations:**
   Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions. Solution of partial differential equations of the type $P_p + Q_q = R$, $f(p,q) = 0$. $F(z,p,q) = 0$, $f(x,p) = \phi(y,q)$, $Z = px + gy + f(p,q)$. Solution of partial differential equation by direct integration (Simple problems), solution by method of separation of variables. Derivation and solution of wave equation and one dimensional heat equation (only simple problem to be asked)

   10 Hrs.

4. **Numerical Methods:**
   Finite differences, Forward and Backward differences. Interpolation and extrapolation. Gregory Newton interpolation formulae for forward and backward differences. (No proof for formulae). Lagrange's formula for uneven interval (No proof). Netwon's divided difference formula.
   Numerical solution of ordinary differential equations. Taylor's series method. Euler's modified method. Runge Kutta method of fourth order.

   8 Hrs.

5. **Vector Calculus:**
   gradient divergence and curl, their physical meaning and identities. Line, surface and volume integrals. Simple problems - Green's theorem, divergence and stoke's theorems - simple applications. **10 Hrs**

Reference books:

1. Engineering Mathematics - B.S.Grewal.
2. Engineering Mathematics - Shastry, Vol. I & II.
3. Advanced Engineering Mathematics - E.Kreyszig.
4. Applied Numerical Analysis (5^{th} Edition) - Gerald and Wheatley.
5. Introductory Methods of Numerical Analysis(4^{th} ed.)- S.S. Sastry, PHI

ECE-201 ANALOG ELECTRONIC CIRCUITS [3 1 0 4]

Total number of lecture hours – 48

Introduction to BJT: Review of transistor biasing and stability. [4]

Transistor at low frequencies and high frequencies:
h-parameters, conversion formulas for the h parameters of CE, CB and CC configurations, Analysis of a transistor amplifier using h parameters, Emitter follower, comparison of CE, CB, CC configurations, Analysis of CE, CB, CC configuration using simplified hybrid model, high input-resistance transistor circuits. Hybrid - π CE transistor model, CE short circuit current gain, CE amplifier with load. [12]

Multistage amplifiers:
Distortion in amplifiers, Frequency response of an amplifier, bandwidth of cascaded amplifiers, and low frequency response of an RC coupled stage, effect of coupling and emitter by-pass capacitor on low frequency response. [4]

Power amplifiers:
Classification of large signal amplifiers, Analysis and design with respect to efficiency, linearity and harmonic distortions of class A, class B and AB push-pull amplifiers. [4]

FET: Structure of JFET and MOSFET, Characteristics, small signal and large signal model, Analysis of CS, CD and CG amplifiers at low and high frequencies, FET biasing. [8]

Feedback amplifiers:
Concept of feedback, types of feedback – their advantages and disadvantages, effect of feedback on frequency response & impedances, Analysis of voltage-series, voltage-shunt, current series & current-shunt feedback amplifiers. Voltage-series and Current shunt Feedback amplifiers using FET [6]

Oscillators:
Barkhausen criterion, conditions for sustained oscillations – RC phase shift, Colpitt's and Hartley, Wein bridge oscillators – Analysis & design – pierce crystal oscillator. [6]

Sweep Circuits:
Sweep parameters, exponential sweep circuit, Miller & Bootstrap circuits. [4]

Reference Books:

1. **J.Millman & C.C.Halkias** "Integrated Electronics".
2. **Behzad Razavi** "Fundamental of Microelectronics".
3. **R.L.Boylestad & L.Nashelsky** "Electronic Devices and Circuit Theory".
4. **Millman & H.Taub** "Pulse, digital and switching waveforms"
5. **A.P.Malvino** "Electronic Principles".
6. **A.S.Sedra & K.C Smith** "Microelectronics".

ECE 203 NETWORK ANALYSIS [3 1 0 4]

Total number of lecture hours: 48

Network equations:

Nodal and loop analysis of networks, source transformation, star delta transformations. **3 Hours**

Laplace transformation and its application:

Definition, Basic theorems in Laplace transformation, properties of Laplace transforms, inverse Laplace transforms, partial fraction expansion, initial and final value theorems, Shifting theorems, step, ramp and delayed functions. Solution of RL, RC, RLC networks using Laplace transformation method, Laplace transform of periodic and non periodic signal

5 Hours

Network Theorems:

Superposition, Reciprocity, Millman's theorems, Thevinin's and Norton's theorems, Maximum Power transfer theorem, Tellegan's Theorem and Millers Theorem. **7 Hours**

First order and higher order differential equations:

General and particular solutions of RL, RC and RLC circuits. **4 Hours**

Transient behaviour and Initial conditions in networks:

Behaviour of circuit elements under switching condition and their representation. Evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.

6 Hours

Linear wave shaping:

Response of RC & RL circuits to step, pulse, square wave, ramp and exponential inputs, compensated attenuators. **11 Hours**

Two port network and network functions:

Open circuit impedance parameters, short circuit admittance parameters, Transmission parameters, Hybrid parameters, relationship between two port parameters, Parallel connection of two port networks, series connection of two port networks, cascade connection of two port networks, Driving point impedance and admittance functions, Transfer functions. **8 Hours**

Network Topology:

Graph of a network, Concept of tree and co-tree, incidence matrix, f-circuit matrix and f-cutset matrix. **4Hours**

REFERENCE BOOKS:

1. **M.E. Van Valkenberg(2000),** "Network analysis", Prentice Hall of India
2. **Franklin F. Kuo, "**Network analysis and Synthesis", Wiley International Edition
3. **Joseph Edminister,**"Electric Circuits" **,** Schaum's Series,McGraw Hill
4 **P.M. Chandrashekharaiah, "**Electric Circuits"
5**. Millman & H. Taub** "Pulse, digital and switching waveforms"

ECE-205 LOGIC DESIGN [3 1 0 4]

Total number of Hours: 48

Number Systems and Codes:
Review of number systems, BCD codes and arithmetic, Gray code, self-complimenting codes, Error detection and correction principles. [4]

Digital Circuits:
Switching algebra & simplification of Boolean expressions. De Morgan's Theorem. Implementations of Boolean expressions using logic gates. [3]

Combinational Logic Design:
Combinational circuit analysis and synthesis, Techniques for minimization of Boolean functions such as Karnaugh map, VEM and Quine-Mc Cluskey methods. Design of arithmetic circuits, code convertors, multiplexers, demultiplexers, encoders, decoders & comparators. Parity generators and checker. [12]

Introduction to Sequential Logic:
Need for sequential circuits, Binary cell, Latches and flip-flops. RS, JK, Master-Slave JK, D & T flip flops. [3]

Synchronous Sequential Circuit Design:
Fundamentals of Synchronous sequential circuits, Classification of synchronous machines, Analysis of Synchronous Sequential circuits, Design of Synchronous and Asynchronous Counters, Shift registers & Ring counters, Analysis and design of Finite State Machines. Timing issues in synchronous circuits. [12]

ASM charts
Introduction, ASM Chart conventions, Design examples. [4]

Logic Families:
Performance metrics of logic gates, Basic Transistor-Transistor Logic and CMOS logic. [4]

Asynchronous Sequential Circuits:
Fundamentals of Asynchronous Sequential circuits. Analysis and design of Asynchronous Sequential circuits. Pulse mode and Fundamental-mode Circuits. Cycles, Races and Hazards in asynchronous circuits. [6]

References:

1. Donald D.Givone, *"Digital Principles and Design",* Tata McGraw Hill, 2002.
2. Morris Mano, *"Digital design",* Prentice Hall of India ,Third Edition.
3. William I. Fletcher, *"An Engineering approach to Digital Design",* Prentice Hall of India, 2009.

4. Zvi Kohavi, *"Switching and Finite Automata Theory",* Tata Mc Graw Hill, second edition.
5. A. Ananda Kumar, *"Switching Theory and Logic Design"*, Prentice Hall of India ,2009.
6. C.H.Roth, *"Fundamentals of Logic Design"*, Thomson, 2000.

ECE 207 COMPUTER ORGANISATION AND ARCHITECTURE [3-1-0-4]

Total number of Hours: 48

Basic structure and operation of Computers: Introduction to the basic operational concepts of digital computer. Overview of architecture of typical computers; Accumulator based, General Register machines and stack machines. [06]

Instruction Set: Instruction formats, types and addressing modes. Reverse Polish notation. Opcode Encoding techniques. [04]

ALU Design: 2's complement number system review. Basic ALU Organization, General Register design-Combinational shifter design -Adders; CLA, CSA and Wallace tree-ALU design- Arithmetic processors. IEEE floating point representation. [06]

Algorithms: Multiplication of signed and unsigned integers, Booths multiplication Algorithm, Division of unsigned integers – Restoring type. [04]

Control Unit Design: Basic concepts, Bus structures. Design methods-Hardwired and micro programmed. Micro programmed control-Micro instruction formats. Hardwired and micro programmed Control unit design examples. [14]

Memory Organization: Memory hierarchies, Main memory and cache memory. Cache mapping functions- associative and direct. introduction to virtual memory. [04]

Input/output Organization: Isolated I/0, memory mapped I/0, programmed I/0, Interrupt driven I/0, DMA; transfer methods and bus arbitration. [06]

Pipelining and parallel processing: Instruction pipelining and pipeline hazards. Introduction to VLIW, vector processors and multithreaded processors. [04]

References:

1. **M.Raffiquzzaman & Raja Chandra**, (1990), "Modern Computer Architecture", Galgotia publications, *New Delhi* .
2. **M Morris Mano**, (2002), "Computer system architecture", *3rd edition, Pearson Education, Delhi*.
3. **Nicholas Carter**, (2006), "Computer architecture", *Schaum's outlines, McGraw-Hill, New Delhi*.
4. **V.Carl Hamacher, Z.Vranesic & S.Zaky,** (*1987*), "Computer Organization", *2nd edition, McGraw Hill International Edition, Computer Science series.*
5. **Tanenbaum A.S**, (1984) , "Structured computer organization", *Prentice Hall Engelwood* Cliffs N.J.

ECE 209 SIGNALS AND SYSTEMS (3-1-0- 4)

Introduction: Definitions, Overview of specific systems, Classification of signals, Basic operations on signals, Elementary signals and functions, Systems viewed as interconnections of operations, properties of systems. [9]

Time domain representations for Linear time-invariant systems: Introduction, Convolution: Impulse response representation for LTI systems, properties of the impulse response representation for LTI systems, Differential and difference equation representations for LTI systems, Block diagram representations. [10]

Fourier representations for signals: Introduction, Discrete-time periodic signals: The discrete-time Fourier series, continuous-time periodic signals: The Fourier series, Discrete-time non-periodic signals: The discrete-time Fourier transform, continuous-time non-periodic signals: The Fourier transform, properties of Fourier representations. [10]

Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier transform representations for periodic signals, convolution and modulation with mixed signal classes, Fourier transform representation for discrete-time signals, sampling, Reconstruction of continuous-time signals from samples. [9]

Application of Laplace Transform: Continuous Time System Analysis using Laplace transform, Region of convergence and Stability, Analysis of continuous time signals and systems. [4]

Z-Transform: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform, Transform analysis of LTI systems, the unilateral Z-Transform. [6]

References:

1. **Simon Haykin & Barry Van Veen**, (2005), "Signals and Systems", *John Wiley &Sons, New Delhi*
2. **A.V.Oppenheim , A.S.Willsky &A. Nawab,** (2002), "Signals and Systems" *PHI. /Pearson Education, New Delhi*
3. **H.Hsu, R. Ranjan** (2006) "Signals and Systems", Schaums's outline, *Tata McGraw – Hill, New Delhi*
4. **B.P.Lathi**., (2005), "Linear systems and Signals", Oxford University Press

ECE-211 DIGITAL ELECTRONICS LAB [0 0 3 1]

Total number of lab sessions – 12

1. Study of Implementation techniques of combinational circuits.
2. Implementation of Arithmetic circuits using logic gates and MSI chips.
3. Building circuits using MSI chips and their applications.
4. Designing of sequential circuits.
5. Implementation of FSMs

6. Design of Asynchronous sequential circuits

ECE 213 SIGNALS AND CIRCUIT SIMULATION LAB [0 0 3 1]

Total number of lab sessions – 12

1. Simulation of circuits using passive elements R, L, C
2. Characteristics of active devices
3. Amplifiers
4. Oscillators/Generators
5. General Applications of diodes, OPAMP, 555.
6. Analysis of signals and systems using Matlab

MAT-214 ENGINEERING MATHEMATICS - IV [3 1 0 4]

Total number of lecture hours - 48

Introduction to probability, finite sample spaces, conditional probability and independence, Baye's theorem, one dimensional random variable, mean, variance, Chebyschev's inequality. 10 hrs.

Two and higher dimensional random variables, covariance, correlation coefficient, regression, least squares principles of curve fitting. 8 hrs.

Distributions: Binomial, Poisson, uniform, normal, gamma, Chi-square and exponential, simple problems. 8 hrs.

Fourier Transforms and z-transforms, solution of difference equations using z-transforms - Fourier transforms, Fourier sine and cosine transforms, Parsevals identity, convolution theorem, solution of boundary value problems by Fourier Transforms. 10 hrs.

Numerical differentiation – Numerical integration .Trapezoidal and Simpon's rules – Difference equations with constant coefficients, solutions.

Solution of system of Linear equations. Gauss-Jacobi, Gauss –Seidal and relaxation methods eigen value problems - Power method of evaluations of largest eigen value. 14 hrs.

Text Books:

1. P.L.Meyer (1979), "Introduction to probability and Statistical Applications", second Edn., American Publishing Co.
2. S.S.Sastry (1990), "Introductory methods of Numerical analysis", 2nd edn., Prentice Hall
3. Erwin Kreyszig (1985), "Advanced Engineering Mathematics", 5th edn., Wiley Eastern.
4. Openheim A.V & Schafer R.W (1975), "Digital Signal Processing", 1st edn., Prentice Hall.

Reference books:

1. Hogg & Craig (1975), "Introduction to Mathematical Statistics", 4th Edn., MacMillan,

2. Ross S.M (1987), " Introduction to probability and statistics for Engineers and Scientists", 2nd Edn.Wiley International.
3. Trivedi K.S (1982), "Probability and Statistics", Prentice Hall
4. Grewal B.S. (1989), "Higher Engg. Mathematics:, Khanna Publishers

ECE-202 INTEGRATED CIRCUITS SYSTEMS [3 1 0 4]

Total number of lecture hours - 48

Operational Amplifier
Introduction: Basic block diagram of OPAMP. [1]

Differential Amplifier:
Types of differential amplifier, analysis using block diagram, characteristics of differential amplifier, analysis of emitter coupled differential amplifier using small signal hybrid model, methods of improving common mode rejection ratio using constant current source and current mirror circuits, current repeaters and active load. [6]

Level shifter, output stage and op.amp. parameters:
Circuit operation and analysis of level shifter and output stage of an operational amplifier; transfer characteristics of op.amp, measurement of operational amplifier parameters. [3]

Linear applications of operational amplifier:
Characteristics of ideal operational amplifier, open loop and closed loop operation of operational amplifier, Inverting amplifier, non inverting amplifier, input resistance, output resistance and band width; sign changer, scale changer, summing amplifier, adder, voltage follower, integrator, differentiator, voltage to current converter, current to voltage converter, difference amplifier, instrumentation amplifier and bridge amplifier. [9]

Active filters:
Design and analysis of first and higher order low pass, high pass, band pass (wide and narrow band) and band elimination (wide and narrow band) and all pass active filters. [6]

Non-linear applications of operational amplifier:
Precision half wave and full wave rectifiers, peak detector, sample and hold circuit, log and antilog amplifiers, analog multipliers and dividers, comparators, window detector, Schmitt trigger, square wave, triangular wave generators and pulse generator. [8]

Timer:
Introduction, pin details of 555 I.C., functional diagram of 555 IC, astable multivibrator, positive and negative edge triggered monostable multivibrator, linear ramp generator and FSK generator. [4]

Data converters:

Principles of digital to analog converter (DAC) and analog to digital converters (ADC), binary weighted, R-2R digital to analog converters, flash type, successive approximation type, counter type and servo tracking type and dual slope analog to digital converters, specifications of ADC and DAC. [6]

Phase-locked loops:
Functional diagram of voltage controlled oscillator - 566 I.C. and its analysis. Operating principle of PLL, study of IC 565, circuit analysis of phase detector. Definition and derivation for free running frequency, lock range and capture range. Applications of PLL as frequency multiplier, frequency divider, AM and FM demodulation and FSK demodulation

[5]

References:

1. **Stanley William D. (2004**) "Operational Amplifiers with Linear Integrated Circuits" *Prentice Hall*
2. **Milman Jacob (1979)** "Microelectronics", *McGraw Hill*.
3. **Franco Sergio (1997)** "Design with Op amps & Analog Integrated Circuits*" McGraw Hill*
4. **David L. Terrell, Butterworth - Heinemann (1996) "**Op Amps Design, Application, and Troubleshooting"
5. **Ramakant A. Gayakwad (1987)** " Op-Amps and Linear Integrated Circuits" *Prentice Hall of India*
6. **Choudhury Roy D, Shail B. Jain (1991)** " Linear Integrated Circuits" *Wiley Eastern*

ECE 204 MICROPROCESSORS AND MICROCONTROLLERS [3 1 0 4]

8086 MICROPROCESSOR
Introduction to 16-bit microprocessors, History of Microprocessors, Intel 8086 and 8088 Architecture, Bus Interface Unit and Execution Unit, The Instruction Pipeline, Data and Address Bus Configuration, Memory Segmentation, Memory Address generation, I/O Port addressing. Functions of all signals, Minimum and Maximum Mode signals. Bus Cycles, Bus driver 8288. [8]

Addressing Modes, Instruction Set in detail, Assembler directives, Assembly Language Programming, Programming examples, Macros, DOS function [10]

Interrupt processing, Hardware and Software interrupts, Internal interrupts. [2]

Interfacing: Memory interfacing, Programmable peripherals Interface-8255, Programmable I/O interface 8254, Programmable Interval timer 8251 Programmable USART. Programmable Interrupt controller 8259. [6]

8051 MICRO CONTROLLER
Introduction microcontroller. Difference between microprocessors and microcontrollers. Microcontroller survey, CISC and RISC Microcontrollers, Architectural features and Advantages. Applications of Microcontrollers. [2]

Introduction to 8051 family. History of 8051. Architectural features of 8051. Programming model. Pin details, I/O Ports, Addressing Modes. [4]

Instruction set of 8051, Arithmetic and logical instructions, Byte level and Bit level, Jump, loop and call instructions, Programming examples. [4]

Counters and Timers programming, RS 232 standard, Serial I/O in 8051, Interrupts in 8051, Interrupt based Timer/Counter and Serial programming. [6]

Interfacing: External memory, LCD, ADC, DAC, Sensor, Seven segment display, DC motor, Stepper Motor, Keyboard. Interfacing using 8255. [8]

Text Books:

1. "The Intel Microprocessors (Eight Edition): Barry B. Brey, Pub-Pearson (Prentice Hall). 5. The 8086 Microprocessor, Kenneth Ayala, Cengage Learning.
2. Liu and Gibson, 'Microcomputer systems the 8086/8088 family', 2nd ed., PHI.
3. Microprocessor & Interfacing, Douglas Hall, TMH.
4. Advanced microprocessor and peripherals by A K Ray and K M Bhurchandi TMH
5. "The 8051 Microcontroller and Embedded Systems Using Assembly and C" by Muhammad Ali Mazidi, Janice Gillipse Mazidi and Rolin D. Mckinlay, Second Edition, Pearson Education.
6. "The 8051 Microcontroller and Embedded Systems Using Assembly and C" By Kenneth J Ayala and Dhananjay V Gadre, Cengage Learning.

ECE-206 DIGITAL SYSTEM DESIGN AND HDL [3 1 0 4]

Total number of lecture hours - 48

Digital system design implementation options:

Digital System implementation using MSI/LSI circuits like PLDs, PLAs and PALs. Full-custom, semi-custom, standard cell based, Programmable ASICs – PLDs, CPLDs, MPGAs and FPGAs.Y-chart, Synthesis, Technology mapping. [8]

FPGA Architectures and applications:

Architecture of ACTEL, XILINX and ALTERA logic families, logic module, switching technology, I/O cells, Programmable interconnect. Implementation of Digital circuits using FPGAs. [8]

Digital testing and testability:

Different fault models, path sensitization algorithm, D algorithm, Boolean difference method, PODEM. Testing sequential circuits: iterative test generator, critical path. Design-for-test (DFT) methods: DFT guidelines for combinational circuits, other DFT methods like scan path, BILBO and Boundary scan. [12]

Hardware Description Languages:

Introduction to HDL, VHDL modeling concepts, entities and architectures, object types, Data types, Delay and delay models. Behavioral, Structural and Data flow models. Generics, Subprograms, Packages and use clauses, Configurations, VHDL standards. Test benches, Typical case studies. Introduction to Verilog programming. Behavioral, Data flow, and structural modeling. Basic constructs Coding examples. [20]

References:

1. M.J.S.Smith, "Application Specific ICs", *Pearson* 1997.
2. Michael L. Bushnell, Vishwani D. Agrawal, *"Essential of Electronic testing for digital, memory and mixed VLSI signal"*,Kluwer Academic Publishers, 2002.
3. Parag K. Lala, *"Fault tolerant and Fault testable hardware design"*, BS publication,1990.
4. Alexander Miczo, Russell D. Lambert,Miczo *"Digital logic testing and simulation",* Wiley-interscience,2nd edition.
5. J.Bhaskar "*VHDL Primer"*, Prentice Hall India,3rd edition.
6. J.Bhaskar "*Verilog Primer*", Addison Wesley Longman Singapore Pvt Ltd. 3rd edition
7. C.H.Roth, "*Digital System Design using VHDL*", PWS,1998.
8. Ashenden Peter J, "*Designer'S Guide To Vhdl"*, Morgan Kaufmann Publishers,3rd Edition.
9. Samir Palnitkar "*Verilog HDL*", Pearson Education Asia,2001.

ECE -208 ELECTROMAGNETIC WAVES [3 1 0 4]

Total number of Hours: 48

Review of Vector analysis:
Cartesian, Cylindrical and Spherical co-ordinate systems. [04]

Electrostatics:
Coulomb's law and its applications; Electric field intensity and Electrostatic potential due to point charges, line charge, surface charge and volume charge distribution. Electric flux and electric flux density; Gauss's law and its applications; Divergence and Gauss divergence theorem, Ohm's law, continuity equations and relaxation time; Capacitance, capacitance of coaxial cable, two-wire transmission lines etc; energy and energy density in electrostatic fields; boundary conditions: dielectric-dielectric, dielectric-conductor. Poisson's and Laplace's equations: solution to Laplace's equations for problems of one dimension. [14]

Magnetostatics:
Magnetic field intensity, Biot-Savart's law; magnetic flux and magnetic flux density; Ampere's law and its applications; Stoke's theorem, scalar and vector magnetic potentials; Boundary conditions; Faraday's laws of electromagnetic induction, motional induction in a conductor; Torque on a conductor; Self and Mutual inductance; Energy and energy density in a magnetic field.
[10]

Electromagnetic Waves:
Maxwell's equations in integral and point form for free space and material media, for sinusoidal time-varying fields; Electric and Magnetic Wave equations and their solutions; Uniform plane wave propagation in various media; relation between electric and magnetic fields; characteristics of plane waves in various media; Poynting vector and complex Poynting vector theorem, instantaneous and average energy in plane waves. [10]

Reflection of Electromagnetic Waves:
Normal incidence of plane waves from dielectric-dielectric and dielectric- conductor medium; Transmission and reflection coefficients and Standing wave ratio; Oblique incidence of plane waves, Brewster's angle, total reflection. Wave polarization [10]

References:

1.**Jr.Hayt and Bucker**, "Engineering Electromagnetics" *7th Edition , McGraw Hill.*
2.**Martin A Plonus** "Applied Electromagnetics" *McGraw Hill*
3.**John D Kraus**, " Electromagnetics" *4th Edition, McGraw Hill*
4.**Cheng**, "Fields, Waves and Electromagnetics" *2nd Edition, Addison Wesley.*
5.**Ramo, Whinnery and Duzer** "Fields and Waves in Electromagnetic systems",.
6.**Jordan and Balmain**, "Electromagnetic waves and Radiating systems" *EE Edition*
7.**Sadiku**, "Elements of Electro Magnetics", *3rd Edition, Oxford university*
8.**B.Guru & H.Hiziroglu**, "Electromagnetics Field Theory Fundamentals",*2nd Edition, Cambridge university Press.*
9.**N.N Rao**, "Elements of Electromagnetics", *VI Edn., Pearson Publishers, New Delhi.*
10. **K. E. Longren, S. V. Savov and R. J. Jost,** "Fundamentals of Electromagnetics with MATLAB", PHI, 2009

ECE-212 MICROPROCESSOR AND MICROCONTROLLER LAB [0 0 3 1]

Total number of lab sessions – 12

1. Arithmetic and Logical Instructions, Arrays Code Conversions,String Instructions using 8086
2. Programming DOS interrupts of 8086
3. Programming 8051- Bit manipulation, Timer/Counter, Interrupts, Serial Communication
4. Interfacing to 8051- LCD, Keyboard, DAC, ADC, Seven segment Display, Elevator, Stepper Motor, logic controller, traffic light controller, DC motor.

ECE 214 ELECTRONIC CIRCUIT DESIGN LAB [0 0 3 1]

Total number of lab sessions – 12

1. Device characteristics and circuits – BJT, FET, UJT, Zener diode
2. Amplifiers and Waveshaping
3. Applications of OP AMPs
4. Multivibrators – Timer 555 and OP AMP
5. Rectifiers, filters and Voltage regulators (OP AMP., 78XX, LM317, 723)
6. Oscillators – Phase shift, Hartley, Colpitts and Crystal.

ECE-301 ANALOG COMMUNICATION [3 1 0 4]

Total number of lecture hours: 48

Spectral analysis:
Review of Fourier Transform Theory, Energy, Power, Parseval's Theorem, and Spectra of signals, Cross-Correlation and Auto-correlation functions, Power and Energy spectral density. [9]

Random Processes:
Review of Probability theory and Random Variable, Central Limit theorem, Random Process, Correlation. [10]

Noise:
Introduction, Thermal Noise, Shot Noise, Signal to Noise ratio, S/N of a tandem connection, Noise Factor, Amplifier Noise in terms of F, Noise Factor of Amplifiers in Cascade, Noise Factor and Equivalent input Noise Generators, Noise Factor of a Lossy Network, Noise Equivalent Temperature, Narrow Band pass Noise. Introduction to communication system [4]

Amplitude modulation:
Introduction, Time and Frequency domain analysis, Modulation index for Sinusoidal AM, Average power for Sinusoidal AM, Effective voltage and current for sinusoidal AM, Single tone AM, AM by several sine waves. Generation of AM using square law Modulator and switching modulator, Detection of AM using square law Detector and Envelope detector, AM transmitter and receiver, Noise in AM system. [6]

Double Side Band Suppressed Carrier (DSBSC) Modulation:
Introduction, Time and Frequency domain analysis, Generation of DSBSC using balanced modulator and ring modulator, Coherent detection of DSBSC modulated waves. Noise in DSBSC system. [4]

Single Side Band (SSB) Modulation:
Introduction, Time and Frequency domain analysis, Generation of SSB using Filter method, Phase Discrimination method and Third method, Coherent detection of SSB. Noise in SSB system. Pilot carrier system. VSB modulation. [5]

Angle modulation:
Introduction to phase Modulation (PM) and frequency modulation(FM), FM Time and frequency domain analysis, Modulation index for sinusoidal FM, Average power for sinusoidal FM, Single tone FM, Generation of FM using Direct Method and Indirect method, Detection of FM using slope Detector, zero cross detector and phase locked loop, Amplitude limiters in FM, Automatic frequency control (AFC), FM stereo Transmitter and Receiver, FM receiver, Noise in FM system, pre-emphasis and De-emphasis filters. [10]

References:

1. **Simon Haykin** (1989) "An Introduction to Analog & Digital Communications" Willey Eastern, New York.
2. **Dennis Roddy & John Coolen** (2001) "Electronic Communications" Fourth Edition, PHI.
3. **Kennedy** (1994) "Electronic Communication Systems" Third Edition, TMH.
4. **Taub and D.L.Shelling**,(2000) "Principles of Communication systems" Second Edition McGraw Hill Book Co.
5. **B P Lathi**,(2005) "Modern Digital and Analog Communication" 3e, *Oxford University Press.*
6. **Cooper and McGillem** (2007) " Statistical Probabilistic methods for Signals and System Analysis" Oxford *University Press.*

ECE-303 DIGITAL SIGNAL PROCESSING [3 1 0 4]

Total number of lecture hours – 48

Review: Time and frequency analysis of signals and systems. [3]

Z-**transform and its application to the analysis of LTI systems:** Review of z-transform, unilateral z-transform, solution of difference equations, Analysis of LTI system in z-domain-system function, pole-zero analysis, stability [5]

Discrete Fourier Transform: Frequency domain sampling and reconstruction of discrete time signals – DFT, properties of the DFT, use of DFT in linear filtering, filtering of long data sequences, DFT as linear transformation, Efficient computation of the DFT- FFT Algorithms, Radix 2 DITFFT and DIFFFT, in-place computation, pipeline FFT, Goertzel Algorithm. [8]

Implementation of Discrete time Systems: Structures for FIR systems – Direct form, cascade form, Frequency sampling and lattice structures. Structures for IIR systems – Direct form, cascade and parallel form, lattice ladder structures. Finite word length effects. [8]

Design of IIR filters: Classical design by impulse invariance, bilinear transformation and matched Z transform, characteristics and design of commonly used filters – butter worth, Chebyshev and elliptic filters, Spectral transformations, Direct design of IIR filters. [8]

Design of Digital FIR Filters:
General considerations, Linear phase FIR Filters, Symmetric and anti-symmetric impulse response, Design using windows, frequency sampling design, Optimum design. [8]

Power Spectrum Estimation:
Estimation of power spectra from Finite duration of observation of signals. Non-parametric methods of PSD estimation: Periodogram, Bartlett, Welch, Blackman and Tukey methods (qualitative analysis). Parametric methods of PSD estimation: AR, ARMA and MA modeling, Yule-Walker, Burg method, least square estimation and sequential estimation method of AR modeling (qualitative analysis). [8]

References:

1. **Proakis J.G and.Manolakis D.G. Mimitris D**. (2003) "Introduction to Digital Signal Processing" *Prentice Hall,* India
2. **Oppenheim A.V.and Schafer R.W.** (2003) "Discrete Time Signal Processing", *Pearson education.*
3. **Ifeachar and Jervis** (2003) "Digital Signal Processing: A Practical approach" *Pearson education,* Asia
4. **Rabiner L.R and Gold D.J** (1988) "Theory and applications of digital signal processing" *Prentice Hall,* India
5. **Sanjit Mitra K** (2001) "Digital Signal Processing: A computer based approach", *TMH*
6. **Johnson J.R**,(1994) "Introduction to Digital Signal Processing" *Prentice Hall,* India

ECE-305 VLSI DESIGN [3 1 0 4]

Total number of Lectures - 48

Introduction:
VLSI technology trends, performance measures and Moore's law. [2]

MOS devices and Circuits:
MOS transistors. Study of depletion and enhancement mode operations. Threshold Voltage. Second order effects in MOSFETs. Analysis of NMOS and CMOS inverter circuits. [6]

Fabrication of ICs:
Lithographic process of MOS and CMOS fabrication. N-well, P-well and twin tub processes. Latch-up in CMOS. SOI process. VLSI Yield and economics. [5]

MOS Circuit design & Layouts:
Pass transistors and transmission gates. Implementation of Boolean functions and combinational circuits using switch logic & gate logic. Pseudo NMOS inverter, Dynamic and clocked CMOS inverters. Clocking strategies, Flip flops and sequential circuits. Static and dynamic memory cells. RAM, ROM and PLAs. Stick diagrams, Design rules and layouts, Scaling of MOS circuits. [15]

Basic circuit concepts and performance estimation :
Sheet resistance, Standard unit of capacitance. Estimation of delay in NMOS and CMOS inverters. Driving of large capacitive loads. Super buffers. Power dissipation in CMOS. [6]

Sub system design:
Design strategies, Design issues and structured approach. Design examples such as Adders, ALUs and Shifters. Design of sequential circuits. [8]

Current trends:
BiCMOS and GaAs devices and circuits. Low power VLSI circuit techniques, analog and mixed signal design. [6]

References:

1. Jan M Rabaey, "*Digital Integrated Circuits"*, Prentice Hall India, 2003
2. West N and Eshraghian K, *"Principles of CMOS VLSI Design"*, Addison Wesley Publication, 2nd Edition.
3. Sung Mo Kang and Yusuf leblebici, "*CMOS digital Integrated circuits design and analysis"*, Tata Mcgraw Hill, 3rd edition.
4. Amar Mukherjee, "*Introduction to NMOS & CMOS VLSI systems Design",* Prentice Hall, 1986.
5. Pucknell D.A and Eshraghian K , *"Basic VLSI Design"*, PHI publication, 2009.
6. Allen, *"CMOS Analog Circuit Design"*, Oxford University Press.,2nd Edition

ECE-307 **ANTENNAS** **[3 1 0 4]**

Total number of lecture hours - 48

Introduction:
Types of Antennas, Radiation Mechanism, current distribution. [3]

Fundamentals:
Radiation pattern, power density and radiation intensity, Directivity, Gain, efficiency, HPBW, input impedance, Radiation efficiency, effective area, PLF, Antenna Temperature [8]

Vector potentials:
Electric and magnetic vector potentials, solutions for wave equations, far-field radiation, Duality theorem, Reciprocity theorem. [5]

Linear wire Antennas:
Infinitesimal, small and finite dipole Antennas, Region separation, Half wave length dipole, Image theory, vertical and horizontal antenna on perfect conductor, effect of earth curvature. [7]

Loop Antennas:
Small circular loop Antenna, circular loop with constant current, Ferrite loop. [4]

Arrays:
Two element array, N-element array – uniform, broadside, ordinary end-fire, Non-uniform Amplitude Arrays, planar and circular arrays. [8]

Study of other types of Antennas:
Qualitative study of Folded dipole, long wire, V, Rhombic, Helical, Yagi-Uda, log-periodic, Aperture, and horn Antennas, Babinet's principle, Huygens's principle. [5]

Micro Strip Antennas:
Rectangular and Circular Patch, Quality Factor, Bandwidth, Efficiency [4]

Propagation of EM waves:
Ground wave Propagation, Space Wave Propagation, Troposphere and ionosphere propagation and its effect on Radio Waves. [4]

References:

1. **Constantine A.Balanis** (2010) "Antenna Theory" , 3e, *John Wiley & Sons, New Delhi*
2. **John Kraus** (2010) "Antenna and wave Propagation", 4e, *Tata McGraw – Hill, New Delhi*
3. **K.D.Prasad** (2009) "Antenna and Wave Propagation", 3e, Satya Prakashan, New Delhi
4. **F. E. Termen** (1995) "Radio Engineering" *Tata McGraw – Hill, New Delhi*

ECE 309 COMMUNICATION NETWORKS [3 1 0 4]

Introduction: Uses of computer networks, types of networks, network hardware, network software, network design issues, network design tools, ISO-OSI reference model, TCP/IP reference model, Examples networks, Network standardization. Switching techniques, Multiplexing and Multiple Access techniques, Packet Switched Networks. [15]

Circuit switched network: Transmission, switch mode, integrated – services digital network (ISDN) ISDN services, ISDN interface, ISDN system architecture, the digital PBX signaling, perspective on ISDN, applications for global ISDN and future trends [5]

Local area network: Data link layer, error detection and correction, elementary data link protocol, sliding window protocols, data link control. HDLC standard. Channel allocation, multiple access protocol, IEEE standards, fiber optic networks, LANs and Network of LANS [10]

Packet switched network: Routing algorithms, congestion control algorithm, internetworking, network layer in internet, internet control protocols, limitations of IP_{v4}, Introduction to IPV6 Protocol IP addressing, networking devices, data links and transmission, Wireless Networks and Mobile IP. Transport and end to end protocols, congestion control techniques, the internet transport protocol TCP and UDP, performance issues, connection management Handshaking. [12]

Advanced Concepts: Application layer and network management, Network Security. Packet Queues and delays, Little's theorem, Birth and death process, Queuing disciplines, M/M/1 Queues, Traffic models, ATM Networks, Quality of service and resource allocation, VPNs and MPLS, Cellular Telephone and Optical networks, VOIP and Multimedia networking. Mobile Adhoc Networks, satellite networks and Wireless Sensor Networks. [6]

Reference:

1.Nader F. Mir, "Computer and Communication Networks", Pearson Education, 2007
2.Garcia and Widjaja, "Communication Networks", McGraw Hill, 2006
3.J.F. Hayes, "Modelling and analysis of Computer Comm. Networks", Plenum, 1984.
4.Jean Walrand & Pravin Varaiya, "High Performance Communication Networks" , Morgan Kaufmann Publishers, 2002.
5.William Stallings "Data & Computer communication," 7th Edition. *Prentice Hall*
6.Andrew S.Tanenbaum, "Computer Networks" , 4rd *Edition. Prentice Hall PTR-2003*

ECE 323 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS [4-0-0-4]

Total number of lecture hours: 48

Review of different types of microprocessors and microcontrollers [01]

16 bit microcontrollers:

CPU, register file, memory, serial and I/O ports, watchdog timer. [03]

32 – Bit Microprocessors:

ARM processor fundamentals, programmer's model, pipeline, ARM instruction set, programming, Input and output, ARM modes, Exceptions, Exception handlers. [12]

Memory hierarchy and cache, memory management units, Embedded ARM Applications, VLSI Ruby II Advanced communication processor, VLSI ISDN Subscriber processor, Ericsson-Bluetooth base band controller. ARM7100, SA-1100. [10]

Introduction to 80386 & 80486, registers, operand addressing, bus operation, pin functions, software compatibility, memory system, pipelining, task switching [08]

Power PC architecture, machine organization, 601 – chip, instruction queue and dispatch unit, instruction fetch unit, fixed and floating point units, memory management unit, cache unit, bus interfacing and bus timing. Introduction to Power PC 603. [07]

64 – Bit Microprocessors:

Block diagram, prefecher, superscalar execution, dynamic branch processing, code and data cache, floating point pipeline, register stack manipulation. [07]

References:

1. Steve Furber "ARM System-on- Chip Architecture", *Second Edition , Pearson Education,* 2000
2. J.R.Gibson "ARM Assembly Language-an Introduction" *Dept. of Electrical Engineering and Electronics, The University of Liverpool*, 2007
3. Andrew N.Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide" *Elsevier,*2004
4. B.P. Singh and Renu Singh " Advanced Microprocessors & Microcontrollers ",*New Age International,* 2005.
5. Intel 80386 Programmer's Reference Manual 1986.

ECE 325 VLSI/ULSI PROCESS TECHNOLOGY [4 0 0 4]

Total Number of Hours: 48

Material Properties: Physical properties, Crystal structure, Miller indices, Packing Density, Defects, Dislocation. [4]

Crystal Growth: Silicon Crystal Growth - Czochralski and Float Zone Technique, Distribution of dopants, Segregation/Distribution coefficient. [3]

Silicon Oxidation: Thermal Oxidation process- Kinetics of Growth, Deal-Grove Model, Impurity Distribution, Masking properties, Oxide thickness characterization, LOCOS, SWAMI [6]

Photolithography: Photo resists, Lift Off technique, Optical Lithography, masks, photo resists, Pattern transfer, Resolution enhancement techniques. Next generation lithography- electron beam lithography, X-ray lithography, Ion beam lithography. [6]

Diffusion: Basic diffusion process, Fick's law, Pre-deposition and drive-in diffusion, Diffusion profile for various dopants, Lateral Diffusion. [6]

Ion Implantation: Range of Implanted Ions, straggle, ion stopping, ion Channeling, Annealing, Rapid Thermal Annealing, Measuring sheet resistance and doping profile. [6]

Etching: Wet chemical etching of Silicon, Silicon dioxide, Silicon Nitride and Aluminum. Dry etching, Plasma fundamentals and etch mechanism. [5]

Epitaxy: Epitaxial growth technique, Molecular beam epitaxy. [4]

Metallization: evaporation and sputtering [3]

Realizing resistor, capacitor, BJT, MOSFET, elctromigartion. Single and Double Damascene process. [5]

References

1. **S.K. Gandhi**, "VLSI Fabrication Principles", Second Edition, John Wiley & Sons, 1983.
2. **S. M. Sze**, "VLSI Technology", Second Edition, McGraw Hill, 1988.
3. **Stephen A. Campbell**, "The Science & Engineering of Microelectronic Fabrication", Second Edition, Oxford University Press, 2005.
4. **Gary S. May and S. M. Sze,** "Fundamentals of Semiconductor Fabrication", Wiley Student edition, 2004.
5. **Douglas A. Pucknell, Kamran Eshraghian**, "Basic VLSI Design", Third Edition, Prentice Hall, 1994.

ECE-327 DIGITAL MEASUREMENT TECHNIQUES [2 1 0 3]

Total number of lecture hours - 48

Introduction and Philosophy:
Philosophy of digital and microprocessor/microcontroller based instruments. [2]

Time measurement techniques:
Time standards; Measurement of time interval between events, order of events, Vernier technique, Very low time, period, phase, time constant measurements; [7]

Frequency measurement techniques:
Frequency, ratio and product, high and low frequency measurements; Deviation meter and tachometer, Peak/valley recorder. [7]

Programmable circuits:
Programmable resistors, amplifiers, and filters. Digital to Analog Converters: Programmable amplifiers as DACs, Multi-stage WR DACs, Weighted current-, weighted reference voltage-, weighted charge-DACs; Ladder DACs, Design of DACs with respect to spread and total resistance; Hybrid multiplier and divider. [8]

Analog to Digital Converters:
V/f and V/t converters, Direct ADCs, ramp, tracking, dual slope, successive approximation and flash types; Multi-stage flash type ADCs, DVM and its design. [7]

Voltage ratio measurement techniques:
Digital ohmmeter, capacitance meter; impedance meters (polar and Cartesian types); Decibel meters; Q meter tan-delta meter; Modulation index meter. [8]

Sampling theory and its applications:
Sampling theory and its applications in current, voltage, power, energy measurements. [3]

Elements of digital signal processing:
FFT, DHT, digital filters. [6]

References:

1. **T. S. Rathore** (1996) "Digital Measurement Techniques", *Narosa Publishing House, New Delhi*.
2. **B. S. Sonde** (1974) "Monographs on System Design using Integrated Circuits", *Tata Mc-Graw Hill*.
3. **D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss** (1988) "Digital Signal Processing", *J Wiley and Sons, Singapore*.

ECE-329 ELECTRONIC SYSTEM DESIGN [3 1 0 4]

Total number of lecture hours =48

Introduction: Electronic system design flow, design stages, methodology, documents and design files, system requirements, cost, time to market, testing and debugging procedures 2hrs

Electronic components and its properties: Silicon crystal growth (CZ method ,float zone method),Capacitors, types of capacitors, capacitor packaging, resistor, and resistor types, resistor packaging, inductors, switches. 4 hrs

Peripherals :USB host and peripherals controllers, CODEC, headphone, SPDIF, RS232, LCD, I/O devices, audio/video codec, keyboard, VGA, RF, RF/IO interfaces, buck stick connectors, power supply, clock circuit, embedded pro section, memory section voltage regulators, current buffers peripherals, ADC ,DAC, couplers, isolators, high voltage driver circuit, relay board MOSFET, protection circuit, troubleshooting, control, IO sections, buzzer/LED's, board debugging unit.10hrs
.

Power Section: Power electronics, voltage references, current references, and voltage regulators, current buffers and drivers, power distribution network, power isolators, power management techniques, ICs and Components for power section, packaging details for power components. 6hrs

IO Devices and Displays: Push button switches, board support stand, PCB grooved, JTAG pre and Debugging , cooling/heat sink, battery backup section, external memory interface, PCB dimension, two sided, multilayerd boards. 6hrs

Debugging section: Trouble shooting circuits and interfaces, test point design, board debugging unit, LED indication, control section, JTAG interfaces. 3hrs

SMD components: SMD IC packaging, component packaging, assembling, pad dimensions, through hole components ,TV mother board,CRTs, Multilayer PCBs. 6hrs

Interface: RS232, JTAG, parallel port, USB cable, RCA cable, BNC, multi function probes, high and low frequency probes, wired and wireless interfaces, components and ICs 3hrs

Soldering and manufacturing: Through hole soldering, wave soldering, SMD soldering, Wavesoldering Technique.Reflow soldering Technique, component mounting designand flow. 6hrs

Testing: ***QC, rework, quality testing, testing standards, hot and cold checks, debugging 2hrs***

Books

1.Peter van zant**,** *Micro chip fabrication, Mcgraw hill2004*
2. Howard. W. Johnson and Martin Graham, *High speed Digital Design, A Hand Book of Black Magic*, Prentice Hall, 2004
3. Eric Bogatin, *Signal Integrity-simplified*, Prentice Hall, 2004
4. Douglas Brooks, *Signal Integrity Issues and Printed Circuit Board Design*, Prentice Hall, 2003
5. Stephen H. Hall, Garrett W. Hall and James A. McCall, *High-Speed Digital System Design—A Handbook of Interconnect Theory and Design Practices*, John Wiley & Sons, 2000
6. Bruce R. Archambeault, *PCB Design for Real-World EMI Control*, Kluwer Academic Publishers,
7.Rudolf strauss,*surface mount technology*. Butterworth-Heinemann Ltd oxford ox28dp, 1994.

ECE- 331 ADVANCED BROADCASTING & DISPLAY TECHNIQUES [4 0 0 4]

Total number of Hours: 48

A. Broadcasting Techniques

Microphones, loudspeakers, recording and reproduction of sound-disc, tape, film recording, playback system. High fidelity equipment for reproduction of sound. Loudspeaker enclosures and baffles. Stereophonic sound system. Studios and auditorium: Theory of reverberation, its limitation, measurement and adjustment. Acoustic materials, design considerations of broadcasting studios and auditorium. [08]

Broadcast transmitters- master oscillators, frequency multiplier, high and low level modulation system. Class A, AB, and C power amplifiers, feeder lines. Block diagram and principles of amplitude modulated and frequency modulated transmitters. Studio equipment and control room apparatus. OB equipment and receiving center's facilities. Communication receiver, Intermediate frequency, image frequency. Receiver characteristics and measurement. Design considerations of modern broadcast transmitters and receivers. Transmitting and receiving antennas. FM transmitters and receivers. [08]

Television broadcast studio facilities, block diagram of television transmitter. Digital television. Design considerations of transmitter and receiver. Feeder line, Balun, diplexer, vestigial side band filters. Transmitter- receiver relationship. Transmitting and receiving antennas. Block diagram of intercarrier type television receiver, RF tuner, mixer and 10- circuit design, Sync. Separator. IF amplifier characteristics and design. Trap circuit. [08]

Elements of colour television, colour vector diagram, colour difference signal, I,Q,Y signals and their bandwidths. Colour cameras and picture tubes, colour killer circuit, compatibility. Propagation of television signal, telecine, CCTV, CATV, MATV, TV booster, VCR, VCP. [08]

B. Display devices and applications

Cathode Ray Tube, Light Emitting Diode, Organic Light Emitting Diode, Liquid Crystal Display, Plasma Display Panel, Electronic Visual Display (Touch screen) [16]

References:

1. **AM Dhake.** "Television and Video Engineering". Prentice Hall of India(P) Ltd., New Delhi
2. **George Kennedy** "Electronic communication system" Prentice Hall of India(P) Ltd., New Delhi.
3. **Moriyoshi Ohara et al**., "Digital link: High functional digital monitor interface," SID 99 Proceedings, May 18, (1999).
4. **Hiroshi Ishikawa**, "Digital link that realizes QXGA," seminar note at "LCD/PDP International '98," October 28, (1998).
5. **S.P. Bali (2005)** "Consumer Electronics" ,Pearson Education.

ECE – 333 CIPHER SYSTEMS [3 1 0 4]

Total number of hours: 48

Some topics in Number theory:
Prime numbers, Euclidian Algorithm, Divisibility, Congruences,Chinese remainder theorem, Discrete algorithms. [07]

Introduction to cipher systems:
Monograph and digraph, linear and shift transformations, affine transformation, Enciphering matrices, Vigenere and Beufort systems, Diffusion and confusion. [07]

New data encryption standards:
Block ciphers-Feistel, DES-SDES, DES, 2DES, 3DES, RC5.Blowfish algorithms, Stream ciphers-RC4, Finite field theory, AES, Rijndael algorithm, Placement of encryption function, Traffic confidentiality, Key distribution. [13]

Public key cryptography and Key management:
Principles of Public-Key Cryptosystems, Hellman and Merkel algorithm, RSA algorithm, Elliptic Curve arithmetic, Elliptic curve cryptography, Key management, Diffie-Hellman key exchange. [10]

Message authentication and Hash functions
Authentication Requirements, Authentication functions, Message Authentication codes, Hash Functions, Security of Hash functions and MACs,Secure Hash Algorithm,Whirlpool,HMAC,CMAC, Digital signatures and authentication protocols. [11]

References

1. **William Stallings (2003)** "Cryptography and Network Security principles and Practice". 3rd edition, Prentice-Hall of India Pvt.Ltd. Pearson Education Asia.

2. **William Stallings (2009)** "Cryptography and Network Security principles and Practice". 4th edition, Prentice-Hall of India Pvt.Ltd. Pearson Education Asia.

3. **B.A.Forouzan and D.Mukhopadhyay** "Cryptography and Network security". 2nd Edition, Mc GrawHill.

4. **Bernard Menezes** "Network Security and Cryptography, 2010, Cengage Learning

ECE-311 VLSI LAB [0 0 3 1]

Total number of lab sessions – 12

1. Coding examples using VHDL for combinational and sequential circuits and simulation.
2. Study of various modeling styles using VHDL.
3. Synthesis of combinational and sequential circuits.
4. Implementation of digital circuits using the FPGA/CPLD.
5. Coding examples using Verilog for logic circuits and simulation.
6. Generate lay outs for simple logic circuits using layout editor and analyze.

ECE 313 DIGITAL SIGNAL PROCESSING LAB [0 0 3 1]

Total number of lab sessions – 12

1. Time domain and Frequency domain Analysis of signal s and systems
2. Analysis in *z*-domain
3. Filter Design
4. Applications to Speech and Image Signal Processing
5. Introduction to Code Composer Studio
6. Filter Implementation using DSP Kits

ECE-302 DIGITAL COMMUNICATION [3 1 0 4]

Total number of lecture hours - 48

Signal Detection

Model of digital communication system, Gram-Schmidt orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to the noisy input, detection of known signals in noise, probability of error, correlation receiver, matched filter receiver, detection of signals with unknown phase in noise. [5]

Pulse Modulation systems:

Pulse amplitude modulation (PAM), band width requirements and reconstruction methods, time division multiplexing, pulse duration modulation (PDM), generation of PDM signals and reconstruction methods. Sampling theorem, Analog to digital conversion, quantization and encoding techniques, application to pulse code modulation (PCM), quantization noise in PCM, companding in PCM systems, Time division multiplexing (TDM), examples of PAM and PCM systems. The T1 PCM system in telephony. The delta modulator and its operation, quantization noise and slope overload in delta modulators. Comparison of delta modulation and PCM, Introduction to linear prediction theory with applications in delta modulation.

[8]

Base band digital data transmission:

Base band digital communication systems, multilevel coding using PAM, pulse shaping and band width consideration, inter symbol interference (ISI). Nyquist condition for zero ISI, band-limited Nyquist pulses, the eye diagram. Duobinary and modified duo binary encoding, Optimum detection of a base band data communication systems. Performance limitation of base band data communication due to noise probability of error expression for multi-level data signals.

[6]

Digital modulation techniques:

Band pass (modulated) digital data systems, binary digital modulation, PSK, DPSK, and FSK. M-ary data communication systems, quadrature amplitude modulation (QAM), systems, QPSK, OPSK, and MSK. Introduction to OFDM. Effects of noise in modulated digital communication systems, optimum binary systems. Probability of error expression for binary communications, probability of error in QAM systems, comparison of digital modulation systems, Application of modems for transmission over telephone lines. [11]

Information theory and coding:

Introduction to information theory, definition of information, examples of simple sources. Information rate and Shannon's coding theory. Shannon's theorem and channel capacity. Block coding for error detection and correction, parity check bits and block coding. Examples of cyclic error correcting codes. Convolution codes., tree, trellis and decoding algorithms. Introduction to TCM and turbo coding.

[10]

Introduction to Spread Spectrum System:

Direct sequence SSS. Frequency hopping SSS. Application – Ranging multi path CDMA. Spreading sequences. [8]

References:

1. **Haykin S** "Digital Communications" *John Wiley and Sons.*
2. **Taub H and.Schilling D.L** "Principles of Communication systems",*McGraw-Hill Co*.
3. **Hsu H.P.** "Analog and Digital Communications", *Schaum's outline series*.
4. **Proakis J G** "Digital communications" *McGraw-Hill, 2009.*
5. **Lathi B P** "Modern Digital and Analog Communication" 3rd Edn., *Oxford University*
6. **Sklar B K** "Digital Communication", *Pearson*
6. **Cooper and McGillem** (2007) "Statistical Probabilistic methods for Signals and System Analysis", *Oxford University Press*.

ECE – 304 MICROWAVE COMPONENTS AND DEVICES [3 1 0 4]

Total number of hours: 48

Transmission lines:
Transmission line equations and their solution, characteristic impedance, reflection coefficient, Transmission lines at high frequencies, standing waves on transmission line for different loads, SWR, eighth, quarter and half wave line, impedance matching. [06]

Smith Chart:
Construction single and double stub matching. [04]

Guided Waves:
Transverse electric, Transverse magnetic and Transverse electromagnetic waves in conducting planes, characteristics of TE TM and TEM waves, wave impedance, attenuation [04]

Rectangular and circular wave guides:
TE, TM and TEM waves in rectangular and circular wave guide, characteristics of TE and TM mode and excitation of wave guides, [06]

Strip Lines and Micro strip lines:
Characteristic impedance, losses and quality factor Q of micro strip lines, coplanar strip lines and shielded strip lines, parameters and its properties. [03]

Passive Components:
Resonators, Directional Couplers, E-plane Tee, H-plane Tee and Hybrid Tee, Hybrid ring, Attenuators, Circulator, Faraday rotation principle, Isolators, Gyrators, Phase Shifters, their applications [06]

Microwave active Devices:
Limitations of conventional vacuum tube devices [01]

Two cavity klystrons: Reentrant cavities, velocity modulation process, bunching process, output power and beam loading. [03]

Reflex klystron: Velocity modulation, power output and efficiency and electronic admittance. [03]

Traveling Wave Tube: Slow wave structure, amplification process, convection current, axial electric field, wave modes and gain consideration. [03]

Magnetron: Mode of oscillation, Strapping and Rising Sun Magnetron. [02]

Parametric Amplifiers: Physical structure, nonlinear reactance and Manley Rowe relations, applications. [02]

Microwave diodes and transistors:
Tunnel diode, Varactor diode, Gunn diode, IMPATT diode, Microwave transistors and FETs. [05]

References

1. **Ryder J.** "Network lines and Fields" *Prentice Hall, 1999*
2. **Jordan and Balmain** "Electromagnetic waves and Radiating System" *Prentice Hall,*1968
3. **Liao S.** "Microwave Devices and Circuits" *Prentice Hall* , 2004

4. **David M. Pozar** "Microwave Engineering" *John Wiley & Sons* , 2004
5. **Richard E. Collin** "Foundations for Microwave Engineering" *John Wiley & Sons*, 2001
6. **Kennedy,** " Electronic Communication System" *Tata McGraw Hill*, 1999
7. **Annapurna Das & Sisir K Das,** "Microwave Engineering" *Tata McGraw Hill*, 2006

ECE-306 LINEAR AND DIGITAL CONTROL SYSTEM [3 1 0 4]

Total number of lecture hours: 48

Block Diagrams and Signal flow graphs:
Transfer function, Block Diagram, Simplification of systems, Signal flow graphs, Gain formula, State diagram, Transfer function of discrete data systems (PTF), Zero order hold. [8]

Systems modeling:
Modeling of electrical and Mechanical Systems (translational & Rotational), System equations, its electrical equivalent (analogous) networks. [3]

Time Domain Analysis:
Stability, Routh-Hurwitz criterion, time response for Continuous data systems, type and order of systems, Steady state error for linear Systems, Unit step response for second order systems, Root locus properties and construction. [10]

Frequency Domain Analysis:
Introduction, second order prototype system, Bode diagram, Gain and Phase margins, Nyquist stability criterion. [5]

Compensators and controllers :
Proportional, Integral, PI, PD and PID controllers, Lead, Lag and Lead-Lag compensators. [6]

State space representation :
Stability Analysis, State transition matrix, Eigen values, Controllability and observability [4]

Digital Control systems :
Stability and its tests, time response, Mapping between s-and Z- plane, Steady state error [4]

Process controls:
Process and process control, model identification, feedback and feed forward controls and control strategies, actuators. [4]

Controllers:
Z-transform based control algorithms, PID controllers – direct digital controllers. [4]

References :

1. **S.I.Ashon** "Microprocessors with applications in process control".
2. **B.C.KUO** "Automatic Control Systems" 7th Edition, PHI.
3. .**Nagrath and Gopal** "Control system engineering" PHI.
4. **K.Ogata** "Modern control engineering" 2nd Edition., PHI.
5. **D'azzo and Houpis** "Linear Control System Analysis and Design" TMH.

ECE 308 **Embedded System Design** **[3 1 0 4]**

Introduction to Embedded systems, Architecture of Embedded systems, Hardware and Software. [4]

Overview of Linux commands, Shell programming, GNU Development tools, gcc, g++, gdb, GNU makefile, Revision control systems, [4]

Fast interrupts, Interrupt controller, Interrupt latency, Interrupt programming, Device driver [4]

Process of Embedded system development, Communication interfaces- RS232, SPI, I^2C and Programming. [8]

Systems programming, Pthreads, Synchronization with Semaphores, Synchronization with Mutexes. [4]

Operating systems : Overview, Multitasking OS. [2]

RTOS: Introduction, Task swapping methods ,Scheduler algorithms, Priority inversion, Task, Thread , Processes, Memory model, Memory management [8]

Choice of RTOS, Overview of embedded/RTOS, Programming in RTOS, Semaphore & mutex implementation [8]

Development of protocol converter, Case studies [6]

References:

1. Steave heath, "Embedded system design", 2nd edition 2003,elsevier
2. K.V.K.K Prasad, "Embedded / Real time systems: Black book", Revised edition 2005.
3. Wrox, Linux Programming 3rd edition 2005, o'reilly.
4. Frank vahid , Embedded systems.
5. Rajkamal, Embedded system, 2nd edition.
6. Peckol, contemporary design tool/embedded systems
7. Shibu k.v , "Introduction to Embedded systems", mcgraw hill 2009

ECE- 324 ASIC DESIGN [3 1 0 4]

Total Number of Hours: 48

Introduction to ASIC design:
Types of ASICs, ASIC/FPGA design flow, Programmable ASICs, Programmable ASIC Interconnect, ASIC economics. [8]

ASIC Library Design:
Transistor as resistors, Transistor as parasitic capacitance, Logic Effort, library cell design [4]

Logic Synthesis and Simulation
FSM Synthesis, Timing Analysis-Static Timing Analysis, Clock tree Synthesis. [8]

Algorithms for VLSI Design Automation
Physical design - Basic Concepts, Partitioning, Floor planning, Placement, Routing algorithms. Layout compaction. Case study. [16]

Signal integrity and interconnect problems Transmission line effects, Impedance mismatch, cross talk and issues in high speed design. [6]

Introduction to Verification Verification challenges, Advanced functional verification, unified verification methodology. [6]

References:

1. M.J.S.Smith, *"Application Specific ICs"*, *Pearson*, 1997.
2. Nigel Horspool and Peter Gorman**,** *"The ASIC Handbook "*, Prentice Hall, 2001.
3. Sabin H. Gerez, *"Algorithms for VLSI Design Automation"*, John Wiley & Sons,1999.
4. Naveed Sherwani, *"Algorithm for VLSI Physical Design Automation*", Kluwer Academic Publishers,1998.
5. Paul Wilcox, *"Professional Verification – a guide to advanced functional verification*", Springer India, 2004.

ECE-326 Bio-MEMS and Microsensors [3 1 0 4]

Total number of lecture hours – 48h

Introduction:
Historical Background of MEMS [2]

Bulk Micromachining: Isotropic Etching and Anisotropic Etching, Wafer Bonding. [5]

Surface Micromachining: Sacrificial layer etching issues, stiction. [5]

MEMS Transduction and Actuation Techniques: Electromechanical, Piezoelectric, Electrostrictive, Magnetostrictive, Electromagnetic and Electrodynamic transducers. Electrostatic and Electrothermal actuators. Comparison of electromechanical actuation schemes. [3]

Microsensing for MEMS: Piezoresistive, Capacitive, Piezoelectric, Resonant sensing and Surface Acoustic Wave sensors. [3]

Basic Bio-MEMS Fabrication Technologies: UV Lithography of Ultrathick SU-8 for Microfabrication of High-Aspect-Ratio Microstructures and Applications in Microfluidic and optical components. [6]

LIGA Process: A Fabrication Process for High-Aspect-Ratio Microstructures in Polymers, Metals, and Ceramics [7]

Microfluidic Devices and Components for Bio-MEMS: Micropump Applications in Bio-MEMS, Micromixers. [7]

Sensing Technologies for Bio-MEMS Applications: Coupling Electrochemical Detection with Microchip, Capillary Electrophoresis, Culture-Based Biochip for Rapid Detection of Environmental Mycobacteria, MEMS for Drug Delivery, Microchip Capillary Electrophoresis Systems for DNA Analysis. [10]

References:
1. RF MEMS and Their Applications, Vijay K. Varadan, K.J. Vinoy and K.A. Jose, Wiley, 2003 Edition.

2. Bio-MEMS-*Technologies and Applications,* Edited by Wanjun Wang and Steven A. Soper, CRC Press, 2007.

3.Richard P.Buck,William E.Hatfieldc (1990) "Biosensors Technology" Marcel dekker USA
4. Stephen D. Senturia, "Microsystem Design" by, Kluwer Academic Publishers, 2001.
5. Marc Madou, "Fundamentals of Microfabrication" by, CRC Press, 1997.Gregory Kovacs, "Micromachined Transducers Sourcebook" WCB McGraw-Hill, Boston, 1998.

ECE-328 OPTICAL FIBER COMMUNICATION [3 1 0 4]

Total number of lecture hours : 48

Planar dielectric waveguides.
Derivation and solution of eigenvalue equation for planar symmetric dielectric waveguides. TE and TM modes, birefringence in planar dielectric waveguides. Power calculations [8]

Step and graded index fibers
Derivation and graphical solution of wave equation for step index fibers with emphasis on single mode fibers. Concept of V number and its significance. Power calculations. Birefringence in single mode fibers. Hi-Bi fibers. Application of optical fibers in communication networks.
[8]

Distortion of optical pulses propagating through fibers
Intermodal and intramodal (chromatic/material and waveguide) dispersion. Propagation of Gaussian optical pulses through dispersive fibers. Dispersion compensation mechanisms [9]

Fiber amplifiers:
Concept of optical amplification. Erbium Doped Fiber Amplifier (EDFA), SOA [6]

Advanced modulation and demodulation formats for optical fiber communications:
Coherent detection of ASK, FSK and PSK. Optical DQPSK, DOPSK and QAM. Optical CDMA
[8]

Wave propagation through anisotropic media
Concept of permittivity tensor and index ellipsoid. Linear electro-optic effect (Pockel's effect). Bulk optic amplitude and intensity modulators. Integrated optic amplitude and intensity modulators based on Mach Zehnder Interferometer. [9]

References:

1. **G.Keiser** (1991) "Optical Fiber Communications" *Tata McGraw Hill,New Delhi*.
2. **M.Sathish Kumar** (2005) "Fundamentals of Optical Fiber Communication", *Prentice Hall of India, New Delhi*.
3. **A.Ghatak and K.Thyagarajan** (1998) "Introduction to Fiber Optics" *Cambridge University Press, NY*.
4. **A.Ghatak and K.Thygarajan** "Optical Electronics" *Cambridge University Press, NY*
5. **G.L.Li and P.K.L.Yu** (2003) "Optical Intensity Modulators for Digital and Analog Applications" *J.Lightwave Technol*., vol 21, pp 2010 - 2013.
6. **G. P. AGRAWAL, "OPTICAL FIBER COMMUNICATION"---??**

ECE-330 DIGITAL SPEECH PROCESSING [4-0-0-4]

Total number of lecture hours: 48

Anatomy and Physiology of speech production, Categorization of speech sounds, Acoustic theory of speech production, Uniform lossless tube model, Effects of losses in the vocal tract, Digital models for speech signals. [4]

Time-dependent processing of speech, Short time energy and Average magnitude, Short time average zero-crossing rate, Speech Vs Silence Discrimination using Energy and Zero crossings, Short time Auto-correlation function, Pitch period estimation using Auto-correlation function. [8]

Short Time Fourier Transform Analysis, Spectrographic Displays, Linear Predictive Coding: Linear Models of Speech, Basic Principles of LPC, Auto-correlation method, Covariance method, Durbin's recursive solution for the auto-correlation equations. Pitch detection using LPC parameters, Formants Analysis using LPC parameters. [8]

Need for coding, Speech redundancies, Measure to evaluate Speech quality. Waveform Coding: Time Adaptive Waveform Coding, (APCM), Differential PCM, Linear Predictive Coding (LPC vocoders), Voice excited LPC vocoders. Frequency Domain Coders: Filter bank Analysis, Sub band coding, Adaptive Transform Coders. Analysis by Synthesis Vocoders: Phase Vocoders, Channel Vocoders, Homomorphic Vocoders. [12]

Text to Speech Synthesis: Principles of Speech Synthesis, LPC synthesis, Unrestricted Text to Speech systems. [6]

Feature Extraction: LPC, Cepstral Coefficients, MFCC, Pattern Matching by Dynamic Time Warping (DTW), Hidden Markov Models (HMM), and Artificial Neural Networks for speech recognition. [10]

References:

1. Rabiner L.R and Schaffer R.W, (2007) "Digital Processing of Speech Signals", *Prentice Hall*, NJ
2. Thomas F. Quatieri (2004), "Discrete-time Speech Signal Processing—Principles and Practice", Pearson Education, Inc.
3. Douglas O' Shaughnessy (1987), "Speech Communications: Human and Machine Reading", *Addison-Wesley.*
4. Deller J.R, Proakis G.J and Hansen J.H.L, (2000), "Discrete Time Processing of Speech Signals", *IEEE Press.*
5. Rabiner L.R and Jaung (1993), "Fundamentals of Speech Recognition", *Prentice Hall.*

Total number of lecture hours - 48

Multirate Signal Processing: Multi-rate Systems, Decimation and Interpolation (integer and fractional), Decimation Filters, Interpolation Filters, Interpolated FIR Filters for Decimation and Interpolation Filters, Perfect Reconstruction System, Poly Phase Filter Structure, Poly Phase Filter Structure for Decimation and Interpolation, Filter Banks, Uniform DFT Filter Bank, Quadrature Mirror Filter Bank (QMF) [16]

Multi-resolution Analysis and Wavelet Transform: Short-time Fourier Transform, Wavelet Transform, Discrete-time Orthonormal Wavelets, Continuous-time Orthonormal Wavelet Basis [8]

Adaptive Filtering: Principle of Adaptive filters, Tapped Delay Line and Weiner Filters, Steepest Descent Algorithm, Least Mean Square (LMS) Algorithm, Direct Least Square and Recursive Least Square (RLS) Algorithms, Application of Adaptive Filters as Noise Canceller, Echo Canceller, Side lobe Canceller, Adaptive Line Enhancer. [12]

Homomorphic Signal Processing: Homomorphic system, Complex Cepstrum, Properties of complex Cepstrum, Complex Cepstrum of exponential signals, Real Cepstrum, Homomorphic systems for convolution and de convolution, Examples of Homomorphic signal processing: - Communication signal processing and Speech processing. [12]

References:

1. P. P Vaidyanathan, 'Multirate Systems And Filter Banks', *Prentice Hall*, India (1993)
2. A.V Oppenheim.and R.W. Schafer, 'Digital Signal Processing', *PHI Learning* (2008),
3. S. J Orfanidis, 'Optimum Signal Processing', *Mc Graw Hill* , NJ (2007)
4. Elliot *et al* **,** **'**DSP Handbook'
5. M H Hayes, **'**Statistical signal processing and modeling', *John Wiley &Sons*, Inc (2002),

ECE-334 MOBILE COMMUNICATION [3-1-0-4]

Total Number of Hours: 48

Introduction to Wireless Communication Systems:
Evolution and Fundamentals, Examples of Wireless Communication Systems, Cellular Telephone Systems, Trends in Cellular Radio and Personal Communication Systems [6]

Cellular Concepts: Frequency for Radio Transmission, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, , Improving the Coverage and Capacity of Cellular Systems.Multiple Access System , TDMA, FDMA, CDMA [5]

Medium Access Control: Hidden and Exposed , Far and Near Problem, Protocol for MAC [5]

Mobile Radio Propagation :
Large Scale Path Loss, Free Space Propagation Model, Ground Reflection Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor

Propagation Models, Signal Penetration through Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath Measurements, Types of Small Scale Fading: Time Delay Spread, Doppler Spread; Raleigh and Ricean Distributions. [5]

Modulation Techniques used for Mobile Radio:
Amplitude Modulation, Angle Modulation, Digital Modulation, Linear Modulation, Constant Envelope Modulation, Combined Linear and Constant Envelope Modulation, Performance of Modulation in Fading and Multipath Channels. [5]

Wireless Systems and Standards:
AMPS, ETACS, USDC, GSM – System Architecture, Radio Subsystem, Channel Types, Frame Structure, Signal Processing in GSM; GPRS, CDMA Digital Cellular Standards, PACS ,Wireless Lans ,Future advancement in Mobile Network [12]

Mobile Network Layer , Mobile Transport Layer, Mobile Application Layer [10]

References:

1. **Theodore S. Rappaport**, Wireless Communications Principles and Practice, Pearson Education, Asia.
2. **Kamilo Feher**, Wireless Digital Communications, Modulation and Spread Spectrum Applications, Eastern Economy Edition.
3. **William C. Y. Lee**, Mobile Cellular Telecommunications, McGraw Hill International
4. **Jochen H Schiller** Mobile Communication

ECE 336 QUEUEING THEORY [3 1 0 4]

Review probability: Axioms of probability - Conditional probability - Total probability – Baye's theorem- Random variable - Probability mass function - Probability density function - Properties - Moments - Moment generating functions and their properties. (4)

Introduction to Queue and Queueing Theory: Model of Queue, Queue Parameters, Analysis of a simple Queue, Equilibrium solution. Closed and Open Queues. (3)

RANDOM PROCESSES AND MARKOV CHAINS: Stochastic process, Markov process, Poisson process and Exponential Distribution, Continuous-time Markov chains, Homogeneous Markov chain, Discrete time Markov chains, Homogeneous Discrete time Markov chain, Irreducible Markov chain, Birth-Death processes, Continuous time Birth-Death Markov chain, Equilibrium solution, Global balance equation of a state. Conditions for existence of solution for Birth Death chain.
(6)

Queuing system: Little Theorem, M/M/1: Arrival statistics, Service statistics, Markov Chain formulation, global balanced equations, Occupancy distribution, M/M/m: The m server system, M/M/∞: Infinite server system, M/G/1 system, M/M/m/m: The m server loss system.
(10)

Application: Delay analysis of FCFS queues, Multidimensional Markov Chains in Circuit switching
(4)

Residual approach Analysis: Queues with General statistics, M/G/1 System, M/G/1 Queue with vacations, Queues with Reservation and Polling, Single user system, Multiuser system, Limited service systems, Priority Queueing, Queues with Multiple priorities, Preemptive resume or non preemptive priority. G/G/1 system, Upper bound for the G/G/1 system. (8)

Network of Queues: Series Queues, Jackson Networks, Extension of Jacksons Theorem. Closed Queueing Networks. Cyclic Queues (7)

Applications of Queuing theory: Multi access communication, ARQ strategies. (6)

References:

1. Sanjay Kumar Bose, "An Introduction to Queueing Systems", Kluwer/Plenum Publishers, 2002. (*skb@iitk.ac.in)*
2. Gross Donald;Harris Carl M "Fundamentals of Queueing Theory", John Wiley and Sons Singapore 2004.
3. Bhat U. Narayan, "An Introduction to Queueing Theory: Modeling and Analysis in Applications", January 2008, Dallas Tx.
4. Cooper R. B., "Intoduction to queueing theory", Edward Arnold, 1981.
5. Daigle John N, "Queueing theory for telecommunications", Addison Wesley, Massachusetts 1992
6. Gross Donald;Harris Carl M, "Fundamentals of queueing theory", John Wiley and Sons 2004.
7. Edward D. Lazowska, John Zahorjan, G. Scott Graham, Kenneth C. Sevcik, "Quantitative System Performance : Computer System Analysis using Queuing Network Models", Prentice-Hall, Englewood Cliffs, N.J.

ECE – 338 Time-Frequency and Wavelet Transforms [3-1-0-4]

Total number of lecture hours: 48

Time-frequency analysis and wavelet transforms. Stationary and non-stationary signals. Short-time Fourier transform (STFT). Need for Wavelet transform. [6]

Multi-resolution analysis and Continuous Wavelet Transform (Qualitative treatment) [2]

Continuous wavelet transform: Energy spectrum of a wavelet, energy of Mexican hat wavelet, wavelet manipulations, Relation between scale and (pseudo) frequency, CWT coefficients, Identification of coherent structures, edge detection, Wavelet transform of an intermittent signal, fractal signals, Inverse wavelet transform, Signal energy, wavelet based energy, and power spectra. Wavelet transform in terms of Fourier transform, Short time Fourier transform and Heisenberg boxes. Spectrogram, Wavelet transforms in two or more dimensions. [12]

Discrete wavelet transform: Frames and orthogonal wavelet bases, dyadic grid scaling and orthonormal wavelet transforms, Scaling function and multiresolution representation. Scaling equation, scaling coefficients and associated wavelet equation, Haar wavelet, Coefficients from coefficients : fast wavelet transform, Discerete input signals of finite length,Multi-resolution algorithm

[10]

Designing orthogonal wavelet systems: Refinement relation for orthogonal wavelet systems, restrictions on filter coefficients. Designing Daubechies orthogonal wavelet system wavelets [8]

Discrete wavelet transform (DWT) and relation to filter banks: Signal decomposition (analysis), relation with filter banks, Frequency response, signal reconstruction, upsampling and filtering, perfect matching filters. Generating and plotting of parametric wavelets, Orthogonality conditions and parameterization, polyphase matrix and recurrence relation. Precise numerical evaluation of Φ and Ψ, cascade algorithm, Biorthogonal wavelets [10]

References:

1. P. S Addison, "The illustrated Wavelet transform Handbook", *Institute of Physics Publishing*, 2002.
2. C S Burrus, A Gopinath, and Haitao Guo, "Introduction to wavelets and wavelet transforms", *Prentice-Hall*, 1998.
3. K P Soman and K. I. Ramachandran, "Insight into Wavelets from theory to practice", *Prentice-Hall of India*, 2005.

ECE-312 EMBEDDED SYSTEM DESIGN LAB [0 0 3 1]

Total number of lab sessions – 12

1. Linux commands, shell programming, Interrupt programming (gnu tools practice)
2. Char device driver programming, RS 232 communication
3. Spi programming, I2c programming
4. Semaphores, Mutex
5. Rtlinux , semaphores, Rtlinux, mutex
6. Protocol convertor, GPS System

ECE-314 COMMUNICATION LAB-I [0 0 3 1]

Total number of lab sessions – 12

1. Active filters and Equalizers
2. Modulation schemes, Transmission and Reception
3. Transmission Lines and Waveguides
4. Phase Locked Loop
5. Sampling Techniques and Time division multiplexing
6. Antennas.

HSS - 401 ESSENTIALS OF MANAGEMENT & ENGINEERING ECONOMICS [4 0 0 4]

Total number of lecture hours – 48

Management - Definition of Management, Nature and scope of management, Functions of managers, Corporate social responsibility, Theories of Planning, Organizing, Staffing Leading and Controlling.
Engineering Economics - Introduction to Micro and Macro Engineering Economics, Value, Utility, Consumer & Producer goods, Factors of Production, Law of demand and supply, Elasticity of demand & supply, Equilibrium of demand and supply. Time value of Money, Economic Evaluation of Alternatives, Replacement analysis and Depreciation.

References:

1. **Koontz D.** (Latest Edition), "Essentials of Management*" Mc Graw Hill*, New York.
2. **Peter Drucker** (Latest Edition) " Management, Task and Responsibility" *Allied Publishers*.
3. **Peter Drucker** (2003) "The practice of management", *Butterworth Hein Mann*.
4. **Tuesen G. J. & Tuesen H. G.** (Latest Edition) "Engineering Economy" *Prentice Hall of India*, New Delhi.
5. **De Garmo L. Paul** (Latest Edition) "Engineering Economy" *Macmillan*, New York.
6. **Blank L. T. & Tarquin A. J.** (Latest Edition) "Engineering Economy" *Mc Graw Hill*, New York.
7. **James L. Riggs, David D. Bedworth, Sabah U. Randhawa** (Latest Edition) "Engineering Economics" *Tata McGraw – Hill Publishing Company Ltd*, New Delhi.

ECE-401 COMMUNICATION SYSTEMS [3 1 0 4]

Total number of Hours: 48

Radar systems:
Introduction to Radar systems, Simple form of Radar range equation. Factors affecting Radar range equation, Pulse Radar, Branch and Balanced type duplexer. Radar displays, Radar beacon, MTI Radar, Delay-line canceler, blind speed. [08]

Basic Telephone system, signaling tones, Digital Subscriber Lines [02]

Satellite communication systems:
Introduction to Satellite communication, Basic transmission theory, system noise temperature and G/T ratio, Satellite orbits, Satellite speed and period, angle of elevation, orbital spacing, orbital effects in communication system performance, Satellite subsystems-communication subsystems, Telemetry, command and control subsystems, power subsystem, Satellite link design, frequency allocations, bandwidth, Earth station technology, Multiple access techniques, Application of Satellites – Surveillance, TV, Telephones. [10]

Wireless communication systems:
Introduction to wireless communication systems. Paging systems, cordless telephone systems, Concept of cellular mobile communication-frequency reuse, cell splitting, macro cell and micro cell. Operation of Cellular systems. Mobile radio propagation –Free space propagation model, Ground reflection model, Freznel zone geometry. [08]

Overview of optical fibers:

Types of Optical fibers. numerical aperture. Concept of cylindrical waveguide, Optical fibers as cylindrical wave guide. V number /parameter [05]

Attenuation and dispersion in optical fibers:
Losses due to scattering and bending. Optical pulse spreading due to material and waveguide dispersion. [05]

Optical sources and detectors:
Semiconductor LED, Laser diode, hetero- structure construction. DFB and DBR Laser diodes. PIN and APD detectors. [05]

Optical communication systems:
Analog and Digital Optical communication systems, SNR and BER. Link power and rise time budget. [05]

References:

1. **Skolnik Merrill I** (2004) "Introduction to radar systems" *Tata McGraw Hill ,India*
2. **Timothy Pratt** (2006) "Satellite communication systems" *John Wiley and Sons*
3. **William Stallings** (2006)"Wireless Communication and networks "*Pearson Education*
4. **Theodore S Rappaport**(2006) "Wireless Communications: Principles and Practice" *Pearson Education, Asia*.
5. **Louis E.Frenzel** (2004)"Communication electronics-Principles and Apllications"*3rd edition, TMH*
6. **Gerd Keiser** (1991) "Optical Fiber Communication" *McGraw Hill*.
7. **Satish Kumar M** (2005**)** "Fundamentals of Optical fiber communication" *PHI*.

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ECE-403 POWER ELECTRONICS [3 1 0 4]

Total number of lecture hours - 48

Power Electronics Devices
Thyristor, Power BJT, Power MOSFET, IGBT – turn on and turn off mechanisms, device turn on and turn off characteristics, ratings, protection and snubber circuits, safe operating area, secondary breakdown, gate/base driver circuits, power computations [9]

Controlled rectifiers
Half controlled, fully controlled single phase and three phase converters under different loads such as R, R-L with / without free-wheeling diode, Dual converters and cyclo-converters [9]

DC – DC switched mode converters
Buck, Boost, Buck-Boost, Cuk, Fly back, Forward, Double ended forward, Push pull, Current fed converters [9]

Resonant converters
Zero current switching and zero voltage switching converters, series resonant converter, parallel resonant converter, series-parallel resonant converter [6]

DC –AC switched mode inverters

Half bridge and Full bridge single phase inverters, fourier series analysis, amplitude and harmonic control, PWM techniques, three phase inverters with 120^o and 180^o conduction, Induction motor speed control. [9]

Applications
Switched mode power supplies, power conditioners, UPS, A.C.Voltage stabilizers [6]

Reference Books

1.**Daniel W. Hart** "Introduction to Power electronics"
2.**Muhammad H .Rashid** (2004) "Power electronics-Circuits, devices and applications" *Prentice-Hall of India, New Delhi, Third edition*
3.**Ned Mohan** (1995) "Power electronics – Converters, applications and design" *John Wiley & Sons. INC, Second edition*.

ECE 405 WIRELESS COMMUNICATION [3-1-0-4]

Introduction: Modeling of wireless channels, wireless channel as a random linear time varying system, stochastic characterization of time varying systems. [8]

Modeling: Wireless channel modeling, Wide-sense stationary uncorrelated scattering assumption; characterizing key parameters of wireless channels, wireless channel discretization and discrete-time representation [12]

Fading and diversity techniques: Noncoherent and coherent reception - error probability for uncoded transmission. Time diversity, interleaving, constellation rotation Frequency diversity, spread spectrum systems for anti jamming and counter multipath fading- CDMA. Rake receiver; code design for wireless channels, product distance design criterion, diversity order estimates on the basis of the scattering function. OFDM, MC-CDMA, MIMO systems and space time coding.
[18]

Wireless channel capacity: Capacity of parallel Gaussian channels; capacity of fading channels: ergodic capacity and outage capacity; high versus low SNR regime; waterfilling capacity.
[10]

References

1. D. Tse and P. Vishwanath, "Fundamentals of Wireless Communication", *Cambridge University Press*, 2005
2. T. S. Rappaport, "Wireless Communication: Principles and Practice", *Pearson*, 2002
3. J. G. Proakis and M. Salehi, "Digital Communications", *McGraw-Hill*, 2008
4. K. Fazel and S. Kaiser, "Multicarrier and Spread Spectrum Systems", *Wiley*, 2003

ECE-407 INFORMATION THEORY AND CODING [3-1-0-4]

Total Number of Hours :48

Probabability, Random Variables, Discrete and Continuous Random Variables, Stochastic Processes [05]

Brief history and application of Information theory, Representation of information, Entropy and Entropy calculations, Probability distribution of Discrete sources and channels. [07]

Information sources, Zero memory sources, Markov sources, Extension of the sources, State diagram representation, Instantaneous and Uniquely decodable codes. [07]

Average length of the code, Kraft's inequality, Compact codes, Shannon's theorem, Shannon-Fano coding, Huffman coding. [07]

Code efficiency, Code redundancy, Information channels, Probability and Entropy relations in Information channels, Mutual information and properties. [07]

Noiseless and Deterministic channels, Cascading of channels, Channel capacity. [04]

Reliable communication over unreliable channels, Error probability, Maximum likelihood decisions, and decision rules, Fano Bound Shannon's second theorem and Random coding. [06]

Error Correcting Codes, Block Codes, Hamming Code, Cyclic Code [05]

References:

1. **Thomas M Cover and Joy A Thomas(2004) "**Elements of Information Theory " John Wiley and Sons
2. **Abrahamson** , Information theory and coding Mcgraw Hill
3. **Meyer ,** Probability Theory
4. **Ranjan Bose** Error Correcting Code

ECE 423 ADVANCED EMBEDDED SYSTEM DESIGN [4 0 0 4]

Linux software Structure, Linux Limitations, eLinux [6]
Hardware of Embedded systems, DMA controllers, Interfacing to analogue world [6]
Software of Embedded systems, Compilation process, Native Vs Cross Compilers, Run-Time Libraries Writing a Library, Using alternative Libraries, Porting Kernels [8]
Downloading, Emulation & Debugging techniques [6]
Buffering and Other Data Structures, Linear buffers, Directional Buffers, Double Buffering, Buffer exchange, Linked Lists, Circular buffers, Buffer under run & Overrun, Allocating buffer memory, memory Leakage. [8]
Software Examples –Creating Software State machines [4] Design Examples [4]
Real Time without a RTOS [6]

REFERENCES:

8. Steave heath, Embedded system design, 2nd edition 2003,elsevier
9. K.v.k.k prasad, Embedded / Real time systems: Black book, revised edition 2005.
10. Wrox, Linux Programming 3rd edition 2005, o'reilly.
11. Frank vahid , Embedded systems.
12. Rajkamal, Embedded system, 2nd edition.

ECE-425 ANALOG AND MIXED SIGNAL DESIGN [3-1-0-4]

No of Lecture Hours: 48

Introduction to Analog and Mixed Signal Design:
Design flow and design issues, Analog Design Octagon, Second-order Effects, Low-frequency and high-frequency small-signal MOSFET models, SPICE/BSIM model parameters. [4]

CMOS Analog Circuits:
Current sources and sinks, Cascode Current Mirror, Sensitivity Analysis, High-performance current mirrors, Wilson current mirror, Wide-swing current mirror etc, Active loads: diode-connected MOS load, current source/sink load, Current and Voltage References, CMOS Amplifiers: CS, CD, CG with different active loads considering second-order effects. Differential amplifier with a current-mirror/current-source load, Cascode Amplifier, Folded Cascode Amplifier, Current amplifiers, Analog multiplier [12]

CMOS Operational Amplifier:
Basic CMOS Op-amp design, Operational Transconductance Amplifiers, Wide-swing OTA, Folded-cascode OTA, Fully differential Op-amp/OTA, High-speed Op-amp, Current Conveyor (CC), Current feedback Op-amp (CFOA) [8]

Mixed-Signal Circuits:

Introduction to Current-mode Signal Processing (CMSP):
Voltage-mode versus Current-mode approach, Advantages, Current-mode building blocks and circuits [2]

Sampled-data Filters:
Switched-capacitor (SC) and switched-current (SI) based integrators and filter circuits. [2]

Continuous-time (CT) Filters:
OTA-C and g_m-C based integrators, first-order and second-order filters, high-frequency transconductors , Ladder filters, Doubly terminated ,Fully-differential design approach, Transconductor-C implementation of filter topologies, phase compensation, Q-peaking, Effects of finite BW, Sensitivity [10]

Data Converters:

Fundamentals, Sample and Hold Characteristics, Converter specifications,Implementation of data-converters: DAC Architectures-Current-mode R-2R Ladder Networks, Current steering DAC, Charge scaling DAC, Cyclic DAC, Pipeline DAC, ADC Architectures- Flash ADC, Successive approximation ADC, Data converter SNR, Noise-shaping Data Converters. Oversampling ADC, Sigma-delta A/D conversion. [6]

Mixed Signal Layout Issues: Layout for passive components-resistors, programmable capacitor arrays, Layout for analog circuits like Current Mirror, Differential amplifier, OTA etc, Width Correction, Layout techniques for improved matching, Common centroid approach, Guard Rings, shielding [4]

Reference Books:

1. David A.Johns, Ken Martin, Analog Integrated Circuit Design, Johns Wiley & Sons, 2002. ISBN 0-471-14448-7
2. R.Jacob Baker, Harry W.Li, David E.Boyce, CMOS circuit design, Layout, and Simulation, IEEE Press, PHI Pvt Ltd, 1998.
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw –Hill Edition 2002.
4. R. Jacob Baker, CMOS: Mixed-Signal Circuit Design, volume II, Wiley Interscience, 2002. ISBN: 0-471-22754-4
5. Alan Hastings, "The art of Analog Layout", PHI,2001.
6. P.V.Anand Mohan, Current-mode VLSI Analog Filters :Design and Applications,Birkhauser ,2003. ISBN : 81-8128-211-6
7. T Deliyanis, Y Sun and J K Fidler, Continuous-Time Active Filter Design, 1999, CRC Press.
8. Rudy van de Plassche, CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters,2nd edition, Springer International Edition

ECE - 427 Soft Computing Techniques [3-1-0-4]

Total No of lecture hours: 48

Introduction: Model of neuron, feedback, Network architectures, Knowledge representation, Fundamental Learning processes, Learning tasks [2]

Rosenblatt's perceptron: Introduction, Perceptron, The perceptron convergence theorem, Relation between the perceptron and Bayes classifier for a Gaussian environment, The batch perceptron algorithm [6]

Multilayer perceptrons: Batch learning and online learning, The back propagation algorithm ,XOR problem, The hessian and its role in online learning, Optimal annealing and adaptive control of the learning rate, Generalization, Cross validation ,Applications [8]

Kernel methods and Radial basis function (RBF) networks, k means clustering Hybrid learning procedure for RBF networks. Support vector machines, Principal component analysis, Self organizing maps, Applications. [10]

Dynamical systems, Discrete time and gradient type Hopfield networks, Applications in optimization problems,Basic concepts of recurrent auto associative and heteroassociative memories,storage and retrieval algorithms, Energy function reduction, applications [10]

Fuzzy Logic:
Introduction-Block diagram representation of the different types of fuzzy systems, concept of membership functions, Brief comparison of classical sets and fuzzy sets, Basic operation on fuzzy sets, composition of fuzzy relations projection and cylindrical extension, extension principle.
[6]

Linguistic variables, fuzzy IF-THEN rules-fuzzy propositions, Implications. Fuzzy logic and Approximate reasoning, Fuzzy rule base, structure of fuzzy rule base and properties of set of rules. Fuzzy inference engine, Fuzzifiers, Defuzzifiers, Design of Fuzzy rule based systems.
[4]
Introduction to Neuro fuzzy systems with GA optimization [2]

References:

1 Simon Haykin, "Neural Networks and Learning Machines", Third *edition, PHI edition private Limited,New Delhi*, 2009
2 Jacek M Zurada, "Introduction to artificial Neural Systems", *Jaico publication.* 2006
3 Li Xin Wang, "Introduction to fuzzy systems and control", *Prentice Hall publication,* 1997
4 Timothy J Ross, "Fuzzy Logic with Engineering Applications", *Intl. Edition, McGraw Hill publication*, 2008
5 Shivanandam & Deepa , "Principles of Soft Computing" , *Wiley India edition,* 2009
6 Jang J S R , Sun C T, Mizutani E, "Neuro-Fuzzy & Soft Computing", *PHI* ,1997

ECE 429 DSP ALGORITHMS AND ARCHITECTURE [4 0 0 4]

Introduction. Digital signal processing and DSP systems, Numeric representations and arithmetic; data-path Architecture of Digital Signal Processors : Need for special DSPs, Special features of Digital Signal Processors, Addressing, Issues involved in processor design - speed, cost, accuracy, pipelining, parallelism, finite word length effects, quantization errors.
[10]

Data flow representations, pipelining and parallel processing, re-timing, unfolding, register minimization techniques, systolic architectures, Algorithms for fast implementation of convolution, FIR, IIR and adaptive filters, DCT, analysis of finite word length effects Architecture and features of sample fixed and floating point processors (TI 5X,3X, families), Designing DSP based systems with ADC, DAC , memory interfacing. [15]
VLIW architecture (TI 6X family processor). DSP operating systems- RTOS, BIOS, DSP development tools - assembler, simulator, cross compiler. DSP controller Low power design strategies; Architecture, programming and applications of general purpose digital signal processors (Emphasis on TI & AD processors [15]

Application case studies: Speech coding, image and video compression, Viterbi decoding, wireless communication. Resent Trends in DSPs [8]

REFERENCE

1.Phil Lapsley, JeffBier, Amit Shoham, Edward A. Lec , " DSP Processor Fundamentals" IEEE. Inc.,(USA)-1997.
2.E.C Ifeachor and B.W.Jervis, " DSP – A practical approach " , Addison Wesley.
3.K.K. Parhi, "VLSI Digital signal processing systems: Design and implementation", John Wiley, 1999.
4.Lars Wanhammar, "DSP Integrated Circuits", Academic Press, 1999
5.S.M. Kuo, B.H.Lee, "Real-Time Digital Signal Processing: Implementations, Applications, and **6**.Experiments with the TMS320C55X", Wiley, 2006
7.User manuals of various fixed and floating point DSPs. Application guides from DSP manufacturers

ECE-431 LOW POWER VLSI DESIGN [4-0-0-4]

Total number of lecture hours: 48

Introduction: Need for Low Power design, Sources of power dissipation in Digital Integrated circuits. Emerging low power approaches, Hierarchical Low Power Design Methodologies.

Device & Technology Impact on Low Power: Physics of power dissipation in CMOS devices. Dynamic and static power dissipation, Transistor sizing & gate oxide thickness. Impact of technology Scaling and Device innovation.

Probabilistic Power Analysis: Random logic signals, probability and frequency, probabilistic power analysis techniques, signal entropy.

Circuit level Power reduction techniques: Power consumption in circuits. Design of Flip Flops and Latches. High capacitance nodes, interconnects and repeaters. Low power digital cell library.

Logic level Power reduction techniques: Gate reorganization, pre-computation logic, signal gating, logic encoding, state machine encoding, reduction of power in address and data buses.

Low power Clock Distribution: Power dissipation in clock distribution, Single driver versus Distributed buffers, Zero skew versus Tolerable skew, chip and package co design of clock network

Low power Architecture and Systems: Power and performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design.

Software level power reduction techniques and power aware software design.

References:

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", *KAP*, 2002.
2. Rabaey, Pedram, "Low power design methodologies" *Kluwer Academic*, 1997.
3. Kaushik Roy, Sharat Prasad, "Low Power CMOS VLSI Circuit Design" *Wiley*, 2000.
4. Kiat, Samir S, Rofail-Seng Yeo, Wang-Ling Goh, "CMOS/BiCMOS ULSI Low Voltage Low Power", *Pearson,* 2002.

ECE 433 SYSTEM ON CHIP DESIGN [4 0 0 4]

Total number of Hours: 48

Introduction to Processor Design, Processor architecture and organization, Abstraction in hardware design, Processor design trade-offs, Design for low power consumption, Architecture for low power. [6]

Subsystem design principles- pipelining, Data paths, Combinational shifters, Adders, ALUs, Multipliers, High density memory, Field-Programmable Gate Arrays, Programmable Logic Arrays. [10]

Pipeline ARM organization, ARM instruction execution, ARM implementation, Development tools, Architectural Support for System Development, The ARM memory interface, The Advanced Micro controller Bus Architecture (AMBA), The ARM reference peripheral specification, Hardware system prototyping tools, The ARMulator, The JTAG boundary scan test architecture , The ARM debug architecture, ARM Processor Cores, ARM CPU cores, Intellectual property design, Memory Hierarchy, Memory size and speed, On-Chip memory, Caches, Cache design – an example, Memory management. [20]

Floor planning, Floor planning methods, Off- chip connections, Architecture Design, Register – Transfer Design, High level synthesis, System on –chips Embedded CPUs, Architecture Testing, Chip design, Design Methodologies, Microprocessor Data path, Hardware/ Software Co –Design [12]

REFERENCES:

1. Steve Furber "ARM System-on- Chip Architecture", *Second Edition , Pearson Education, 2000*
2. Wayne Wolf , " Modern VLSI Design , System –on- Chip Design" *Third Edition, Pearson Education,2005*
3.F.Balarin, "Hardware-software co-design of embedded systems" ,*Kluwer academic publishers, 1997*
4. IEEE Sstem on chip Design
5. IEEE Design and test of computers
6 IEEE Microcontroller -

ECE-435 DATA COMMUNICATION AND NETWORKING [3-1-0-4]

TOTAL NUMBER OF HOURS :48

Block Codes: Parity check codes, Linear Codes, generator matrix, parity check matrix, syndrome Circuit, Decoding Circuit, Error detecting and Correcting capability, Standard array, Cyclic codes: systematic encoding and decoding, Hamming codes, Extended Golay code. Introduction to convolutional codes, State diagram, Trellis diagram, Tree diagram representation, coding gain calculation, Viterbi decoding. Trellis Coded Modulation (TCM) [10]

Review of Digital Modulation techniques,PN sequences, maximal length sequences, properties, spectral characteristics, auto-correlation properties, Generation of PN sequences, Gold sequences, Sequence Generators, DS/BPSK system, time domain analysis, spectral characteristics, processing gain and jamming margin, probability of error, performance evaluation, DS/QPSK system and other advanced schemes,Slow and fast hopping systems, BFSK-FH system, time domain analysis, spectral

characteristics, processing gain and jamming margin, probability of error, performance evaluation,Hybrid Model,Jamming Techniques. Code Synchronisation Techniques.

[20]

ISDN History,Services,Subscriber access to the ISDN,the ISDN layers,Broad band ISDN,Future of ISDN. [6]

ATM design goals,architecture,switching,switch fabrics,ATM layers,Service classes,ATM Applications.

[12]

References:-

1 Digital Communications:Fundamentals and Applications-2nd ED by Bernard Sklar,Pearson Education India.

2 Data Communications and Networking –3rd ED by Behrouz A. Forouzan, TATA McGrawHill

1. ATM Networks-Handel Adisson Wesley

4. Peterson R.L. and Ziemer R.E., "Introduction to Spread Spectrum Communication" *Pearson Education*, Asia

5.George R. and Cooper C.D., "Modern Communications and Spread Spectrum", *McGraw Hill, 2nd Edition.*

ECE-437 SPREAD SPECTRUM COMMUNICATION [3-1-0-4]

Total number of lecture hours = 48

Overview: Review of basic digital modulation, bandwidth considerations, Principle of spread spectrum communication, Direct sequence and frequency hopping principles. PN sequences, maximal length sequences, properties, spectral characteristics, auto correlation properties, Generation of PN sequences, Gold sequences, Barker codes,Walsh-Hadmard Codes,Kasami codes,Non Linear Code Generators.

[10]

Direct Sequence Spread Spectrum System:

DS/BPSK system, time domain analysis, spectral characteristics, processing gain and jamming margin, probability of error, performance evaluation, DS/QPSK system and other advanced schemes. MSK-Spread Spectrum,Hybrid Spread Spectrum [12]

Frequency Hopping Spread Spectrum System:

Slow and fast hopping systems, BFSK-FH system, time domain analysis, spectral characteristics, processing gain and jamming margin, probability of error, performance evaluation.

[8]

Code tracking: Code acquisition and synchronization [8]

Application of Spread Spectrum communication:

Anti-jamming, Low probability detection, Multi-path rejection, Code division multiple Access(CDMA), CDMA in digital mobile systems. [10]

References:

1. **Peterson R.L. and Ziemer R.E.**, "Introduction to Spread Spectrum Communication" *Pearson Education*, Asia
2. **George R. and Cooper C.D.,** "Modern Communications and Spread Spectrum", *McGraw Hill, 2nd Edition.*
3. **John Dixon**, "Spread Spectrum Communication", *John Wiley and Sons*
4. **Sklar B,** "Digital Communication Fundamentals and Applications", *Pearson Education,* Asia

ECE-439 DIGITAL IMAGE PROCESSING [3-1-0-4]

Total number of hours - 48

Basic Image Processing: **Fundamentals of digital image processing, image perception, Image sensing and acquisition, sampling and Quantization, image representation,basic relationship between pixels. [6]**

Image enhancement and restoration: Spatial Domain methods: Basic grey level transformation, Histogram equalization, Image subtraction.Spatial filtering: Smoothing, sharpening filters, Laplacian filters.Frequency domain filters : Smoothing, Sharpening filters, Homomorphic filtering. [8]

Image Transforms: Fourier transfrom, Fast Fourier Transform Short Time Fourier Transfrom, Cosine Transform , discrete wavelet transform. [4]

Image Segmentation: Detection of discontinuities. Edge linking and boundary detection, Thresholding, Region based segmentation. [8]

Représentation & description : Représentation, boundary descriptor, regional descriptor. [6]

Image Compression Algorithms and standards: Lossless compression: Variable length coding, LZW coding, Bit plane coding, predictive coding, DPCM. Lossy Compression: Transform coding, Wavelet coding. Basics of Image compression standards: JPEG, JPEG2000. [8]

Morphological Processing : Introduction dilation Erosion, open and close. Thinning and thickening. [4]

Application: Character recognition, Biomeical Image processing. Watermarking, multi resolution analysis. [4]

TEXT BOOKS

1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education 2003.

REFERENCES

1. William K Pratt, Digital Image Processing John Willey (2001)
2. Image Processing Analysis and Machine Vision – Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy (1999).
3. A.K. Jain, PHI, New Delhi (1995)-Fundamentals of Digital Image Processing.

ECE 441 Error Control Coding [3 1 04]

Introduction to Channel coding Theory: Block diagram of Data transmission and storage, ML decoding, Coding Gain, Types of errors, Error Control strategies.

[3]

Finite Field Theory: Group, Field, Order of group elements, Finite fields, Polynomials over fields, Polynomial Division. Polynomial factorization over a field, Irreducible polynomials, Existence and construction of codes of a given size, Examples of finite field construction, Power notation, primitives and primitive polynomials, minimal polynomials.

[7]

Linear Block Codes: Vector Space View of Codes, Generator Matrices, Parity check matrices, Dual codes, Self-orthogonal and Self-Dual codes, Examples of dual codes, Relation between parity-check matrix and dual code Minimum Distance Decoder, Hamming Distance, Error Correcting Capability of codes, Graphical View of Decoding Syndrome Decoder, Relationship between Minimum distance and Parity-Check Matrix Construction of Codes, Hamming Codes, Hamming bound, Singleton bound, ML and Map decoding for Repetition codes, Probability of decoding error.

[10]

Cyclic Code: Cyclic Code, Representation of code as polynomials, Generator and Parity check matrices of cyclic codes, encoding, syndrome computation and error detection, Decoding: Megitt decoder, Puncturing Codes, Shortening codes

[7]

Multiple bit error correcting codes: Minimum polynomials, contruction of Generator Matrices, Parity check matrices and their properties, Construction of BCH codes for given minimum distance, Vandermonde matrices, BCH bound Properties of BCH codes, Dimension of BCH codes, Examples of BCH codes, Systematic encoding, Syndrome decoding for BCH codes, Error Locators, Decoding of BCH codes. Reed-Solomon(RS) Codes, Dimension, Definition of distance, weight in GF(2^m), Generator polynomial, Minimum distance and binary expansion of RS codes. Decoding overview, error locators, and error value.

[10]

Convolutional Codes: State diagram, Trellis diagram, Tree diagram representation, Encoding, Coding gain calculation, Viterbi decoding. Trellis Coded Modulation(TCM)

[8]

ARQ Strategies: Basic ARQ Strategies [3]

References:

1. **Shulin and Daniel J.Costello Jr,** (1983) “Error control coding Fundamentals and Applications” , *Prentice Hall*
2. **McWilliams & Sloane** “Error Correcting Codes” *North Holland Publishing Co.*
3. **Richard E.Blahut**, (1987) "Principles and Practices of information theory" *Addison Wesley*.
4. **Peterson and Weldon** “Error Correcting Codes” *John Wiley*
5. **Berlekamp** “Algebraic Coding Theory” *McGraw-Hill.*
6. **B. Sklar,** “Digital Communications Fundamentals and Applications”, Englewood Cliffs, New Jerse Prentice Hall, 1988**.**

ECE-443 MICROWAVE INTEGRATED CIRCUITS [3 1 0 4]

Total Number of lecture hours : 48

Transmission Line:

Introduction, Current and Voltage Relation, Impedance Matching [3]

Microstrip line:

Analysis using conformal transformation and Hybrid mode method [4]

Characteristic impedance, Guide wavelength and loss, Slot line – Wave guide analysis, coupling to axial and microstrip lines [4]

Coplanar line:

Analysis using conformal transformation and Hybrid mode method. [3]

Micro strip line devices:

Directional couplers, Microstrip coupler and branch-line couplers, even and odd mode analysis, coupling coefficient and bandwidth. Impedance transformers and filters. Lumped elements for MIC design and fabrication of inductors, resistors and capacitors, Non-reciprocal components, microstrip circulators, isolators, phase shifters. [12]

Microstrip Antennas:

Radiation mechanism, radiation fields, patch antennas, traveling wave antennas, slot antennas, excitation techniques, surface waves. [6]

Design of microstrip circuits:

High power circuits – Transistor Oscillator, step recovery diode frequency multiplier, avalanche diode oscillator, PIN diode switch, low power circuits Schottky diode, Balanced mixer, parametric amplifier, PIN diode limiter, Diode phase shifter. [7]

Hybrid MICs:

Dielectric Substrates, thick film technology, thin film technology, methods of testing, encapsulation of devices, mounting [5]

Application:

MICs in phased array radars and satellite television systems. [4]

References:

1. **K.C.Gupta and Amarjit Singh** (1974) "Microwave Integrated Circuits", *Wiley East. Ltd.*
2. **David M Pozar** (1998) "Microwave Engineering", 2nd Edition, *John Wiley & Sons*
3. **I.J.Bahl and P.Bhartia** "Microstrip Antennas" Artech House.
4. **Richard E Collin** (2001) "Foundations for Microwave Engineering" *John Wiley & Sons*
5. **Samuel Liao** (1990) "Microwave Devices and Circuits" *Prentice-Hall of India Ltd.*
6. **Konishi Yoshihiro** (1991) " Microwave Integrated Circuits" *Marcel Dekker*
7. **Richard E Collin** (1985) "Antennas and radiowave propagation" *John Wiley*

ECE-445 MATERIALS SCIENCE FOR MICRO AND NANO ELECTRONICS
[3 1 0 4]

Total number of lecture hours - 48

Matter and Energy:
Material properties. Liquid crystals, polymers, biomaterials, ceramics, superconductivity, thin films. Structure property relationships – Microstructure, substructure, atomic structure, density and porosity, imperfections, thermal expansion, thermal conductivity, mechanical strength, electrical conductivity, absorption, reflection and transmission, luminescence. [5]

Catalysis
General principles, classification homogenious, heterogeneous & enzyme catalysis, physisorption, chemisorption, examples of industrial applications. [4]

Phase transitions:
Classification based on order with examples, Phase transformation, examples [4]

Metals, alloys & semiconductors:
Some special alloys, shape memory alloys – concepts, terminologies, examples & applications. Properties of alloys. Magnetic materials. Semiconductors–solarcells and lasers.
[4]

Advanced ceramics and glasses:
Structure, processing and grain growth, properties, examples and applications. High temperature ceramic superconductors. Dielectric materials – Ferroelectricity and piezoelectricity. Introduction to different types of glasses. [6]

Polymers and composites:
Polymers: classification, processing, properties, advanced polymers – conducting polymers, applications. Composites : General introduction, matrix and reinforcing materials, classification, fabrication, structure, properties. Examples for advanced composites- Applications.
[7]

Materials characterization techniques:
Brief introduction to mechanical testing of materials and non -destructive testing of materials.
Micro structural investigation: Metallurgical microscope, grain size. Sophisticated analytical techniques: Electron microscopy: Transmission electron microscopy (TEM), Scanning electron microscopy (SEM).
Atomic and molecular spectroscopies: Principles of atomic absorption, infra- red, and Raman spectroscopies for the determination of impurities. Low energy electron diffraction (LEED), X- ray photoelectron spectroscopy (XPS/ESCA) and Auger Electron analysis. Energy dispersive analysis of X-rays (EDAX).
Thermal analysis: Principles of differential scanning calorimeter, thermal mechanical analyzer
[10]

Nanotechnology:
nanomaterial synthesis, substrate effect, modification of surfaces, organization, specific examples, applications –biosensors, gas sensors, thermal sensors. [8]

References:

1. **Lawrence H. Van Vlack**, (1998) "Elements of Materials Science and Engineering,."
2. **William F., Smith** (1988*)* "Fundamentals of Materials Science and Engineering" *McGraw Hill*
3. **Michael Shur** (1998) "Physics of semiconductor devices" –Prentice hall of India.
4. Review articles from IEEE journals

OPEN ELECTIVES

ECE *** INTRODUCTION TO COMMUNICATION SYSTEMS [3 0 0 3]

Total number of Hours: 36

Introduction to Electronic Communication: A general model of communication systems-transmitter, communication channel, receiver, attenuation, noise and fading. Types of Electronic communication, Modulation and multiplexing, The electromagnetic spectrum and bandwidth. [4]

Telecommunication Systems: Basic Telephone system, signaling tones, DTMF, Cordless Telephones, Private branch Exchange(PBX), Facsimile, Paging systems, Internet Telephony, VoIP fundamentals. [4]

Overview of optical fiber communication: Types of Optical fibers. Numerical aperture Optical fibers as cylindrical wave guide. Attenuation and Dispersion in optical fibers, Losses due to scattering and bending, Optical sources and detectors- Semiconductor LED, Laser diode, PIN and APD detectors. WDM, Link power budget. [10]

Satellite communication systems: Principles of Satellite Orbits and Positioning, Satellite speed and period, Angle of elevation, Satellite subsystems-communication subsystems, Telemetry, command and control subsystems, power subsystem. Earth station technology, Multiple access techniques. Application of Satellites – Direct Broadcast Satellite, Digital Satellite Radio, Surveillance, Global Positioning System. [6]

Wireless communication systems: Concept of cellular mobile communication-frequency reuse, cell splitting, sectoring, macro cell and micro cell. Operation of Cellular systems. Architecture of GSM systems [4]

R**ADAR Systems:** Introduction to Radar systems, Pulse Radar, Duplexer. Radar displays, Radar beacons, MTI Radar [4]

Wireless Technologies: Wireless LAN, PAN and Bluetooth, ZigBee and Mesh wireless networks, WiMAX and wireless metropolitan area networks, RFID and Near-Field communications. [4]

References:

1. **Louis E. Frenzel** (2004) "Communication electronics-Principles and Apllications"*3rd edition, TMH*
2. **Satish Kumar M** (2005**)** "Fundamentals of Optical fiber communication" *PHI*.
3. **Timothy Pratt** (2006) "Satellite communication systems" *John Wiley and Sons*
4. **William Stallings** (2006) "Wireless Communication and networks "*Pearson Education*
5. **Theodore S Rappaport** (2006) "Wireless Communications: Principles and Practice" *Pearson Education, Asia*.
6. **Gerd Keiser** (1991) "Optical Fiber Communication" *McGraw Hill*.
7. **Kennedy** (1999) "Electronic Communication Systems" *Tata McGraw Hill*

ECE *** TRANSDUCERS AND INSTRUMENTATION [3 0 0 3]

Total number of lecture hours – 36

Generalized measurement system, static characteristics of instruments. Resistance potentiometer and thermometers. Thermistors, photo resistors and thermocouple. Induction potentiometers, Magnetostrictive transducer, Capacitive transducers, piezoelectric crystals. Accelerometer and Vibrometer. Optical sensors, IC sensors. Introduction to fiber optic sensors. Intelligent and smart transducers. Piezoelectric transducer. Digital transducers.

References:

1. S. Ranganathan, 'Transducer Engineering', Allied Publishers Pvt. Ltd., 2003.
2. A.K. Sawhney, 'A course in Electrical & Electronic Measurement and Instrumentation', DhanpatRai and Co (P) Ltd., 200D.
3. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.

E.A. Doebelin, 'Measurement Systems – Applications and Design', Tata McGraw Hill, NewYork,1990.

ECE *** CONSUMER ELECTRONICS [3 0 0 3]

Total number of Hours: 36

Audio System: Microphones, Head Phones and Hearing Aids, Loud Speakers, Loud Speaker Systems, Optical Recording and reproduction systems – CDs, DVDs, Blue ray technology, iPods, MP4 players and accessories, Home Audio systems [7]

Television: Elements of TV Communication System, Scanning, Composite Video signal, Need for synchronizing and blanking pulses, Picture Tubes, Construction and working of Camera Tubes, Block diagram of TV Receiver, LCD and Plasma TV fundamentals, Block diagram and principles of working of cable TV and DTH. [12]

Telecommunication Systems: Basics of Telephone system, Caller ID Telephone, Intercoms, Cordless Telephones, Cellular mobile systems. [6]

Office Electronics: Automatic Teller Machines, Facsimile machines, Digital Diaries, Safety and security systems. [6]

Home Electronics: Digital Camera system, Microwave ovens, Washing Machines, Air Conditioners and Refrigerators. [5]

References:

1. S.P. Bali (2005) "Consumer Electronics" ,Pearson Education.
2. R.R.Gulati (2001) "Monochrome and Color Television" New Age International Publisher.
3. A.Dhake (2000) "Color Television"

ECE *** INTRODUCTION TO MICROPROCESSORS [3 0 0 3]

Not for circuit Branches
Pre requisites- Basic knowledge of digital electronics

Introduction , Computer and its organization, Programming System, microprocessor, Evolution of Microprocessors, Address bus, Data bus, Control bus, tristate bus, clock generation, Connecting microprocessors to I/O devices, Architectural Advantages of Microprocessors, Data Transfer schemes. Interrupt Processing [10]

Hardware Architecture of Intel 8085, Addressing Modes, Instruction set and programming. [12]

Peripheral Interfacing- memory interfacing, Programmable peripherals Interface-8255, Light Emitting Diode, Seven Segment Display, Digital to analog Converter, Analog to Digital converters [12]

Advance Microprocessors, System design using microprocessor- case studies. [4]

Reference Books:

1. Krishna Kant , " Microprocessors and Micro controllers" , PHI , India, 2007
2. Barry B. Brey, "The Intel Microprocessors", PHI , India, 2007

ECE *** MEMS Technology [3 0 0 3]
Total number of lecture hours – 36

Historical Background of MEMs, Bulk Micromachining, surface micromachining, Micro cantilevers as test structures, sensors and actuators. Design of MEMS pressure sensors, accelerometer, RF MEMS Devices, biosensors

1. Stephen D. Senturia, "Microsystem Design", Kluwer Academic Publishers, 2001.
2. Marc Madou, "Fundamentals of Microfabrication", CRC Press, 1997.
3. H. Bao, "Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes" Elsevier, New York, 2000.
4. Wanjun Wang & Steven A. Soper, "Bio-MEMS Technologies and Applications", CRC Press.

ECE *** MICRO CONTROLLERS AND APPLICATIONS [3 0 0 3]

Not for circuit Branches
Pre requisites- Basic knowledge of digital electronics and microprocessors

Introduction to microcontroller. History of Micro controllers, Embedded versus External memory devices. Microcontroller survey, CISC and RISC Microcontrollers, Harvard and von Neumann Architecture, Commercial Micro controller Devices [6]

Introduction to 8051 family, History of 8051, Architectural features of 8051, Programming model. Pin details, I/O Ports, Addressing Mode, Instruction set of 8051 and Programming . [10]

Programming the 8051 resources, Counters, Timers, Serial I/O and Interrupts. [10]

Peripheral Interfacing- memory interfacing, stepper motor, LCD Light Emitting Diode, Seven Segment Display, Digital to analog Converter, Analog to Digital converters . [8]

The 8051 based system design- case studies. [4]

Reference Books:

7. Krishna Kant , " Microprocessors and Micro controllers" , PHI , India, 2007
8. Muhammad Ali Mazidi, Janice Gillipse Mazidi, Rolin D. Mckinlay,"8051 Microcontroller and Embedded Systems Using Assembly and C" , Pearson Education, 2010.
9. Ajay V Deshmukh, "Micro controllers- Theory and Applications", TMH, New Delhi , 2008.

ECE *** ELECTRONIC PRODUCT DESIGN & PACKAGING [2 1 0 3]

Total number of lecture hours: 38

Industrial design: Product planning, Creativity, Aesthitics, Ergonomics, control panel organization, Product detailing, Product finishes. [10]

Thermal management: Introduction to thermal sources, heat calculations, heat transfer methods, heat sink selection, cooling methods in electronic systems. [6]

Packaging Techniques: Introduction to Electronic Packaging, Microelectronics and Packaging Technologies, Introduction to Silicon Integrated Circuit Chips, Semiconductor Devices, Area Array Technologies: Ball Grid Arrays, Flip Chip, Chip-Scale Packaging, First Level Packages-IC packaging. Second Level Packages: Printed Circuit Boards and Other Substrates. Third Level Packages: Connectors, Cables, Modules, Cages and Cabinets. Reliability Prediction and Measurement. [12]

Noise in electronic systems and EMI: Design of low noise circuits. Interfacing of analog and digital systems. PCB design and layout; System assembly considerations. Sources of EMI, Shielding of signal lines, Ground loops, Noise emission characteristic of SMPS and other power electronic equipments, Reduction techniques, Reflections and cross talk in digital circuits. [10]

References:

1. **Flurshiem C. H**. " Industrial design and Engineering", Springer Verlog.
2. **P. Horowitz and W Hill** (1995) "The art of electronics", Cambridge.
3. **H.W.Ott** (1989) "Noise Reduction Techniques in Electronic Systems", Wiley..
4. **W.C. Bosshart** (2000) "Printed Circuit Boards: Design and Technology", Tata McGraw Hill.
5. **G.L. Ginsberg** (1991) "Printed Circuit Design", McGraw Hill.

ECE *** NEURAL NETWORKS & FUZZY LOGIC [3-0-0-3]

Total No of lecture hours:36

Fundamental concepts & Models of Artificial Neural Systems, Biological neurons, Mc-culloch Pitt's model, Feed forward and Feed back network, Supervised and unsupervised learning. N/N learning rules . [6]

Supervised learning methods,Linear single layer classifiers: Classification model, features and decision regions, Design of Linear discriminant function classifiers, Minimum Distance classifiers, Non parametric classifiers and R category perceptron classifiers [5]

Multi layer feedforward classifiers: Linearly non separable pattern classification, error back propagation training, learning factors, applications of EBPTA [4]

Dynamical systems, Discrete time and gradient type Hopfield networks, Applications in optimization problems,Recurrent auto associative and heteroassociative memories,storage and retrieval algorithms,Energy function reduction,applications. [4]

Unsupervised learning methods,Hamming net and maxnet, Feature mapping, Kohenen's self organizing feature maps, cluster discovery network (ART1), Counter propagation networks.Applications [4]

Introduction to kernel methods
Radial basis functions,Support vector machines, Probabilistic neural networks, Applications [2]

Fuzzy Logic:
Introduction-Block diagram representation of the different types of fuzzy systems, concept of membership functions, Brief comparison of classical sets and fuzzy sets, Basic operation on fuzzy sets, Fuzzy relations and extension principle – Fuzzy relations, Cartesian product, composition of fuzzy relations projection and cylindrical extension, extension principle. [4]

Linguistic variables, fuzzy IF-THEN rules-fuzzy propositions, Implications. Fuzzy logic and Approximate reasoning,Fuzzy rule base, structure of fuzzy rule base and properties of set of rules. Fuzzy inference engine, Fuzzifiers, Defuzzifiers,Design of Fuzzy rule based systems [5]

Introduction to Neuro fuzzy systems with GA optimization [2]

References:

1. Jacek M Zurada, "Introduction to artificial Neural Systems", *Jaico publication.* 2006
2. Simon Haykin, "Neural Networks and Learning Machines" ,Third *edition, PHI edition private Limited,New Delhi,* 2009
3. Li Xin Wang, "Introduction to fuzzy systems and control", *Prentice Hall publication,* 1997
4. Timothy J Ross, "Fuzzy Logic with Engineering Applications", *Intl. Edition, McGraw Hill publication*,2008

ECE-409 COMMUNICATION LAB-II [0 0 3 1]

Total number of Lab Classes: 10

List of experiments:

1 Active and Passive Microwave and Microstrip Devices

2 Advanced Modulation Formats

3 Optical Communication

4 Line coding techniques

5 Communication Networks

References:

1 **Davis Bernard&Kennedy George (2001) "**Electronic Communication Systems**",** ***Fourth edition,Tata McGraw Hill pub.***

2 **Simon Haykin** (2005) "Digital Communications" *John Wiley & sons*

3 **Jordan Edward C ;Balmain Keith G** (2003) "Electromagnetic waves & Radiating systems" *Prentice Hall , India*

4 **Liao Samuel Y** (2003) "Microwave devices & circuits", *Prentice Hall ,India*

ECE 411 POWER ELECTRONICS LAB [0 0 3 1]

Total number of Lab Classes: 12

1.I-V CHARACTERISTICS OF POWER DEVICES.

2.TRIGGERING CIRCUIT FOR SCR.

3.SINGLE PHASE CONVERTERS.

4.SWITCHED MODE CONVERTERS.

5.PRACTICAL POWER ELECTRONICS CIRCUITS.

References

1. **Daniel W. Hart** "Introduction to Power electronics"
2. **Muhammad H .Rashid** (2004) "Power electronics-Circuits, devices and applications" *Prentice-Hall of India, New Delhi, Third edition*.
3. **Ned Mohan** (1995) "Power electronics – Converters, applications and design" *John Wiley & Sons. INC, Second edition*.