Analog Pulse Modulation: Sampling theorem for band-pass signals, Pulse Amplitude modulation: generation and demodulation, PAM/TDM system, PPM generation an demodulation, PWM, Spectra of Pulse modulated signals, SNR calculations for pulse modulation systems. Waveform coding: uantization, PCM, DPCM, Delta modulation, Adaptive delta modulation- Design of typical systems and performance analysis.Pulse Shaping, Nyquist criterion for zero ISI, Signalling with duobinary pulses, Eye diagram, Equalizer, Scrambling and descrambling.Signal space concepts: geometric structure of the signal space, L2
space, distance, norm and inner product, orthogonality,- Base band pulse data transmission: Matched filter receiver, Inter symbol interference, Gram-Schmidt Orthogonalization Procedure. Review of Gaussian random process, Optimum threshold detection, Optimum Receiver for AWGN channel, Matched filter and Correlation receivers, Decision Procedure: Maximum a- posteriori probability detector- Maximum likelihood Detector, Probability of error, Bit error rate. Digital modulation schemes: Coherent Binary Schemes : ASK, FSK, PSK, MSK,GMSK. Coherent M-ary Schemes, Incoherent Schemes, Calculation of average probability of error for different modulation schemes, Power spectra of digitally modulated signals, Performance comparison of different digital modulation schemes.

Text/ Reference Books:

- Simon Haykin; "Communication Systems" John Wiley & Sons.
- B.P. Lathi; "Modern Digital and Analog Communication", 3rd Edition Oxford University Press.
- Sklar; "Digital Communication", 2E Pearson Education.
- K.SamShanmugham; "Digital and Analog Communication Systems"John Wiley & Sons
- R.E. Ziemer and W.H. Tranter; "Principles of Communications" JAICO Publishing House.
- H.Taub and Schilling; "Principles of Communication Systems" TMH.

Computer Architecture

Introduction to basic computer architecture, register transfer, bus and memory transfers, arithmetic, logic and shift micro operations. Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory reference instructions, I/O interrupt, complete computer description, design of basic computer, design of accumulator logic. Micro programmed control, control memory, address sequencing, micro program example, design of control unit. Central Processing Unit: Introduction, general register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, RISC. Pipeline and Vector Processing: Parallel processing, pipelining, arithmetic pipeline, instruction pipeline, RISC pipeline, vector processing, array processors. Input-output Organisation: Peripheral devices, input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, DMA, IOP serial communication. Memory Organisation: Memory hierarchy, main memory, auxillary memory, associative memory, cache memory, virtual memory, memory management, hardware multiprocessor architectures and their characteristics, interconnection structures, inter processor arbitration, inter-processor communication and synchronization, cache coherence.

Text/ Reference Books:

- Morris Mano, "Computer System Architecture", PHI.

- J.F. Heys, "Computer Organization and Architecture", TMH.
- Hwang K. and F.A. Briggs, "Computer Architecture and Parallel Processing", TMH.

Electromagnetic Theory

Maxwell's Equation: Faraday's law, Transformer and motional EMFs, Displacement current, Maxwell equations in final forms, Time varying potentials, Time-Harmonic Fields. Electromagnetic Wave Propagation: Waves in general, Wave propagation in lossy dielectrics, Plane waves in lossless dielectrics, Plane waves in free space, Plane waves in good conductors, Power and Poynting vector, Reflection of a plane wave at normal and oblique incidence. Transmission Lines: Transmission line parameters and equations; Input impedance, SWR, and Power; Smith Chart, Some applications of Transmission lines, Transients on transmission lines, Microstrip transmission lines. Waveguides: Rectangular waveguides, Transverse Magnetic modes, Transverse Electric modes, Wave propagation in the guide, Power transmission and attenuation, Waveguide current and mode excitation, Waveguide resonators.

Text/ Reference Books:

- M. N. O. Sadiku, Elements of Electromagnetics Oxford University Press (India).
- Hayt and Buck, Engineering Electromagnetics TMH.
- Ramo, Whinnery and Van Duzer, John Fields and Waves in Communications Electronics Wiley & Sons.
- David K Cheng, Field and Wave Electromagnetics Pearson Education (India)

Introduction to VLSI Design

Introduction to VLSI, Manufacturing process of CMOS integrated circuits, CMOS n-well process design rules, packaging integrated circuits, trends in process technology. MOS transistor, Energy band diagram of MOS system, MOS under external bias, derivation of threshold voltage equation, secondary effects in MOSFETS, MOSFET scaling and small geometry effects, MOS capacitances, Modeling of MOS transistors using SPICE, level I II and equations, capacitance models. **The Wire:** Interconnect parameters: capacitance, resistance and inductance. Electrical wire models: The ideal wire, the lumped model, the lumped RC model, the distributed RC model, The transmission line model, SPICE wire models. **MOS inverters:** Resistive load inverter, inverter with n type MOSFET load, CMOS inverter: Switching Threshold, Noise Margin, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, Dynamic power consumption, static power consumption, energy, and energy delay product calculations, stick diagram, IC layout design and tools. Designing Combinational Logic Gates in MOS and CMOS: MOS logic circuits with depletion MOS load .Static CMOS Design: Complementary CMOS, Ratioed logic, Pass transistor logic, BICMOS logic, pseudo nMOS logic, Dynamic CMOS logic, clocked CMOS logic CMOS domino logic, NP domino logic, speed and power dissipation of Dynamic logic, cascading dynamic gates. Designing sequential logic circuits: Timing matrices for sequential circuits, classification of memory elements, static latches and registers, the bistability principle, multiplexer based latches , Master slave Edge triggered register , static SR flip flops, dynamic latches and registers, dynamic transmission gate edge triggered register, the C2 MOS register, Pulse registers, sense amplifier based registers, Pipelining, Latch verses Register based pipelines, NORA-CMOS. Two phase logic structure; VLSI designing methodology – Introduction, VLSI designs flow, Computer aided design technology: Design

capture and verification tools, Design Hierarchy Concept of regularity, Modularity & Locality, VLSI design style, Design quality.

Text/ Reference Books:

- Jan M Rabaey, Anantha Chadrakasan Borivoje Nikolic "Digital integrated circuits a design perspective" Pearson education.
- Sung MO Kang Yusuf Leblebici; "CMOS digital integrated circuits" Tata McGraw Hill Publication.
- Neil E Weste and Kamran Eshraghian; "Principle of CMOS VLSI Design" Pearson education

Elective Courses for B. Tech in Electronics & Communication Engineering

Control Systems

Introduction to Control System: Linear, Non Linear, Time Varying and Linear Time Invariant System, Servomechanism, Historical Development of Automatic Control and Introduction to Digital Computer Control, Mathematical Models of Physical Systems, Differential Equations of Physical Systems, Transfer Functions, Block Diagram Algebra and Signal Flow Graphs. Feedback and Non-feedback Systems Reduction of Parameter Variations By Use of Feedback Control Over System Dynamics By Use of Feedback Control of Effects of Disturbance Single By Use of Feedback and Regenerative Feedback. **Control Systems and Components:** DC and AC Servomotors, Synchro Error Detector, Tacho Generator and, Stepper Motors etc.**Time Response Analysis:** Standard Test Signals, Time Response of First-order Systems, Time Response of Second-Order Systems, Steady-State Error and Error Constants, Effect of Adding a Zero to a System, P, PI and PID Control Action and Their Effect, Design Specifications of Second-Order Systems and Performance Indices. **Frequency Response Analysis:** Correlation Between Time and Frequency Response, Polar Plots, Bode Plots, and All Pass and Minimum-Phase Systems. The Concept of Stability, Necessary Conditions for Stability, Hurwitz Stability Criterion, Routh Stability Criterion and relative Stability Analysis. The Root Locus Concept, Construction of Root Loci, Root Contours, Systems with Transportation Lag, Sensitivity of the Roots of the Characteristic equation, MATLAB : Analysis and Design of Control Systems. **Stability in Frequency Domain:** Mathematical Preliminaries, Nyquist Stability Criterion, Definition of Gain Margin and Phase Margin, Assessment of Relative Stability Using Nyquist Criterion and Closed-Loop Frequency Response.The Design Problem, Preliminary Considerations of Classical Design, Realization of Basic Compensators, Cascade Compensation in Time Domain Cascade Compensation in Frequency Domain, Tuning of PID Controllers. MATLAB based Frequency domain analysis of control system.

Text/ Reference Books:

- Nagrath & Gopal. "Control Systems Engineering" New Age International. Publishers
- Kuo B.C. "Automatic Control System"
- Ogata "Modern Control Engineering"
- Scheultz & Melsa. "Linear Control Systems"
- D' Azzo&Houpis. "Linear Control Systems - Analysis & Design"

Fibre Optics Communication

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model. Different types of optical fibers, Modal analysis of a step index fiber. Signaldegradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR. Optical sources - LEDs and Lasers, Photo-detectors - pin-detectors, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties. Optical switches - coupled mode analysis of directional couplers, electro-optic switches. Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solition based communication. Optical amplifiers - EDFA, Raman amplifier, and WDM systems.

Practicals

1. Transmission of Light between two fibers.
2. Fiber optics transmission sensor.
3. Setting of fiber optics analog link.
4. Study of losses in optical fiber.
5. Measurement of numerical aperture.
6. Setting up fiber optics digital link.
7. Principal of Semiconductor Laser Diode.
8. Study of characteristics of fiber optics LED and Photo Detector.
9. Study of time division de-multiplexing.

Text/ Reference Books:

- J. Keiser, Fibre Optic communication, McGraw-Hill, 2nd Ed. 1992.
- J.E. Midwinter, Optical fibers for transmission, John Wiley, 1979.
- T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
- J. Gowar, Optical communication systems, Prentice Hall India, 1987.
- S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
- G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
- G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1992
- F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

Digital Signal Processing

Introduction to signals and systems Discrete time signals and systems, Ztransforms, structures for digital filters, design procedures for FIR and IIR filters. Frequency transformations: linear phase design; DFT. Methods for computing FFT. Noise analysis of digital filters, power spectrum estimation. Signals and signal Processing: characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signal Processing applications. Time Domain Representation of Signals & Systems-Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time

systems, Time-Domain characterization of LTI Discrete-Time systems, state-space representation of LTI Discrete- Time systems, random signals. Transform-Domain Representation of Signals-The Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. Z-transforms, Inverse ztransform, properties of z-transform, transform domain representations of random signals. Transform-Domain Representation of LTI Systems: the frequency response, the transfer function, types of transfer function, minimum-phase and maximum-Phase transfer functions, complementary transfer functions, Discrete-Time processing of random signals. Digital Processing of Continuous-Time Signals - sampling of Continuous Signals, Analog Filter Design, Anti-aliasing Filter Design, Sample-and Hold circuits, A/D & D/A converter, Reconstruction Filter Design. Digital Filter Structure and Design- Block Diagram representation, Signal Flow Graph Representation, Equivalent Structures, bone FIR Digital Filter Structures, IIR Filter Structures, State-space structure, all pass filters, tunable IIR Digital filters. cascaded Lattice realization of IIR and FIR filters, Parallel all pass realization of IIR transfer function, Digital Sine-Cosine generator. Digital Filter Design: Impulse invariance method of IIR filter design, Bilinear Transform method of IIR Filter Design, Design of Digital IIR notch filters, FIR filter Design based on truncated fonner sens, FIR filter design based on Frequency Sampling approach.

Practicals

1: Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals;
2: Discrete systems: attributes, Z-Transform, Analysis of LSI systems, Frequency analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Implementation of Discrete Time Systems.
3: Design of FIR Digital filters: Window method, Park-McClellan's method.
4: Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters.
5: Effect of finite register length in FIR filter design.
6: Parametric and non-parametric spectral estimation. Introduction to multirate signal processing.
7: Application of DSP to Speech and Radar signal processing.

Text/ Reference Books:

- Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007
- Sanjit K. Mitra, "Applications DSP a Computer based approach", TMH, 2006
- Allan Y. Oppenhein & Ronald W. Schater , "Applications DSP",.
- C. Sydney Burrus (Eds), DSP and Digital Filter Design

Microprocessors

Introduction to microprocessor, history of computers, timing and control, memory devices-semiconductor memory organization, category of memory, 8-bit microprocessor (8085):Architecture, Instruction set, Addressing mode, assembly language programming 16-bit microprocessor (8086):architecture, physical address ,segmentation, memory organization, bus cycle, addressing modes, introduction to 80186/80286,assembly language

programming of 8086. Data transfer scheme: introduction, types of transmission, 8257(DMA), 8255(PPI), serial data transfer (USART 8251), keyboard- display controller (8279), programmable priority controller (8259) Programmable interval timer/ counter (8253/8254): introduction , modes, interfacing of 8253, application. ADC/DAC: introduction DAC methods, ADC converters, Types of ADC, ADC IC (0808/0809) , DAC and ADC interfacing and applications.Advance microprocessor: introduction to 32-bit and 64-bit microprocessor, power PC, microcontroller (8051) : introduction, Architecture Alphanumeric displays, LCD, Graphic Displays, high power Devices. Communication Bus protocols :RS 232,RS 485,SPI, Inter integrated circuits interfacing I2C standard.

Text/ Reference Books:

- D.V. Hall : Microprocessor interfacing, TMH second edition
- Barry.B.Brey ,The Intel Microprocessor 8086/8088. 80186, 80286, 80386 and 80486 Architecture Programming and Interfacing ", PHI
- Y. C. Liu and G. A. Gibson: microcomputer systems : the 8086/ 8080A family architecture programming and design, PHI 2nd edition
- John P. Hayes : digital system design and microprocessors, mcgraw hill publication

Information Theory and Coding

Uncertainty, Probablilty, Entropy, Shannon's Measure, Joint Entropy, Mutual Information, Differential Entropy, AEP, Entropy Rates of a Stochastic Process, Markov Chains, Hidden Markov Models, Data Compression, Kraft Inequality, Entropy of English Language, Inference, Sufficient Statistics, Maximum Likelihood and Clustering, Marginalization, Laplaces Method, Model Comparison and Occam's Razor; Maximum Entropy Principle, Maximum Entropy Probability Distributions, Jaynes Concentration Theorem, Applications-Physics, Economics, Statistics. Information in Contingency Tables, Comparison and Fisher's and Maxent Methods of Estimation; Further Applications of Maxent Principle: Pattern Recognition as a Quest for Minimum Entropy, Non-Linear Spectral Analysis, Parametric Entropy Measures: Renyi, Tsallis, Power Laws

Text/ Reference Books:

- J. N. Kapur and H. K. Kesavan, "Entropy Optimization Principles with Applications", Academic Press, 1992
- J. van der Lubbe, "Information Theory", Cambridge University, 1997
- T. M. Cove and J. A. Thomas, "Elements of Information Theory", Wiley, 1991
- R. F. Blahut, "Principles and Practice of Information Theory", Addison Wesley, 1988

Microwave Devices & Circuits

Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept ofImpedance in Microwave transmission.Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangularwaveguide, Circular waveguide, Strip line, Micro strip line.Microwave Network Analysis- Equivalent voltages and currents for non-TEMlines, Network parameters for microwave circuits, Scattering Parameters.Passive and Active Microwave Devices-

Microwave passive components:Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron. Microwave Design Principles- Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas- Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.Microwave Measurements- Power, Frequency and impedance measurement atmicrowave frequency, Network Analyzer and measurement of scattering parameters,Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise atmicrowave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aids to Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect ofMicrowaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Practicals

1. Performance of Gunn Diode & Gunn Oscillator.
2. Performance of Klystron & Reflex Klystron Tubes.
3. Study of Magnetron.
4. Study of Isolators, Directional Couplers (Cross Directional & Multihole) slotted line & Block diagram of basic microwave bench.
5. Performance of VSWR meter.
6. Measurement of frequency of microwave.
7. Measurement of guide wavelength.
8. Measurement of Standing Wave Ratio (VSWR).
9. Measurement of Reflection Coefficient.
10. Measurement of cutoff wavelength (TE10 mode) Using C=2/(m/a) + (n/b)=2a.
11. Study of E-plane, H-plane and Magic Tee.
12. Performance of Pin diode and Pin modulator.
13. Measurement of guided power.
14. Measurement of attenuation in dB for a given component.
15. Study of wave-guide

Text/ Reference Books:

- R.E. Collins, Microwave Circuits, McGraw Hill
- K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

Biomedical Electronics

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc. Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X-ray and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Text/ Reference Books:

- W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
- J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
- A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Antenna and Propagation

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions. Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas. Antenna Arrays- Analysis of uniformly spaced arrays with uniform and nonuniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, Fixed weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

Text/ Reference Books:

- J.D. Kraus, Antennas, McGraw Hill, 1988.
- C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
- R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
- .R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw Hill, 1984.
- .I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House,1980.
- R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
- R.E. Crompton, Adaptive Antennas, John Wiley

Practicals

1. Measurement of load impedance.
2. Measurement of characteristics of Klystron tube & Gunn Oscillator.
3. Measurement of radiation through Horn antenna.