

# SYLLABUS OF MASTER OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

## First Semester

Category: Departmental / Specialization Basket

### PAPER-I

#### **PG / ETCE / T / 111A - Statistical Communication Theory (Comm)**

Discrete Time Random Processes: Random Variables, Ensemble Averages, Jointly distributed random variables, Uncorrelated and Orthogonal Random Variables, Linear Mean Square Estimation, Gaussian Random Variables, Parameter Estimation: Bias and Consistency, Random Processes, Stationary Processes, Autocovariance and Autocorrelation, Ergodicity, Power Spectrum.

Filtering Random Processes: Spectral factorization, Wiener Filtering, the FIR Wiener filter, Linear Prediction, Noise Cancellation, IIR Wiener filter, Noncausal IIR Wiener filter, Causal IIR Wiener filter Discrete Kalman filter, Adaptive filtering-LMS algorithm.

Spectrum Estimation: Bay's estimation, Nonparametric methods, Minimum variance spectrum estimation, Frequency estimation

#### **PG / ETCE / T / 111B - Operating Systems (Comp)**

Introduction: hierarchical and extended machine view. Memory management: Single contiguous allocation, partitioned allocation. Paged and demand-paged memory management.

Processor management: State model, job scheduling, Process scheduling. Multiprocessor scheduling. Process synchronization, Deadlock problem.

Device management: Dedicated, shared and virtual devices, channels and I/O control units, device allocation consideration I/O traffic controller, I/O scheduler.

Information management: File systems, allocation strategy, recovery of files, Design of loaders and linkage editors

Case study: UNIX, DOS.

#### **PG / ETCE / T / 111C - Digital Control System (Con)**

Z-transform, the state-variable representation, stability analysis. Time domain analysis, frequency domain analysis, controllability and observability, Design of controllers, pole placement, state feedback. Observer design. Implementation of digital control law on microcomputer and digital computer.

#### **PG / ETCE / T / 111D - Advanced Logic & Computer Organization (Con)**

Implementation of Logic functions using MSI & Programmable Devices: Shanon's expansion theorem, multiplexer implementation of logic functions, Type-0,1,2,3 etc., analysis of multiplexer design, multiplexer design, multiplexer tree implementation of

logic functions, implementation of logic functions using PLDs-PROM, PAL & PLA, their characteristics, comparison and applications.

Sequential Logic Circuits: Models for synchronous and asynchronous circuits, Algorithm state machines, Transition and Flow map, concept of gated latch, binary decision diagram  
Computer System Organisation: Processors, instruction execution, concept of interpreter, data path, Flynn's classifications, multiplicity of functional units, pipeline machines, linear & non-linear pipelines, reservation tables, vector ALU, array processor, techniques for error detection & Hamming codes.

Instruction formats: Design criteria, trade off between address & opcode, expansion of op-codes, instruction repertoire.

Addressing: Immediate, direct, indirect, register, indexing, stack

Flow of Control: Sequential flow, jump, nested subroutine, subroutine linkage, LIFO stack

Control Logic Design: Data processor, control logic – their relationship, Hardwired and Microprogram control approach.

### **PG / ETCE / T / 111E - Optoelectronic Devices (ED)**

Black body radiation sources of light and their spectral characteristics. Interaction of radiation with matter, photo conductivity, photodetectors and their figures of merits, PIN and APD diodes and their temperature dependence. Solar Cells, luminescence and their uses, Image Intensifier, light amplifiers. Display devices. Optical sources, LCD, LED optocouplers. TV camera and Photo-transistor, Photo SCR. Principles of stimulated amplification, optical resonators. Theory of stimulated emission and optical oscillator in solid state Semiconductor, dye lasers. Laser Diode, Nonlinear optical effect. Propagation characteristics of optical fibre, Material and wave guide dispersions. Modulation and detection of optical signals, nonlinear propagation and interaction, organic and inorganic optical wave guides, fibre amplifiers, integrated optical devices.

### **PG / ETCE / T / 111F - Photonics & Integrated Optics (ED)**

Electronics, Photonics, Propagation of optical Power through Dielectric waveguides – Circular, rectangular and planar, Single mode and multimode waveguides, Evanescent field of single – mode waveguides. Dispersion flattened fibers, polarization maintaining fibers, principle of soliton propagation.

Propagation characteristics of the waveguides, Helmholtz wave equation, Beam Propagation method (BPM), Fourier Transform BPM (FTBPM), Finite difference BPM (FDBPM), Cylindrically Symmetric BPM, Non paraxial and paraxial mode, coupled Mode Theory – circular, rectangular and planar waveguides.

Integrated Optical Devices – Beam splitter, directional coupler, switches, modulators, periodic structures for filters. Bragg diffraction grating, fiber to fiber and Thin film couplers. WDM devices, optical amplifiers, polarization transformation. Optoelectronic integration, Optical sources (LED,LD) optical Detectors (PIN, APD) Optical bias stability and digital optics, optical computation.

Inorganic and Polymer Optical waveguides, Electro-optics and Nonlinear waveguides – fabrication and characteristics, Nonlinear optical polymers and applications.

**PG / ETCE / T/ 111G - Microwave and Millimeter Wave Circuits (MW)**

Circuit Theory in terms of Fidler Concept of Equivalent voltage, current etc. Scattering Matrix, Periodic Structures and Filters, Impedance Transformation, Matching. Microwave and Millimeter wave Devices including ferrite devices. OSNR and dynamic range measurements for PCM/DM/ADM systems. Measurements of Prop. of error of a typical binary data communication systems. Simulation of transversal filter type linear equalizer and measurement of its Performance. Simulation of an adaptive Equaliser and study its performance Error rate measurement in a typical Optical communication system.

**PAPER-II**

**PG / ETCE / T/ 112A - Advanced Digital Communication (Comm)**

Baseband Transmission Systems: Spectral Density of Digital Baseband Signals, Fundamentals of Band Limiting and Eye Diagrams, Pulse-Shaping Techniques, Nyquist's minimum-bandwidth theorem, Nyquist's vestigial symmetry theorem-Raised Cosine Filter, Gaussian Pulse-Shaping Filter. Inphase and Quadrature(I-Q) Modulation and Demodulation: Real and Complex Signal Models, Geometrical Representation of Modulation Signals, Constellation Diagram, I-Q Diagram. Modulation Techniques used in Wireless Systems: BPSK, DPSK, QPSK, Offset QPSK,  $\pi/4$  QPSK,  $\pi/4$ -DQPSK, MSK, GMSK, GFSK, QAM, OFDM, FQPSK, FQAM, FBPSK. Interference: Carrier-to-Interference and Carrier-to-Noise Limited Systems, Cochannel Interference, Adjacent Channel Interference, Externally caused Cochannel Interference Equalization: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Linear Equalizers, Nonlinear Equalization, Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer.

**PG / ETCE / T/ 112B - Programming Methodology (Comp)**

Programming language features: Syntax and semantics- axiomatization of languages, the weakest pre-condition calculus.

Data: Values and types, abstraction concepts, type systems-homomorphism, polymorphism, overloading, inheritance. Parameterized types and modules. Encapsulation, ADT vs object oriented approach.

Program construction: Requirement analysis, specification and related languages, program construction through refinements, concept of verifiable program

**PG / ETCE / T/ 112C - Programmable Logic Controller (Con)**

PLC: Sequential and Programmable Controllers, architecture, programming of PLC, Relay logic, Ladder logic, industrial applications, industrial communication and networking.

Microcontrollers: Architecture, Assembly Language programming and applications

**PG / ETCE / T/ 112D - Distributed Digital Control (Con)**

Distributed system Model : Dynamical mathematical model, Identification – finite element method, finite difference method, Fourier transform technique and control of Distributed parameter system by singular perturbation method and C-coupling and by decomposition & Coordination, Distributed system synchronization and inter process

communication Distributed model simulation, simulation software, Simulation verifications. Hierarchical system and distributed control. Digital Hardware Architecture for distributed control: networking & software. Typical commercially available systems. Honeywell TDC 3000 systems, case studies, Batch controller , Enhanced boiler drum level control.

### **PG / ETCE / T/ 112E - Microelectronic Technology (ED)**

Semiconducting materials and their characterization, capital growth, wafer processing-lapping, polishing and cleaning.

Doping techniques – Thermal diffusion, Ion implantation, epitaxy, liquid phase, CVD, MOCVD, MBE.

Mask fabrication, photolithography, X-ray and electron beam lithography.

Thin film deposition, oxidation, Isolation.

Assembly techniques – Scribing, cleaning, bonding, encapsulation. High package density LSI/VLSI consideration.

Characterization and measurements – I-V and C-V measurements, carrier concentration and doping profile measurements, automated testing techniques for micro-circuits and Reliability.

### **PG / ETCE / T/ 112F - Antenna Analysis & Synthesis (MW)**

Theories of radiation, Kirchoff's principles, Schelkunoff's equivalent principles. Integral transform methods, Green's function, Linear antennas as boundary value probe current distribution and impedance.

Radiation from apertures, general formulas for scattering and diffraction in and effective area of apertures. Different kind of aperture antennas. Reflector antennas. Appropriate methods for solving reflector antenna problems. Primary feed system design, Shaped beam antennas.

Cassegrain antenna system.

Antenna array analysis and synthesis. Synthesis optimizations, Phased arrays.

Integrated antennas.

### **PAPER-III**

#### **PG / ETCE / T/ 113A - Computer Communication Network (Comm/Comp)**

Introduction to transport of data traffic over networks of digital transmission media, architecture concepts in 150's OSI layered model in computer communication . Physical layer standards, Data link layer. ARQ scheme and their analysis. Delay models based on queueing theory. Network layer, Topology, routing, flow control, configuration control, inter networking. Multiple access, local area network (LAN) IEEE standards for LAN's Transport layer; issues and standards integrated service network.

Communication protocol: Higher protocol layer, transport layer, session layer, design issue and RPC's presentation layer, Design issue. ASNI data compression technique, cryptography, Application layer design issue, File transfer, concurrency control, Electronic mail, virtual protocols.

Formal specification of protocols, specification languages, Estelle, SDZ, Lotos, validation techniques, protocol analysis and synthesis, executable protocol. Validation of IBM's SNA. Reliability and vulnerability of computer communication network.

**PG / ETCE / T/ 113B - Computer Architecture (Comp)**

Pipelining and Vector processing, Array processor, Multiprocessor architecture and programming, Data flow computing, RISC architecture, VLSI computing structure, Content addressable memory, Multidimensional Access memory.

**PG / ETCE / T/ 113C - Nonlinear Control System (Con)**

Introduction: Comparison of linear and nonlinear control loops, general methods for solving nonlinear control problems. Models of nonlinearities in closed-loop.

Filtered nonlinear system-the Describing Function (DF) analysis. Quasi linearisation and DF evaluation of common nonlinearities. Sinusoid input/random input DF. Limit cycle & stability analysis using DF. Circle criterion.

State space analysis and formulation of phase trajectory equations for type 0,1 and 2 systems. Response analysis using phase plane, phase trajectory selection for optimal control, bang bang control.

State variable analysis, controllability and observability, Stability analysis of nonlinear systems, Lyapunov's direct method, Lyapunov's stability theorems, generation of Lyapunov functions.

Numerical solution of state equation. Euler's method, Runge Kutta algorithm. Adam's & Gear's predictor corrector method, case studies.

**PG / ETCE / T/ 113D - Microwave & Millimeter Wave Devices & Applications (ED/MW)**

Principles of IMPATTs and Transferred Electron Devices, modes of operation, power frequency consideration.

Principles of MESFET, Bipolar Transistor HEMTS- Basic operation, Device performance analysis, Equivalent circuits and parameter extraction.

Principles of MASER and super conducting Devices, device modeling and characterization. Design principles of oscillators and amplifiers and their evaluation Technique.

**Category: Inter - Disciplinary Basket**

**PAPER-IV**

**PG / ETCE / T/ 114A - Artificial Intelligence & Soft Computing**

Reasoning, Machine Learning, Intelligent Search, Intelligent Planning, Perception, Applications in Expert Systems, Machine Vision and Robotics, Control, Signal Processing and Pattern Recognition. Applications in System Design, Prediction, Optimization and Identification problems, Use of Fuzzy Logic, Neurocomputing and Evolutionary Algorithms in the above problems.

### **PG / ETCE / T/ 114B - Physical Electronics**

Theory of atomic collision – gaseous break down and plasma. Plasma waves in electron beam, Plasma wave introduction, Helicon waves, Ideal periodic lattice, periodicity, energy bands in semiconductor.

Block wave functions, concepts of effective mass, quantisation of vibrational energy, phonons, defect dislocation and impurity states.

Free carrier in semiconductor, statistical distribution, Fermi energy in degenerate and non-degenerate semiconductors, of quasi-Fermi levels, Transport phenomena in Semiconductor – Boltzman transport equation, scattering mechanism, mobility diffusion, galvano-magnetic, thermoelectric and acoustoelectric amplification. Carrier generation & recombination process, intrinsic & extrinsic surface-recombination & interpretation of typical time dependent diffusion equation, photoconductive method of measuring lifetime and surface recombination velocity.

### **PAPER-V**

#### **PG / ETCE / T/ 115A - Neuro-Fuzzy & Evolutionary Computation**

Fuzzy sets and Logic, Fuzzy reasoning, Fuzzy pattern recognition, Fuzzy control, Supervised, Unsupervised and Reinforcement Neural Algorithms, Genetic Algorithm, Swarm and Differential Evolutionary Algorithms, Applications in Image Processing, Pattern Recognition and Robotics.

### **PAPER-VI**

#### **PG / ETCE / T / 116A - Digital Signal Processing**

Structures for the implementation of LTI systems: Direct form I and II structures, linear constant co-efficient difference equation, recursive and non-recursive systems, canonical form, Moving Average System, cascade realizations, parallel form realizations, design examples, FIR and IIR systems.

Composite-Radix FFT: Radix-3 and Radix-4 FFTs, DIT and DIF FFT algorithms, Flow diagram, decomposition of DFTs.

Design of FIR filters: Linear-phase FIR filters, symmetric and antisymmetric impulse responses, magnitude and phase characteristics of the frequency response, design examples, linear-phase zeros and their implementations, Window techniques, concept of main and side lobes, Rectangular, Hamming, Hanning, Blackman and Bartlett Window functions, comparison of different types of windows.

Digital Signal Processor: Architecture, Instructions, Assembly level Programming, introduction to Code Composer Studio.

### **Category: Sessional Courses**

#### **SESSIONAL 1**

#### **PG / ETCE / S / 111- Laboratory**

## **SESSIONAL 2**

**PG / ETCE / S / 112- Seminar**

### **Second Semester**

**Category: Departmental / Specialization Basket**

#### **PAPER-VII**

##### **PG / ETCE / T/ 127A - Satellite Communication (Comm)**

Historical development of satellites: Communication satellites; orbits and description, orbital period and velocity, azimuth and orbital inclination, coverage angle and slant range, eclipse, placement of satellite in geostationary orbit.

Satellite Description : Communication subsystem, Telemetry, command and ranging subsystem, Altitude control subsystem, electrical power subsystem.

Earth Station : earth station Antenna type, gain, pointing loss. Antenna gain-to noise temperature ratio  $G/T$ .  $G/T$  measurements. Antenna tracking power amplifier, low noise amplifier, Up conversion , Down conversion – Conversion process; transponder Hopping, Polarization hopping, redundancy configuration. Spurious effect of frequency conversion.

Satellite transponder : Transponder model, transponder channelization, Frequency plans and processing transponders.

Satellite Link : Basic link analysis, interference analysis, Rain induced attenuation. Satellite link design, link with frequency reuse and link without frequency reuse. Satellite Multiple access system.

Frequency Division Multiple Access : Principle. SPADE, FDM-FM-FDMA, Companded FDM-FM-FDMA and SSB-AM-FDMA. Intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ratio.

Time division Multiple Access: Principle, TDMA frame structure, TDMA Burst structure, TDMA Superframe structure, Frame acquisition and synchronization. Satellite position determination. TDMA timing. Demand Assignment Multiple Access and Digital Speech interpolation. ERLANG B Formula. Type of demand assignment, DAMA characteristics, Real time frame reconfiguration, DAMA interfaces, SCPC-DAMA, Digital Speech interpolation. Satellite packet communication.

Satellite spread spectrum communication : Direct sequence spread spectrum system, Direct sequence code division multiple access. Frequency hop spread spectrum system, Frequency hop CDMA DS and FH Acquisition and synchronization. Satellite on-board processing.

Very small Apertime technical network (VSAT) VSAT- Technologies, Network configurations, Multiaccess and networking. Network error control polling VSAT network.

Mobile satellite network – operating environment. MSAT network concept, CDMA MSAT relink. Worldwide timing by satellite relay.

##### **PG / ETCE / T/ 127B - Distributed Processing & Networking (Comp)**

Concept of distributed systems : Definition, Enslow's model, motivation and objective, application areas. Inter process communication : building blocks, client server communication, group communication, case studies. Remote procedure calls: Design issues and implementation. Distributed operating system Kernel, definition of process and threads, naming and protection, communication and invocation File service, Name service model, Time and coordination, synchronization, physical clocks, concept of logical clocks and logical time. Distributed coordination. Replication, Basic architectural and model, consistency and request ordering. Gossip architecture, process group and ISIS. Shared data and transaction, conversation between client and server, simple distributed transaction and nested transaction, Atomic commit protocol, concurrency control, distributed deadlocks transaction with distributed data. Recovery and Fault Tolerance: Transaction recovery, hierarchical and group masking of faults. Security issues, Language for concurrent processes, ADA, CSP. Networking: Network topology, different network structures related to distributed processing.

#### **PG / ETCE / T/ 127C - Stochastic Control (Con)**

Review of Stochastic Processes: theory of Stochastic processes, Gauss Markov process model. Review of system theory: Linear, Nonlinear, Continuous and discrete systems. Modeling: state space model of system with noise, AR, AM and ARMA models. Estimation, Prediction & filtering: Problem formulation, optimal estimation, prediction and filtering for discrete linear systems. Fixed interval, fixed-point and fixed-lag smoothing. Wiener-Hopp Egn. & optimal filtering, Kalman filters. Stochastic optimal control of continuous linear system: Problem formulation, equivalent discrete time model, optimal control and its performance measure.

#### **PG / ETCE / T/ 127D - Quantum Well & nano Structured Devices (ED)**

One-dimensional and two-dimensional solutions of Schrodinger equation. Concept of super lattice, Electrical and magnetic field effect on quantum well structures. Transport properties, Optoelectronic effects, Porous silicon and other hetero-structure devices.

#### **PG / ETCE / T/ 127E - Microstrip Components & Circuits (MW)**

Analysis of Microstrip lines, Method of conformal transformation, Numerical method or analysis of Microstrip lines, Hybrid Model Analysis. Other methods of analysis, Losses in Microstrip. Slot line and coplaner waveguide. Coupled microstrip and directional couplers. Even and odd mode analysis. Theory of coupled Microstrip directional couplers, Branch line couplers. Lumped elements for MICS Design of lumped elements. Microstrip circuit design – Impedance transformers, Filters, Isolator and Phase-shifter.

#### **PAPER-VIII**

#### **PG / ETCE / T/ 128A - Coding Theory (Comm)**

Introduction to Algebra: Groups, identity element, inverse of an element, finite group, fields, modulo addition and multiplication, characteristic of field, Galois field,

polynomial over GF(2), irreducible and primitive polynomials, construction of GF( $2^m$ ), power, polynomial and m-tuples representations, Vector spaces, properties, subspace, linear combination, linear interdependence, spanning of a vector space, basis and dimension of a vector space, dual space, row space, orthogonality.

Linear Block Codes: Definition, message and code words, Generator matrix, systematic code word, parity-check matrix, encoding circuit, syndrome, error detection, syndrome circuit, minimum distance and minimum weight, error-detecting and error-correcting capabilities, standard array and syndrome decoding, decoding circuit.

Convolutional codes: Encoder, constraint length, code tree, code trellis, state diagram, fractional rate loss, generator polynomials, structural properties, branch and path gains, generating function, Viterbi algorithm.

Spreading Codes in CDMA: Linear Feedback Shift Register (LFSR), LFSR Generator Implementations- Fibonacci and Galois implementation, Maximal length sequences-generation, properties, Generation of Gold codes, Kasami sequences, Walsh codes.

Turbo Codes: Generation and properties.

### **PG / ETCE / T/ 128B - Digital Image Processing (Comp/Comm/Con)**

Image representation and Modeling : Monochrome and color representation, color-ordinate systems Monochrome and Color vision Model, sampling and Quantization – Rectangular and Nonrectangular Grid sampling and interlacing. Optimum Liloyd-Max quantizer, Compandor design, Practical limitations.

Image Trnsforms : Two dimensional Orthogonal Transforms, Basic Image, Kroneekes products and Dimensionality: proportion Algorithm etc. for D F T. Hadamard Haar, Slant, DCT and KL Transforms, SUD techniques Image Enhancement, Point operation, Histogram Modeling, Spatial operations, Transform cooperations, Image Restoration-Increase and Weian Filtering, Filtering using transforms, Least square and constrained least square restoration. Maximum Entropy Restoration.

Image Analysis and Vision : Spatial features extraction, Transform, Features, Edge detection, Boundary detection, region representation, Moment Refresevation, Structures sgape, Texture, Scene Matching, Image segmentation and classification techniques.

Image Data Compression : Paxel coding: Entropy coding, Runlength coding, Bit plane coding. Predioctive coding. Delta and DPCM techniques, Transform coding –zonal versus threshold coding. Adaptive transform coding. Vector quantization for compression.

### **PG / ETCE / T/ 128C - Robotics & Computer Vision (Comp/Con)**

Introduction, Homogeneous transformations, Kinematics equations and their solutions: Differential relations, motion trajectories, dynamic & control: Principles of computer vision, three dimensional representation, three dimensional shape recovery from line drawing, extracting shape from shading, range image analysis, stereo vision, machine learning of computer vision algorithm, relational matching, three dimensional object recognition, fundamental principles of robot vision.

### **PG / ETCE / T/ 128D - VLSI Design (ED)**

Analysis & Design techniques for Bi-polar/CMOS integrated circuits, Analytical & Numerical Methods. Analog & Digital Integrated circuits, models, optimization methods, package density & Linewidth discrimination. Computer Aided Design of linear & Digital Integrated circuits, special consideration for LSI & VLSI Design.

### **PG / ETCE / T/ 128E - EMI & EMC (MW)**

Introduction to electrical Noise Pollution. and introduction to EM Specifications and Standards.

EMI Test Method and Procedures: Basic Terms and Definitions, A Summary of EMI and Related instruments, Error Analysis, Conducted Emission Test procedures, Radiated –Emission Test Procedures, Radiated – Susceptibility Test Procedures.

EMI Control Methods and Techniques : An introduction to EMI Control, Sources of Electromagnetic Interference, EMI Receptors and Susceptibility Criteria, Intra-System EMI Prediction and control, EMI Control in Components, EMI Control in Circuits and Equipments.

EMI Test Instrumentation and Systems: The EMI Test Environment, Shielded Enclosures, EMI Emission Antennas, Special Susceptibility Antennas, Conducted Sensors and injectors, Receivers and spectrum Analyzers, Signal and Susceptibility sources, Automatic EMI Measuring Systems.

EMI Production and Analysis Techniques : An introduction to EMI Prediction, Transmitter Models for EMI Prediction, Receiver Models or EMI Prediction, Propagation Models for EMI Prediction, System Models for EMI Prediction, Intra-System EMI Prediction and Control.

### **PG / ETCE / T/ 128F - Computational Electromagnetics (MW)**

Requirement of Computational Electromagnetics, Boundary Value problems, Source Modeling, Method of Moments (MOM), Finite Difference (FD), Finite Difference Time Domain (FDTD), Finite Elements Method (FEM), Method of Lines, Application of these techniques to open and closed boundary problems, Numerical Convergence and Accuracy.

### **PAPER-IX**

#### **PG / ETCE / T/ 129A - Optical Communication System (Comm)**

Optical waveguides, Electromagnetic mode theory for optical wave propagation, Transmission characteristics of optical waveguides. Single mode & multimode waveguides.

Optical fibres types : polymer fibre, silica fibre, polarization maintaining fibre, fluoride fibre rare-earth doped fibres and their characteristics.

Fabrication of optical fibres, fibre parameter measurements.

Passive fibre optic components, fibre optic switches, fibre gratings etc. Fibre amplifiers.

Optical sources for fibre communication. Optical detectors for fibre optic communication, Modulation techniques, Optical transmitters, design considerations of fibre optic digital communication systems, Design consideration of analog communication systems. Calculations of Power budgets.

Fibre optic networking topology & principles, LAN, MAN, CSMA, CDMA, FDDI networking. Multiplexing methods in fibre optic networks. Fibre optic CATV network systems. Concepts of WDM. Principles of soliton wave propagation through optical fibres. Principles of coherent communication in optical fibres.

### **PG / ETCE / T/ 129B - Wireless & Mobile Communication Systems (Comm)**

Introduction: Why Wireless Mobile Communication? Location dependent services, Mobile and Wireless devices, History of Wireless Communication, a simple reference model.

Wireless Transmission: Frequencies for Radio Transmission, Regulation act, Modulation used, Direct Sequence Spread Spectrum, Frequency Hopping Spread Spectrum.

Cellular Systems: Cellular networks, Frequency reuse, GSM and its services, GSM architecture, Protocol architecture of GSM.

Mobile Tracking: Location updated and paging, Handover, Security, Authentication/Encryption.

New Data Services: GPRS, UMTS and IMT-2000.

Wireless LAN: Overview, advantages/disadvantages, IEEE 802.11, Protocol/architecture, Roaming.

Mobile Network Layer: Mobile IP-goals, Entities and terminology in MIP, IP packet delivery, Agent advertisement and discovery, Registration, Tunneling-Encapsulation, Reverse Tunneling, Routing.

### **PG / ETCE / T/ 129C - Compiler Construction (Comp)**

Introduction : structure of a compiler, overview of different modules.

Lexical analysis: concept of regular expression, NFA, and DFA, implementation issues.

Use of LEX program for lexical analysis. Parsing techniques: specification of programming language, context free grammars, derivation of parse trees, ambiguity.

Different bottom up and top down parsing techniques. Use of YACC. Syntax directed translation: Intermediate codes, semantic routines and code generation, symbol tables, storage organization. Code optimization techniques, error detection and recovery.

### **PG / ETCE / T/ 129D - Pattern Recognition (Con)**

Recognition as a classification process, Decision theoretic classification. Bayes' classifier, Syntactic classification. Learning through clustering. Convex and concave decision regions. Linear and nonlinear separability, Neural classifier for convex and concave regions, Fuzzy clustering, Fuzzy c-means clustering algorithm, cluster validity, Semantic classification. String matching, Sub-graph isomorphism in pattern matching. Applications in speech recognition, image understanding and territory planning for mobile robots.

### **PG / ETCE / T/ 129E - Adaptive and Optimal Control (Con)**

Optimal Control: Introduction to optimal control, Performance measure for optimal control problems. The principle of optimality, Concept of dynamic programming, Continuous linear regulator problem.

The Hamilton-Jacobi-Bellman equation, The calculus of variations, Fundamental concepts, Functionals of a simple function, Functionals involving several independent

functions, Constrained minimization of functionals. The variational approach to optimal control problem: Linear regulator problems, Pontryagin principle and state inequality constraints, minimum time and minimum control-effort problems, matrix Riccati equation, case studies.

Adaptive Control: Concept of Adaptive control systems, input adaptation, Model adaptive systems, general criteria for adaptive systems, Plant identification, automatched identification of process dynamics, methods of process identification: cross correlation, parameter adjustment, Implementation of adaptive controllers: using the direct method of Lyapunov, using Neural Networks, Neuro- Fuzzy adaptive controllers, case studies: aircraft adaptive control systems.

### **PG / ETCE / T/ 129F - Electronic Design Automation (ED)**

Device Physics and Models, Device physics of BJT and MOSFET, Short-Channel and hot-electron effects. LDD and LDS structures, BJT Models, Ebers Moll and Gummel Poon models; MOSFET Models; Simple (Sah) Model, BSIM and CSIM Models, Small signal models of BJT and MOSFETS. Model parameters. Device Scaling.

VHDL Simulation: Basic concepts in VHDL, Structural specification, VHDL description of Inverter, NAND gate and 4-bit comparator, VHDL grammar.

Design Organisation and Parameterization: Subprograms, Design Parameterization and Configuration, Illustrative example of an 8-bit Register.

High Level Description: Type declaration and Usage, Parameter Types and Overloading, Types and type related issues, predefined and user-defined attributes.

Dataflow Description in VHDL: Multiplexing and Data Selection, MOS implementation of a multiplexer. State machine Description.

Behavioral Description of Hardware: Process Statement, Assertion Statement

Sequential Wait Statements, Formatted I/O Operations. Illustrative example of MSI Based Design using 74LS00 Logic Family.

HW-SW Codesign: Issues in Codesign, Language Level Modeling and Computation for Embedded Systems. Techniques and Tools for Synthesis of Embedded Hardware and Software.

### **PG / ETCE / T/ 129G - Adaptive and Smart Antenna (MW)**

Adaptive Array Concept: Motivation of using Adaptive Arrays, Adaptive Array problem statement, Signal Environment, Array Element Spacing considerations, Array Performance, Nulling Limitations due to miscellaneous array effects, Narrow band and broad band signal processing considerations

Optimum Array Processing: Steady state performance limits and the Wiener solution, Mathematical Preliminaries, Signal Description for conventional and signal aligned arrays, Optimum Array Processing for narrowband applications, Optimum Array Processing for broadband applications, Optimum Array Processing for perturbed propagation conditions

Adaptive Algorithms: The least mean square error (LMS) algorithm, the Differential Steepest descent algorithm, the accelerated gradient approach, Gradient algorithm with constraints, Simulation studies.

Recursive Methods for Adaptive Error Processing: The weighted Least Square Error Processor, Updated Covariance Matrix Inverse, Kalman Filter methods for Adaptive Array Processing, the minimum variance processor, Simulation studies.

Effect of Mutual Coupling on Adaptive Antennas: Accounting for mutual effects for dipole array- compensation using open-circuit voltages, compensation using the minimum norm formulation, Effect of mutual coupling- Constant Jammers, Constant Signal, Compensation of mutual coupling- Constant Jammers, Constant Signal, Result of different elevation angle.

### **PG / ETCE / T/ 129H - Remote Sensing (MW)**

Techniques for measuring the structure, content, properties and motions of the atmosphere by remote means. Interactions between propagated wave and the atmospheric medium. Scattering absorption and radiation of electromagnetic waves in microwave, between and optical spectrum. Application to measurement of temperature, humidities, rain, inversion layers, wave winds, turbulence etc.

Realtime processing of large volumes of data including high data rate signal and image processing, optical, acousto optical and optical and optical and optical-electronic hybrid processing, realtime pattern recognition processors for such airborne applications as target recognition, tracking, and terminal guidance.

Physical description of continuous image properties of the human visual system, sampling and quantization of imager, matrix representation of image forming and image processing systems, unitary transforms and image compression and image enhancement and restoration.

Volume scattering and emission theory. Radiation transfer method. Behaviour of various surfaces, vegetable canopies.

Principle of spectro radio metry, Meteorological satellite system, radio meters, Infrared spectrometer and multispectral scanner, System on the LAND SAT satellites airborne scanner etc.

### **Category: Inter-Disciplinary Basket**

### **PAPER-X**

### **PG / ETCE / T/ 1210A - Broadband Wireless Networks**

Review of Broadband communication networks DSL, ADSL, HDSL, SDSL, VDSL, Introduction to Broadband Wireless, Evolution of broadband Wireless: Narrowband, First Generation, Second Generation, Emergence of Standard Based Technology, Mobile Broadband Wireless: Market Drivers and Applications, WiMAX and Other Broadband Wireless Technologies, brief of 3G cellular systems, WiFi Systems, WiMAX versus 3G and WiFi, Other comparable systems, Spectrum options for broadband wireless, Business and technical challenges of broadband wireless and WiMAX.

Overview of WiMAX: IEEE 802.16 and WiMAX, Salient features of WiMAX, WiMAX Physical and MAC layer Overview, OFDM Basics, OFDM in WiMAX, Advanced features for performance improvement, WiMAX Reference Network Architecture, Handoff Mechanism, Different types of Services, QoS Architecture.

**PG / ETCE / T/ 1210B - Embedded Systems**

Review of Sequential State machines, Application Specific IC design, PLA, PAL and PLD, Complex PLD and FPGA systems, Logic realization on FPGA, VHDL and VERILOG programming, Microcontroller, Hardware/Software partitioning problems, Verification and validation of Embedded Systems, Embedded operating systems, Embedded In-Circuit Emulators, Drivers for printers/monitors and digital camera, Case study of Embedded design with digital camera as an example.

**PG / ETCE / T/ 1210C - Advanced EM Theory**

Propagation of E.M. wave in Anisotropic Medium e.g. Plasma and Ferrites. E.M.W Scattering and Diffractions, E.M.optics. G.T.D.

Application of Numerical Techniques to Electromagnetics : Over view of Numerical Techniques like Finite Difference. Finite Difference Time Domain Method, Integral Equation Technique, Method of Moments, Spectral Domain Approach. Rayleigh-Ritz variational procedure, Perturbation Techniques, Finite Elements Methods, TLM etc.

**PG / ETCE / T/ 1210D - Computational Biology and Bioinformatics**

Alignment of pairs of sequences, Multiple sequence alignment, Prediction of RNA secondary structure, Phylogenetic prediction, Gene prediction, Protein classification and structure prediction, Generic Analysis.

**Category: Sessional Courses**

**SESSIONAL 1**

**PG / ETCE / S / 121- Term paper leading to thesis**

**SESSIONAL 2**

**PG / ETCE / S / 122- Seminar**

**Third and Fourth Semester**

**Category: Sessional Courses**

**SESSIONAL 1**

**PG / ETCE / TH / 21- Thesis Work**

**SESSIONAL 2**

**PG / ETCE / VV/ 22- Viva-Voce**